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Optimising Markets for Recycling

Final report (approved version)

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LIST OF ABBREVIATIONS

ABP(R)	Animal By-Products (Regulation)
ACN	Alliance Carton Nature
ACR+	Association of Cities and Regions for Recycling and Sustainable Resource Management
ACRR	Former acronym for ACR+
AD	Anaerobic Digestion
AENOR	Asociación Española de Normalización y certificación
AFNOR	Association Française de Normalisation
ASR	Automotive Shredder Residues
BAT	Best Available Technology
BMW	biodegradable municipal waste
BREF	best available techniques reference document
BSE	Bovine spongiform encephalopathy (epidemic)

B2B	Business to Business
B2C	Business to Consumer
C&D	Construction and demolition
C&I	Commercial and industrial
CA	Civic Amenity
CAP	Common agricultural practice
CCL	Climate Change Levy
CEEE	Central Europe and Eastern Europe
CEN	European Committee for Standardization
CEPI	Confederation of European Paper Industries
CPI	Confederation of Paper Industries
CRT	Cathode ray tube
DEFRA	Department for Environment Food and Rural Affairs
DSD	Duales System Deutschland
EA	Environment Agency
EC	European Council
ECN	European Compost Network
ECN-QAS	European Compost Network – Quality Assurance Scheme
EEA	European Environmental Agency
EEP	European Environmental Press
EFTA	European Free Trade Association
ELV	End-of-live vehicle
EP	European Parliament
EPA	Environmental Protection Agency
EPS	Expanded Polystyrene
EPR	Extended Producer Responsibility
EWC	European Waste Catalogue

EWL	European Waste list
GAP	Good agricultural practice
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GHG	Greenhouse gases
GMP	Good manufacturing practice
GPS	Global positioning system
HACCP	Hazard analysis critical control point
HDPE	High Density Polyethylene
HS	Hazardous substances
IFSA	International Feed Safety Alliance
I(R)PC	(Belgian) Interregional Packaging Commission
IPPC	Integrated pollution prevention and control
IPTS	Institute for Prospective Technological Studies
ISM	Integrated system of management
ICV	In vessel composting
LAS	Landfill allowance scheme
LCD	Liquid crystal display
LDPE	Low density polyethylene
Li-Ion	Lithium – Ion
LME	London Metal Exchange
MBT	mechanical biological treatment
MRF	Materials Recovery Facility
MS	Member state
MSW	Municipal solid waste
NGO	Non-governmental organization
NiCd	Nickel Cadmium

NiMH	Nickel metal hydride
NIR	Near infrared detector
NSSD	National Strategy for Sustainable Development
NW(M)P	National Waste (Management) Plan
OCC	old corrugated cardboard
Ofgem	Office of Gas and Electricity Markets
OECD	Organisation for Economic Co-operation and Development
OFMSW	Organic Fraction of Municipal Solid Waste
OVAM	Public Waste Agency for the Flanders Region
OVOCOM	Belgian consultative body for animal food
PAH	Polycyclic aromatic hydrocarbon
PAYT	Pay as you throw (polluter pays)
PCB	Polychlorobiphenyl
PCT	Polychloroterphenyl
PDA	Personal digital assistant
PE-HD	High Density Polyethylene
PERN	Packaging Waste Export Recovery Notes
PET	Polyethylene terephthalate
PMD	Plastic, metal, drink cartons
PP	Polypropylene
PRN	Packaging Waste Recovery Notes
PRO	Producer Responsibility Organisation
(U-)PVC	(Unplasticised) Polyvinylchloride
PPP	Public-private partnership
QAO	Quality assurance officer
QAS	Quality assurance system
QM	Quality management

RDF	Refuse derived fuel
R&D&I	Research, development and innovation
REACH	Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemical substances
REOM	Redevance d'Enlèvement des Ordures Ménagères (service fee)
RES	Renewable Energy Sources
RFID	Radio frequency identification
RO(C)	Renewables obligation (certificates)
RoHS	Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
RRP	Retail Ready Packaging
SIG	Sistema Integrado de Gestión (authorised collective management system)
SLF	Shredder light fraction
SME	Small or medium enterprises
STCM	Société de Traitement Chimique des Métaux
TEOM	Taxe d'enlèvement des Ordures Ménagères (waste management tax)
TGAP	Taxe Générale sur les Activités Polluantes
TSE	Transmissible spongiform encephalopathy
UN-CCD	UN Convention to combat Desertification
UNU	United Nations University
VFG	Vegetable, fruit and garden waste
VITO	Vlaamse Instelling voor Technologisch Onderzoek
VLACO	Flemish Composting Organisation
VLAREA	Order of the Flemish Government for the Establishment of the Flemish Regulations relating to Waste Prevention and Management
VVSG	Vlaamse Vereniging van Steden en Gemeenten
WE	Western European
WEEE	Waste electrical and electronic equipment

WM	Waste management
WMLR	Waste Management Licensing Regulations
WRAP	Waste and Resources Action Programme

EXECUTIVE SUMMARY

The spontaneous attitude with respect to waste in modern developed countries is to consider it as an undesirable side-product of our consumption. In this respect, it is hardly surprising that the pre-dominant attitude with respect to waste management is to find ways to get rid of waste in such a way that this minimizes, or at least reduces, the harmful side-effects of disposal. Relatively limited thought is being given to finding valuable applications for recycled waste instead.

However, waste could also be considered in the first place as just another raw natural resource that needs some further processing before it can be made suitable for human use. In such an approach, waste collection and processing is regarded as an industry producing valuable products. Of course, this does imply that we should downplay the environmental hazards, but rather that we should recognize that environmental hazards are present in almost all industrial processes, and that they are not specific to waste.

Actually, in some circumstances, a vibrant market in recycled products can be observed – this quite naturally raises the question under what conditions a market in recycled products will develop.

Economic theory tells us that, in a market without government intervention, recycling will take place up to the point where the price of the recycled product equals the cost of producing an additional recycled product – in economic jargon, up to the point where price equals marginal cost.

This implies that recycling will increase whenever:

- The price customers are willing pay for a recycled product increases – this is, whenever demand increases.
- The cost of producing additional units of recycled products decreases – this is, whenever supply increases.

This simple framework provides a useful starting point to understand why actual recycling rates are not always as high as they could, or should, be and to understand why they vary over time and space.

Whenever actual market outcomes differ from the market outcomes that would lead to the highest benefits for society as a whole, it is said that market failures occur.

In the case of waste recycling, market failures occur both at the demand and the supply side.

At the demand side, market failures in recycling occur for the following reasons:

- Collected waste is often contaminated by other waste streams. Whenever it is difficult for a buyer to verify the quality of the recycled product, demand will be lower than for a primary product.
- If the users of recycled products have some market power, they use that power to push down prices (which restricts volumes recycled).

At the supply side, the following market failures in recycling occur:

- The producers of primary products do not design products with their eventual "recyclability" in mind. Therefore, it is often expensive to prepare waste for recycling. If this is the case, a "technological externality" is said to occur.

- If collection or recycling firms have some market power, they push up prices for the recycled products (which restricts volumes recycled).

Finally, due to transaction and search costs, demand and supply will not always be "matched" in their most valuable application.

However, the most obvious market failures in the field of waste management are related to the environmental impacts of the alternatives to recycling (illegal dumping, landfilling and incineration).

As these costs are in general not internalised, the costs of the alternative treatment or disposal methods are too low compared to the cost of recycling. Or, in other words, the costs of recycling are too high compared to the cost of the alternatives. This implies that any measure that better internalises the environmental effects of the alternatives to recycling will lead to higher recycling rates as well.

This brings us to the purpose of this study: on the one hand, *understanding how dealing with the market imperfections in recycling markets can help overcome the lack of internalisation of the environmental side-effects of the alternatives*, and, on the other hand, *understanding how a better internalisation of the environmental side-effects of the alternative can improve the market prospects of recycled products*.

The study has been spilt into three tasks.

Task 1 has identified, through a process of prioritization, ten markets which offer the greatest potential environmental and economic benefits from perspectives of improved market operation – the report of Task 1 is included as an Annex.

The concern of Task 2 was to identify market failures, at EU, national and regional level. In task 3, we have discussed policy options which might reduce or remove the market failures.

In discussion with the Commission, it was decided to limit the analysis in step 2 and 3 to the following waste streams:

- Cardboard
- PVC
- Batteries
- Food Waste

6 countries have been selected for the case studies: the region of Flanders in Belgium, the UK, France, Estonia, Poland and Spain.

The report has been built up as follows:

- It starts with a brief overview of the state of the art in those topics of economic analysis that are relevant for our study. This overview contains a general discussion of market failures (including in technological innovation), of environmental externalities related to resource use and on the economics of waste collection and disposal.
- It gives an overview of the EU regulatory context, including of the most important Community initiatives taken to promote environmental technologies.
- It provides the essential fact and figures on production and recycling of the considered waste streams in the EU.

- It contains a description of the state of the art of collection and recycling technologies for the considered waste streams.

- After a first assessment of the market situation at the European level, the analysis proceeds to an in-depth analysis of the 6 countries chosen for the case studies.

The 6 member states covered in this study have very diverse levels of per capita income, geographical structure and histories of waste management. The quality and the relevance of the data we have obtained were also very heterogeneous. Drawing any common lessons from these experiences is therefore challenging, and extrapolating to other waste streams even more so.

The lessons learnt can be split up in two main categories: those concerning the organisation of collection in general, and those linked to specific waste streams. Indeed, when analysing the supply side, it is useful to distinguish between the collection and the recycling phases. In its essence, waste collection is a transport service characterised by economies of density, and it faces very specific issues of market organisation.

For each waste stream, the following questions need to be asked:

- Does the price of the recycled product cover the costs of collection and recycling? In this case, a market will often develop without government intervention.

- Does the price of the recycled products cover the cost of recycling, even if it does not cover the cost of collection? In this case, a market will develop if the government carries the burden of collection, if it *imposes* the collection on private actors or if it finds ways to reduce the burden of collection – this could be justifiable if market failures occur in the collection phase that the government can solve.

In both cases, tackling the other market failures could help (1) create a market where there is none (2) further develop the market where there already is one. This applies both to the market failures in the recycling market and those related to imperfect internalisation of environmental externalities. Thus, market failures can explain why it could be optimal to have recycling, even if the price of the recycled product does not cover the operational costs of recycling.

The answer to the questions listed above depends on a lot of factors that cannot directly be influenced by policy makers:

- The existence of competing primary products puts an upper bound on the price that can be asked for a recycled product. Therefore, the following questions need to be addressed: What are the primary products the recycled products will be competing with? Are recycled and primary products close substitutes? What factors influence these substitution possibilities?

- The costs of collection depend on the cost of labour, but also on energy prices.

- Sometimes, recycling requires investment that cannot be recovered if the recycling activity is stopped. It is then said that the investment is "sunk". In this case there can be an important difference between the optimal decision before the costs are sunk and the optimal decision after the costs have been sunk. This implies that optimal waste policies can be path-dependent.

It follows from this that the optimal approach to recycling can vary substantially through time and space.

Yet, the investigations into the economic drivers and barriers that we have conducted here highlight the way that economic analysis of recycling very often clarifies the problems that should best be tackled by policy.

An additional constraint in the actual design of policies is that much of the information listed above is not currently available, particularly on future prices. In Task 1 of this project, we have set out to identify the ten markets which offered the greatest potential for environmental and economic benefits thanks to an improved market operation. A rough assessment has been made, based upon the information that is publicly available in the EU, but we have to acknowledge that a lot of information is fragmentary, outdated, inconsistent across countries or simply missing. Even the information we have identified for our detailed case studies suffers from these flaws.

Therefore, our objective has been to seek policy conclusions that are robust to changes in factors outside the influence of policy makers, and to avoid recommending policies that are dependent upon the existence of information that is currently not being collected.

Collection

With respect to the organisations of the collection phase, the main lessons learned are:

- Waste collection for residences and small enterprises is generally characterised by economies of density: the average costs of waste collection decrease as the volume of waste collected from a fixed length of network increases. If this is the case, competition in the market is not sustainable. Selective collection of recyclable material exacerbates this problem.

- If competition in the market is not the optimal approach, in-house collection services by the public authorities could be a solution. Alternatively, the collection could be left in the hands of the private sector, but regulated by the public authorities. The two fundamental options are then to either negotiate a contract with a private waste operator or to create "competition for the market" through competitive tendering. An advantage of privatisation is that experiences acquired in other markets (e.g. other regions) can be transposed to new situations. Therefore, multinational companies can play an important role in the diffusion of innovative approaches to waste collection.

- Although there are solid arguments in favour of a decentralisation of municipal waste management, the availability of specialised technical competences imposes constraints on the efficiency of local government. Privatisation is likely to exacerbate these problems rather than to solve them. Therefore, cooperation between local governments and the exchange of good practices are essential if decentralisation is supposed to work.

- Extended producer responsibility (EPR) requires firms, which manufacture, import and/or sell products and packaging, to be financially or physically responsible for such products after their useful life. They must either take back spent products and manage them through reuse, recycling or in energy production, or delegate this responsibility to a third party, a so-called producer responsibility organization (PRO). EPR shifts responsibility for waste from government to private industry, obliging producers, importers and/or sellers to internalise waste management costs in their product prices.

- Across Europe, there is a lack of transparent and consistent data that would allow an objective comparison of the performance of different approaches to Producer Responsibility Organisations (PROs). A useful step would be the creation of a benchmarking system at the European level. This would allow PROs and regulators to compare structures and improve the efficiency of arrangements.

- Whatever the legal form of the PRO, supervision is essential. In order to make supervision viable, auctioning the market to a limited number of organisations may be a good option. However, we have found no arguments in favour of creating monopolies.

– Small and Medium Enterprises (SMEs) face a series of very specific problems (limited competition due to economies of density, high transaction costs). The most promising instrument for stimulating waste sorting by SMEs is probably to pay them subsidies to do so. Good practice exchange could be helpful as well.

PVC

Although recycling of PVC has increased substantially in the recent past, it is still very small compared to annual waste arising.

On the demand side of the market, the following measures could be taken to stimulate collection: public procurement, clear end-of-waste criteria and encouraging contractual specifications that are targeted at performance. Landfilling and incineration should be further discouraged.

On the supply side, the sorting at the source of PVC waste is crucial, certainly in construction and demolition waste. Due to the long life span of PVC, introducing Extended Producer Responsibility is maybe not the most appropriate instrument to stimulate this. A more promising approach would be to provide increased financial incentives for sorting.

With respect to REACH, an important policy trade-off is to be made between, on the one hand, the benefits of recycling and, on the other hand, the external costs linked to additives that were used 30 years ago but that have been banned since.

Other needs for further action include the gathering of better data.

Batteries

Due to the current high prices of lead, the selective collection and recycling of lead acid batteries is currently organised profitably by the private sector. An additional factor is that the expense of a separate collection network can be saved because collection naturally takes place through garages. The only real concern raised with respect to this category is the existence of a black market in waste lead batteries as a way to circumvent the environmental requirements.

There is however no certainty that high collection and recycling rates will last if the price of lead would drop. Taking into account the long time lags that would be needed for policy changes in case this market would become unprofitable, there certainly is no scope for a laissez-faire approach.

One possible approach would be to leave it up to the market to find the most efficient logistical channels and the most valuable applications of the recycled material, while at the same time monitoring whether these applications do not lead to harmful side-effects, and committing to policy interventions should selective collection no longer be profitable.

The situation is different in the case of portable batteries. Our analysis suggests that the introduction of producer responsibility and the existence of a network for selective collection strongly affect collection rates.

In most countries, the current metal prices cover the operational costs of recycling for the following battery types: Nickel Cadmium, Nickel Metal Hydride and Lithium Ion. Thus, for these battery types, imposing selective collection is a necessary but also sufficient condition to create a viable market for recycling. This is economically justified if the external costs linked to incineration and landfilling of these battery types are higher than the cost of selective collection.

The revenues from sales of zinc and manganese however do not cover the *operational* costs of recycling. Thus, imposing selective collection does not suffice to make recycling financially viable: explicit and binding recycling objectives are necessary on top of collection targets. This is economically justified if the external costs linked to incineration and landfilling of these battery types are higher than the combined cost of selective collection *and* of recycling.

On the demand side for collected batteries, the following barriers are important:

- some battery recyclers enjoy market power; existing provisions on the transportation of waste lead to increased transportation costs, further segment the market and therefore exacerbate the problem of market power;

- the use of some recovered materials is prohibited in certain applications.

However, the central constraint on an expansion of batteries recycling is hoarding and illegal disposal by households. The following instruments can be used to reduce this: increase the convenience of the collection system; invest in awareness campaigns; provide financial incentives for bringing back used batteries.

A second issue on the supply side is that disposal through landfilling and incineration is still too cheap and easy compared to the alternatives. As the externalities linked to these options vary from country to country, this does however not imply that a one-size-fits-all solution would be appropriate.

Free-riding in producer responsibility is an important problem because it directly affects the financial resources that are available for the PROs. It is therefore important to create cooperation mechanisms between PROs in order to fight free-riding. The existence of a national registry of producers and of recovery organisations seems an absolute pre-requisite in the fight against free-riding. The lack of enforcement of the WEEE Directive is a specific issue- the establishment of a link between the WEEE and the battery registries would already be a step forward.

With respect to the organisation of battery PRO, we do not see a case for a legal monopoly but we do think that a monopoly could well be the natural outcome with high communication and enforcement costs. If monopoly is indeed the outcome, competition in the collection phase can still be obtained through periodic tendering or "yardstick competition"[1].

The new Battery Directive imposes collection targets and recycling efficiencies for all batteries and introduces EPR as a regulatory instrument. It can therefore be expected that the transposition of the new Battery Directive will have a radical impact in the countries that have not been forerunners in this field.

One approach in the field of prevention that is worthwhile investigating lies in the stimulation of the demand for rechargeable batteries and for electricity taken from the grid, while recognizing that these are not perfect substitutes for primary batteries. A second option would be to have the financial contribution to PROs depend on the expected life time of batteries.

Finally, we should keep in mind that, at current market prices, zinc and manganese do not cover the *operational* costs of recycling. Thus, imposing selective collection does not suffice to obtain recycling: explicit and binding recycling objectives are necessary on top of collection targets.

[1] This refers to a system where incentives are awarded based upon the relative performance compared to other collectors who face a similar market environment.

Food waste and biodegradable waste

None of the countries covered by our analysis has a policy on food waste "as such". What happens with food waste depends on a series of policies that are often uncoordinated or whose primary objective is not to increase useful applications of food waste.

Due to the absence of more specific policies, our analysis has often covered biodegradable waste in general – this includes garden and park waste on the one hand, and paper and cardboard on the other hand.

There exist a wide variety of potential markets for recycled food: compost, technical applications, livestock feed, pet food, biogas production, energy recovery in cement kilns etc. In practice, the information we have found is almost entirely focused on the market for compost.

In the case of Flanders, though, we have also been able to conduct an analysis of the system for selective collection of frying fats and oils, of the uses of industrial organic waste and of animal by-products. These cases clearly show that, in specific circumstances, both waste collection and recycling can be commercially viable:

> The Belgian government has imposed an acceptance obligation for waste frying fats and oils in order to shift the financial burden of waste disposal from the municipalities to the producers. However, due to the current high demand from the biodiesel and "green stream" sectors, the collection of frying fats and oils from the catering sector is now commercially viable. This leads to the parallel existence of, on the one hand, an "official" circuit and, on the other hand, an "informal" sector. Thanks to high market prices for biodiesel and co-incineration, there is, currently, no risk that these waste streams will get back into the food chain. Therefore, the "informal" sector is not a source of major environmental concern. The reason why it is not commercially viable yet to collect waste frying fats and oils from households is linked to the logistics of the collection phase.
>
> The collection of fallen stock in Flanders illustrates how varying market conditions throughout time can affect collection and recycling. In the unregulated market for animal by-products until 1993, prices for meal and fats were high, and collection and processing were profitable businesses. This changed in the 1990s, mainly due to fluctuations in the value of the US dollar and to increased environmental requirements. In order to maintain the viability of collection the Flemish government provided a guaranteed turnover for one specific company (Rendac), thereby creating a de facto monopoly. The collection system is now financed jointly by the Flemish Government and the cattle industry. Cattle holders can choose between paying an annual contribution or a contribution per animal that needs to be collected. The Flemish government guaranteed Rendac's return on capital on top of the reimbursement of all costs – however, this had led to an important increase of the equity capital of Rendac at the expense of the Flemish taxpayer. The collector now receives a fixed sum per ton on top of the cost of collection, treatment and disposal of fallen stock. While this system limits the transfers from the taxpayer to the regulated companies, its drawback is that it does not provide incentives for cost efficiency.

Let us now turn to the issue of compost.

Although recent research has concluded that the market potential in Europe is twice the size of the maximum production potential, 95% of composting plants depend on the gate fee to make a profit. This shows that the demand for compost is currently too low to cover the costs of production.

Although the factors affecting demand and supply can vary significantly between countries, one common factor across countries is that the main motivation behind their policies is to comply with the Landfill Directive by reducing the amounts of biodegradable waste going to landfill. Therefore, compost policy is mainly supply-driven and measures that could contribute to the further development of the market potential are not a priority. This leads to the paradoxical situation that even where the level of recycling is high, the actual use of the recycled product remains limited.

At the supply side, the low quality of compost in some countries has been identified as the main obstacle to further market development. Mixed waste composting is generally of low quality and is mainly used in relatively low-end applications such as agriculture, land restoration and landfill covers.

Selective collection of biodegradable waste has led to mixed results but has performed quite well in some cases. Contamination appears to be relatively limited but effective collection rates can differ widely. A more widespread dissemination of good practices in this regard could a fruitful area for public intervention.

In the UK some technological externalities linked to food packaging have been identified but there are processes on the way to tackle these issues.

However, most problems in the market for compost occur downstream of collection.

A prominent issue here is clearly the distrust of potential end users with respect to the quality of compost – we have here a typical example of asymmetric information as a market failure.

The existence of credible systems of quality assurance and certification is crucial in order to overcome these problems. Some countries have now established such systems, but others have a long way to go. Moreover, a credible system of quality control is probably just a *necessary* condition for creating a viable market for compost. On top of the issues of asymmetric information, we have identified the following barriers as being significant:

- Because the application of nitrogen and phosphorous loads on farmland is limited, applications in agriculture are constrained by the competition from other fertilizers in general, and manure in particular.
- Because of these limitations, demand in regions with important manure production can be very limited. However, high transportation costs compared to the market value of compost act as a barrier to trade to regions where there is no issue of excessive manure supply or where there is a high potential use for compost (for instance, to fight soil erosion).
- Sewage sludges and soil from construction works can act as additional competitors to organic waste compost.

It is clear that these factors can be highly country-specific.

Inasmuch as selective collection of biodegradable waste could contribute to a better quality of biodegradable waste, it would lead to better market prospects for compost. However, not everyone shares this view- some favour the development of mechanical sorting followed by biogas recovery.

Determining "end of waste" criteria at the European level would certainly be a significant step forward compared to the current situation. In this perspective, it is encouraging to see that the new Framework Directive has created a regulatory framework for "end-of-waste" criteria and that compost is covered by one of the case studies undertaken by the JRC – this would allow overcoming problems of asymmetric information and transaction costs. The cost of quality monitoring could however lead to consolidation in the sector, certainly if additional requirements would result from REACH.

The following policy instruments could also be envisaged:

- Pilot and demonstration projects could also play an important role in overcoming distrust and showing the benefits of compost.

- Due to the competition from manure as a fertilizer, stimulating demand for compost could also require modifications in agricultural policy, including the Cross Compliance requirements.
- The market value of compost does not do justice to its external benefits (prevention of soil erosion, carbon sink, humus reproduction, disease suppressing properties, reduction of methane gas production by avoiding landfills etc). Although existing studies have been unable to quantify all such benefits, synergies with the EU Soil Strategy and the European Climate Change Programme should be investigated.
- Review the CAP, the Nitrate Directive and the APBR in the light of their impact on food waste.
- Public procurement could be used to stimulate demand (for instance in public parks).

The extension of Extended Producer Responsibility to food waste is an interesting idea to explore. It could well be that food producers, confronted with the cost of food waste, would take more measures to reduce the amounts thrown away by households: smaller quantities per unit of packaging for instance[2].

The new Waste Framework Directive also requires to promote selective collection with a view to composting and digestion and to stimulate demand.

Finally, high energy prices and the increasing number of government schemes stimulating the demand for renewable energy provide strong incentives for energy recovery from bio-mass (including manure), which will certainly lead to a degree of stronger demand in the future.

Cardboard

Due to limitations in data availability, we often had to analyse cardboard in combination with paper recycling.

In comparison with other waste streams, very high levels of recycling are obtained on average across Europe. This success can be attributed to the combination of high rates of selective collection, high recycling efficiencies and a high demand for recovered fibres.

The very low levels of recycling that are obtained in a limited number of countries are due in the first place to differences in the organisation of selective collection.

Although some technological externalities have been identified in the study, industry has also found ways to set up structural collaboration to deal with these issues.

There are some issues with respect to the monitoring of quality in the collection phase, but these can be largely overcome with modern technology (use of magnetic keys, adapted lids).

Belgium, France, Spain and the UK all comfortably meet the targets the Packaging Waste Directive. However, the data available prevent us from making strong claims with respect to the relative efficiency of the organisation of recovery. The low price of the Packaging Recovery Notes in the UK suggests that, once the collection system to reach the recovery and recycling targets of the Packaging Waste Directive has been put in place, the marginal costs of exceeding this target is relatively low.

The low rates of recycling and recovery in Poland and Estonia can certainly not be attributed entirely to the ill-functioning of the collection systems. Indeed, increasing selective collection makes little sense if there is no appropriate infrastructure to deal with the collected materials. Both countries have a waste management heritage based upon landfilling that cannot be shaken off lightly. Moving away from landfilling requires important investments, and, with limited resources, priorities need to be set that can

[2] Even though, as a side-effect, this could lead to increases in packaging waste!

be highly country-dependent. In the case of Estonia, oil shale waste also constitutes an important additional burden that is specific to this country. The abundance of forest resources in the Baltic area also limits the demand for recycled fibre.

Only 2 countries have introduced a (limited) system of producer responsibility for the advertisement sector and the printed press. This is surprising, taking into account that the contribution of these sectors to paper consumption can hardly be qualified as negligible.

In countries where recycling rates are low, it would be a natural step to focus on supply side measures.

- As in most other cases, the most effective policy instrument to stimulate recycling would be to increase landfill and incineration taxes, and thus to divert paper from these landfill and incineration.
- If these instruments are not available, for instance for reasons of political feasibility, imposing selective collection or financing selective collection by ERP schemes are of course valuable second best solutions.
- At the collection side, the significant recent increase of collection rates in Spain has also shown the crucial importance of a dense, customer oriented collection system combined with active information campaigns.

This does of course not imply that we need not look at the demand side. After all, all other things being equal, the higher market prices for recovered paper, the more market segments become suitable for commercially viable selective collection. Moreover, we have also indicated that we cannot take for granted that demand and prices will remain high: changes in transportation costs may have an impact on future demand from the Far East and other sources of fibre are being explored as potential substitutes.

Public procurement can for instance lead to further improvements in the market position of recovered paper.

The mutual recognition of brokers and transporters could lead to more intra-European trade. The same argument applies to "end of waste" criteria.

It is not clear what environmental benefits would follow from export restrictions or recycled content standards.

Beverage cartons merit a separate discussion. Indeed, recycling and recovery rates are substantially lower than for other types of carton. Moreover, with the exception of France, Green Dot rates for beverage cartons are substantially higher than for other carton types. Finally, in the countries where we have obtained data on the subject, the market value of waste beverage cartons is low or even negative.

The main reason underlying these differences are the significant technological externalities in beverage cartons. However, no specific regulatory action appears to be necessary, except confronting every actor in the chain with the external costs linked to his actions. If, for some reason, this turns out not to be possible, the next decision is to decide what disposal option is required. However, the answer do this question depends largely on local factors, such as the logistics of the collection system, that do not need a uniform answer across the Community.

Recommendations for the use of economic analysis

This study aimed at using economic analysis of market failures in recycling markets to identify the policy options that would be most effective at increasing rates of recycling in the EU, where appropriate.

We have analysed in some depth 4 waste streams in 6 member states with very diverse levels of per capita income, geographical structure and histories of waste management. The quality and the relevance of the data we have obtained were also very heterogeneous. The actual recycling outcomes turned out to widely divergent across countries and waste streams.

Our study has shown that economic analysis provides a powerful tool to understand how apparently small differences in institutional and policy contexts can sometimes have an important effect on outcomes. The in-depth investigations provide examples of the way in which economic analysis can provide insight. By investigating the blocks to high levels of supply or of demand of recycled products, we can see where removing market failures would be likely to lead to higher levels of recycling. This analysis should allow us to identify where policy will be efficient in increasing recycling – and where it may be ineffective, because another remaining market failure will still hold back recycling.

The analysis starts from the consideration that the recycled material is a valuable resource and asks the question "Why isn't that value being realised?". Often, that is for reasons that are due to failures in the economic functioning of the market – issues which may be independent of the environmental problem being tackled. Assessing these market failures using economics identifies the stakeholders' behaviour in terms of the incentives they face, the constraints to which they are subjected (including the technological ones) and the information that is available when they make decisions. This points to appropriate policy action.

For instance, we find that on the supply side, the organisation of collection makes a great difference to outcomes (whatever the policy) and that analysis of the collection market and issues of market power by recycling plants can suggest policy options.

The economic framework helps us identifying unanticipated or counterproductive behavioural responses from policy and points out that even where markets appear to be failing or policy does not exist, private parties can often, but not always, find alternative arrangements for mutually beneficial exchange. It warns us against designing policies that are not robust to changes in market conditions, that overlook the idiosyncrasies of a given situation or that require superhuman skills from those who have to implement these policies. Last but not least, the questions asked by economics can assist us in drafting an inventory of the data that authorities would need to collect in order to take informed decisions.

Maybe a few words should be added on the specific issue of data availability. We have repeatedly pointed to important deficiencies in the data that are available, and we certainly think that better thought should be given on what data needs to be collected in order to support policy. However, a lot of information can be gathered from indirect information.

For instance, suppose that an informal collection network develops in parallel with official collection services. This is only possible, if, for the waste stream in question, there are no economies of density or because there are important costs of environmental and safety compliance that can be avoided in the informal network. We cannot say on prior grounds which hypothesis is correct – it could well be that both are true. However, the lesson from this example is that economics allows to quickly identify the relevant questions to ask.

Another example of indirect evidence is how the low price of the Packaging Recovery Notes is an indicator of the low marginal costs of exceeding the target of the Packaging Waste Directive in the UK.

<u>Policy recommendations</u>

Drawing any common lessons for the use of specific policy instruments from these experiences of different waste streams is challenging, as each situation has its own specifics. Extrapolating to other waste streams on the basis of our analysis is even more so. If we would have to draw a shortlist of measures that are common to all waste streams and countries we have covered, we would propose:

- **Stimulate optimisation of the logistics in the collection phase**. In order to avoid contamination and high sorting costs, selective collection is almost a conditio sine qua non for successful recycling. However, selective collection can be expensive. Moreover, if collection is subject to economies of density, selective collection is almost surely incompatible with competition in the market. This does not imply that selective collection needs to be put in public hands and lose the incentive of competition. There exist several way to "simulate" competition, such as competitive tendering and yardstick competition. However, organising and supervising this requires strong and competent authorities. Exchanges of good practice can play an important role in improving the quality of supervision. This should of course not lead to uniformity in practices. Even in household waste collection, the logistics can be highly idiosyncratic (think of city centres with narrow streets versus residential areas with broad avenues). An important limitation of our current knowledge is that we can only guess at the extent to which the marginal costs of selective collection are justified by the environmental benefits. This is mainly due to a lack of data that would allow a meaningful comparison. The European Union could contribute to our understanding by stimulating the creation of international benchmarking schemes.

- **Rethink the approach to trade**. It is a fundamental insight of economics that division of labour is the basis of all prosperity. If waste were a "normal" product, there would be an unambiguous case for letting the market decide where it could be put to its most productive use. In reality, trade in waste is governed by strict rules. These rules are justified inasmuch as trade imposes risks and costs on other parties than those who have agreed voluntarily to trade the waste. In reality, it has been suggested by some stakeholders that some national authorities use the rules on imports and exports in order to protect their own recycling industry. Potential gains to trade are therefore lost, even when there are no clear environmental benefits. A worthwhile idea to pursue would be to rethink rules on imports and exports from the assumption that free trade should be the rule and to leave the burden of proof to those who want to restrict it. Probably, for most waste streams, the outcome of this process will be the same as what we observe now. But some unjustified barriers, or alternative approaches to dealing with the hazards linked to transportation, may well be identified.

- **Recycled materials should not be discriminated against**. A recurring theme during our stakeholder consultations is that recycled materials sometimes are being discriminated against for reasons that are very hard to understand. Why should compost be subject to regulations in heavy metals and the ABPR, and manure not? Why should tenders impose the use of some specific materials or products, rather than describe the functional requirements? Defining clear end of waste criteria could make an important contribution in this area. Avoiding discrimination does however not imply that the specificity of recycled materials should not be recognized – this is a specific concern with respect to the implications of REACH.

- **Disseminate good practices**. We have already mentioned this with respect to good practices in regulation and organisation, but it could also refer to the adoption of new collection and recycling technologies. Of course, large cities are often already involved in European networks. However, European support could be especially helpful for small towns. As there already exists a multitude of European initiatives to promote innovation, it is important that additional initiatives do not lead to an increase in search costs.

- **Make sure that landfill and incineration taxes correctly represent the external costs of landfilling and incineration**: Our stated objective was to look at the policy options that would lead to a better functioning of recycling markets even in the absence of a correct internalisation of the environmental impacts of resource use. However, our stakeholder consultation has shown that these are the favourite instruments of most stakeholders. This does not imply that uniform landfill or incineration taxes should be promoted at the European level. Several environmental impacts (most notably those related to disamenities) are very local in nature - therefore landfill taxes may very well depend on the population density and the geographical structure of a country. To the best of our knowledge, there is also no reason why landfills and incinerators should be subject to other environmental requirements with respect to their emissions than other sources of pollution.

- **Investigate the possibility to introduce producer responsibility in other waste streams, especially if this could help promote design for the environment**. Where producer responsibility has been introduced, it has turned out to be a very powerful tool. Our study has shown the importance of avoiding a "one size fits all" approach. We have observed a wide variety of EPR systems and have found no model to be clearly superior to all others. Diversity can be a powerful source of learning lessons. However, some schemes clearly did not function very well – the underlying causes were mostly related to poor surveillance of the system, and we have suggested some policy changes that could improve upon the current situation.

- **Ensure that pricing of services for waste holders[3] reflects marginal costs.** If disposal costs reflect externalities, and if producer responsibility schemes are in place, then passing on these (dis)incentives for waste holders to make proper use of selective collection schemes can play an important role in maximising the capture of material for recycling. Such pricing schemes – widely applied in Flanders (and many other countries not included in the case studies) at the household level – can have a powerful incentive effect. However, exchanges of good practice should also consider that such schemes can also – where the selective collection system is not so well designed – generate problems of contamination of the selectively collected fraction. This will for instance be the case if the authorities apply a "pay as you throw" policy and the price for the residual fraction is high compared to the price for the selectively collected fraction – this provides incentives for mixing residual waste with selectively collected waste.

[3] According to the Waste Framework Directive, "waste holder" means the waste producer or the natural or legal person who is in possession of the waste.

1. OBJECTIVES, BACKGROUND, METHODOLOGY AND STRUCTURE

1.1. OBJECTIVES

The objectives of the study are to:

- Quantify the market potential (taking into account global perspectives) for certain waste and recycled material streams and the scale of the economic and environmental benefits or costs from better operation of those markets.
- Analyse the barriers or failures in specific markets for recycling in the EU, across the full life-cycle of materials.
- Identify policy options (whether for environment, economic, competition or industrial instruments) to remove existing barriers and to further promote recycling both at national and EU level, and how such measures could work effectively together by remedying these specific market failures.

1.2. BACKGROUND: MARKET FAILURES IN RECYCLING MARKETS

The Terms of Reference to this study referred to a recent study of the OECD[4] which identified several sources of market inefficiency affecting recycling rates:

- Transaction and search costs in secondary materials markets (costs related to price discovery, "search" costs, administrative costs, negotiation and bargaining costs)
- Information failures ("adverse selection") related to waste quality
- Consumption externalities and risk aversion (i.e. the information failures and commercial disincentives to the use of secondary materials in *final* products)
- Technological externalities related to products (this arises when one firm manufactures a product such that it increases the cost of recycling for the downstream processor, but cannot be compensated for changing its product design)
- Market power in primary and secondary markets

The OECD report has *not* covered the imperfect internalisation of the externalities from raw material extraction and waste management (such as leaching into groundwater, air pollution), which have been assessed elsewhere.

The report suggests some tools to identify the existence of market imperfections, but acknowledges that it is exceedingly difficult to test directly for the efficiency of markets.

The existence of market imperfections can have the following adverse effects:

- Smaller market share for secondary materials than would be the case without transaction costs
- Waste will not be directed to its highest potential value-added use
- Material recovery facilities will incur significant "retooling" costs if waste is of variable quality
- The suppression of the market for secondary materials by primary material producers exercising their market power

[4] Working Group on Waste Prevention and Recycling, *Improving recycling markets*, 2005.

The report points out that, often, the market will find alternative ways to deal with some of these inefficiencies:

- The use of long-term contracts
- The emergence of intermediaries, including web-based exchanges. Several initiatives both by the private sector (e.g. Envirodesk www.envirodesk.be, reststoffenbeurs www.reststoffenbeurs.nl, EUWID recyclingbörse www.euwid-recycling.de, …) as by the public sector (e.g. the Belgian Ministry for Economics http://mineco.fgov.be/enterprises/waste/asp/bulletin_nl.asp) are active for more than 20 years.
- (Costly) testing for quality
- Vertical integration between firms involved in material recovery and firms involved in the collection stage
- Provisions of guarantees in case of misrepresentation
- Dispute settlement mechanisms
- Demonstration projects to reveal information about the suitability of recycled materials.
- The use of performance standards which are generic over products
- The use of deposit-refund schemes or other forms of extended producer responsibility

However, if this is not the case, then public authorities or agencies can play the following role:

- Providing support for intermediaries (or any tool to match "supply and demand") and dispute settlement mechanisms
- Penalise misrepresentation by sellers
- Dissemination of standardised contracts
- Developing material testing protocols
- Diffusing information about the suitability of particular products through public procurement
- Subsidies for research and development in product designs which are more recyclable
- Applying the usual tools of competition policies
- Development of appropriate liability standards

The OECD acknowledges that the instruments used for overcoming environmental externalities might have an adverse effect on other market failures (such as the technological externalities mentioned above).

Whilst the OECD study has been the direct source of inspiration for this project, it is nor the oldest neither the most recent on the subject. We briefly summarize here the other reports we have identified, but refer the reader to them for more details.

In 1993, Mt Auburn Associates and Northeast-Midwest Institute conducted a study for the US Environmental Protection agency, "Developing Markets for Recyclable Materials". It identified the following barriers to market development:

- Imperfect flow of existing information
- Uncertainty about future markets
- Undervaluing of the public costs and benefits
- High transaction costs
- An initial small market can mean higher per-unit costs

- Aversion to risk
- Barriers to investment in R&D when the profits of innovation cannot be appropriated

It covers several materials and products: aluminium, steel, old corrugated containers, motor oil, lead-acid batteries, old newspaper, tires, compost, plastics, glass containers, and used office papers.

It identifies the following instruments that could be used by governments to overcome the barriers:

- Information and technical assistance
- "Buy recycled" programmes
- Financing of business that use recovered materials
- Taxes
- Direct regulation of collection, processing, remanufacture or purchase of secondary materials

In 1999, AEA Technology performed a study for the UK Department of Trade and Industry, entitled "Developing Markets for Recycled Products". The report first assessed the arisings, current recycling rates, the barriers and influencing factors affecting recycling rates of the following waste materials: glass, metals, paper, plastics, rubber, textiles, wood, and oil, and certain specific producer responsibility sectors: packaging, batteries, vehicles, tyres, electrical/electronic equipment, and newsprint.

The study pointed out that in order to increase the amounts of materials recycled, both recycled materials supply-side and demand-side problem areas need to be addressed. This particular report focused on the demand-side area of market development. It listed a number of possible options that could be selected to tackle the barriers to increased market demand, including:

- standards for recyclate and recycled content products;
- guidelines for industry on best practice, and on using recyclate to make new products;
- recycled content agreements with industry;
- buy-recycled initiatives;
- waste exchanges, and recyclables exchanges;
- economic instruments;
- design for the environment
- use of eco-labelling.

It is striking that the problems identified and the solutions proposed in both the report for the EPA and the one for the Department for Trade and Industry overlap almost completely with those in the OECD Report. While this suggests that some issues do not change fundamentally over time and space, it does not imply that repeating the exercise is redundant. Sorting and recycling technologies have evolved, the prices for some primary products have exploded in the recent past, and the Internet has drastically affected transaction and search costs. Last but not least, drastic changes in the regulatory context have been implemented across the EU, especially (but not only) in the new Member States. Inevitably, new lessons are there to be learnt.

ECOTEC Research and Consulting have conducted a study for the UK Department for the Environment, Transport and the Regions concerning Policy Instruments to Correct Market Failure in the Demand for Secondary Materials. The purpose of the study has been to assess the case for government intervention to promote an increase in demand for secondary materials in the UK; to identify policy instruments that could be used to correct market failures for demand for secondary materials; and in particular to provide advice on the applicability of economic instruments in this context.

It covered the following materials:

- paper
- glass
- aluminium
- steel; and
- plastics.

On top of the market failures considered in the other studies quoted here, the ECOTEC study also analysed the following issues:

- Divergence of private and social rates of discount;
- Government failure / issues of regulatory capture.

In 2006, several reports were published that covered the markets for more specific waste streams:

- ICF International conducted a study for the US EPA, "A Study of Potential Effects of Market Forces on the Management of Hazardous Materials Intended for Recycling". Whilst our study will not cover specifically the recycling of hazardous materials, the ICF report has unveiled one new important element: that the existence of low net worth of firms involved in recycling activities can also lead to sub-optimal outcomes.

- URS Australia performed a study on "Market Failure in End-of-life Tyre Disposal" for the Australian Department of the Environment and Heritage. The study considered the "classical" market failures: external costs and benefits, public goods, information failures and monopoly and restricted competition.

- Oakdene Hollins et al undertook a study for the UK Department for Environment, Food and Rural Affairs on the recycling of low grade clothing waste. They covered the market imperfections analysed in the OECD study.

In 2008, the Flemish Public Waste Agency OVAM finalised a study on improving the markets for recycled products (OVAM 2008c). The analysis included following waste streams: soil improvers, debris granulates, paper and cardboard, glass, metals, plastics, tyres and wood. Caste studies covered Germany, The Netherlands, Sweden, the United Kingdom, Austria and France. The study is only available in Dutch but its main conclusions have been integrated in this study where appropriate.

Finally, the ongoing Cost Action E48 "The Limits to Paper Recycling" had as objectives to collect facts, data and experiences to develop scenarios to predict the future ecologically and economically utilisation of recovered paper within the European paper industry. In this perspective, it has sought to identify the ecological and economic limits beyond which paper recycling would no longer be a reasonable option. The topics under study covered, amongst others[5]:

– Expected improvements in existing process technologies

– Pros and cons of established or planned collection systems

– Quality of recovered paper resources not yet exploited

– The future composition of recovered paper

– Development in national and European legislation

– Development of quality standards

The project team has consulted E48 documents that are in the public domain. Obviously, the future output of this Action can provide a complement to this study.

1.3. METHODOLOGY

1.3.1. Summary of step 1

From the initial project specification, the intention of Task 1 was to identify, through a process of prioritization, ten markets, 'either material or product streams, which offer the greatest potential environmental and economic benefits from perspectives of improved market operation.' The specification suggested that the investigation must look widely across a large number of markets, considering both product stream and material stream perspectives.

However, the project team deemed that scoping of Task 1 was necessary to ensure the task is of a manageable size. The approach agreed at the Inception Meeting was as follows:

- To take a long list of markets for materials / products;
- To subject these to a rapid appraisal against four 'filtering criteria' with a view of reducing the number of materials / products for closer examination down to 10;
- To carry out a more detailed, though by no means comprehensive, analysis of these 10 material / product markets with a view to indicating the scope for additional benefits to be derived through the improved functioning of markets for recycling in these areas. This more detailed assessment would be the basis for choosing four materials / products to be examined in more detail in Task 2.

Task 1 was, therefore, split into three sub-tasks:

a) Choice of material / product markets for inclusion in the Task;
b) Rapid appraisal of issues affecting these markets with a view to reducing the scope of the analysis to 10 material / product markets; and

[5] Grossman (2007), Developing Scenarios on the Future of Paper Recycling within E48, presentation given for Cost Action E48.

c) More detailed – albeit still high level – analysis of the potential market failures in the markets for these 10 materials / products, and possible benefits to be derived from addressing these.

Steps a) and b) have been the subject of a separate report that is included in Annex. They have led to the following list:

- Aluminium packaging
- Other non-ferrous
- Batteries
- Cardboard beverage packaging
- Non-packaging plastics
- Food waste
- Tyres
- Furniture
- WEEE
- Catalyst waste

In the process of step c) it became clear that, due to data limitations, it would be impossible to provide useful information on furniture waste. Therefore, the project team has analysed textiles instead.

1.3.2. Markets covered in step 2 and 3

At the Interim Meeting of 17 March, the EC project officer and the project team agreed to limit the analysis in step 2 and 3 to the following waste streams:

- Cardboard
- PVC
- Batteries
- Food Waste

The following three countries have been accepted for consideration for the initial "in depth" analysis[6]:

- the region of Flanders in Belgium
- France
- UK

For the "second stage" analysis, the following proposal has been accepted:

- Spain
- Estonia

[6] This list deviates somewhat from the list agreed initially at the meeting of 17 March. All changes were discussed with, and approved by the EC Project Officer.

- Poland

1.3.3. Approach to task 2 and 3

The EC project officer has emphasized that the main intention is to identify the market failures that would prevent higher rates of recycling even if all externalities were internalised. The project team should only look at policy failures that cause market failures (such as market power, failures in the collection phase, etc).

For the purposes of this study, we use the following definition of market failure:

> A market failure occurs whenever the outcome of the unregulated market can be improved upon (in the sense of potential paretian improvement) through a policy action undertaken by a government under reasonable assumptions concerning the public actor's cognitive capacities, available information and enforcement powers.

The fundamental methodological option taken here is that we do not use an omnipotent and omniscient benevolent dictator as the benchmark, because then the analysis would end up defining every real world outcome as a "market failure". However, governments usually have informational advantages compared to small private players, or are better placed to enforce rules and contracts. It is from this perspective that we judge policy options.

We restrict our analysis to the following potential sources of market inefficiency in the recycling market identified in the OECD study "Improving Recycling Markets":

- Transaction and search costs in secondary materials markets (costs related to price discovery, "search" costs, administrative costs, negotiation and bargaining costs)
- Information failures ("adverse selection") related to waste quality
- Consumption externalities and risk aversion (i.e. the information failures and commercial disincentives to the use of secondary materials in final products)
- Technological externalities related to products (this arises when one firm manufactures a product such that it increases the cost of recycling for the downstream processor, but cannot be compensated for changing its product design)
- Market power in primary and secondary markets

This means that we maintain the approach used in the OECD study "Improving Recycling Markets" of not considering *in this task* the externalities linked to raw material extraction and waste management, as they are outside the scope of the objectives of this study (see Specification to Invitation to Tender, Part 1, Chapter 2). Moreover, it is widely acknowledged in the literature (including in the OECD study) that each market failure (including incompletely internalized environmental impacts) should be tackled with an instrument that is specifically targeted at this specific market failure (for instance, environmental taxes in the case of environmental externalities). However, our analysis *will* consider the environmental impact of the market inefficiencies that are discussed in the study.

As acknowledged in the OECD study, testing *directly* for the efficiency of markets is exceedingly difficult.

Therefore, Task 2 and 3 are mainly based on expert opinions and qualitative assessments, obtained through:

- Desktop research of the relevant academic and professional publications
- In-depth interviews and surveys with representatives of trade federations or selected executives in the sector.
- In-depth interviews and surveys with officials in charge of waste policy in the selected member states.

Following sectors have been considered for inclusion in the survey, depending on the relevance for the markets covered:

- Markets upstream of waste generation: only if it turns out that these are vertically integrated with the recycling activities, or if the producers of primary product are vertically integrated with the waste generators.
- Markets downstream of waste generation
  - Collectors (this can include retailer or wholesalers of waste-generating products)
  - Processors[7]
  - Recyclers
  - Compost processors
- Demand side: users of recycled and/or recovered products
- Facilitators, service providers etc
  - Industry Associations
  - Producer Responsibility Organisations (PROs) (per waste stream or across waste streams)[8]
  - Certifiers
  - Standardisation organisations
  - Waste exchanges, recyclables exchanges (including web-based)
  - Producers of waste management and recycling technology
  - Transporters between each stage
- Public authorities
  - National or regional authorities
  - Municipalities and associations of municipalities

Some of these stakeholder categories can be subdivided further or overlap with other categories.

For instance, collection can take place through house-to-house collection schemes or trough return depots, and can be operated by:

- Municipalities

[7] Those involved in separating, sorting, dismantling, shredding, cleaning, depolluting, pulping, granulation, grinding (in the case of tyres: rethreading and regrooving, shredding, chipping).

[8] For a definition of Producer Responsibility Organisations, see Section 2.3 .

- Retailers of goods subject to some sort of take-back scheme (including vehicle maintenance companies, tyre service centres and recognized car dismantling centres)
- Producers who do not join a Producer Responsibility Organisations (PRO) in the case of Extended Producer Responsibility (EPR) programs[9]
- PRO
- Charity shops (in the case of used clothing)

The surveys for Task 2 and 3 have been held simultaneously in order to avoid "survey fatigue" and to maintain the goodwill of the interviewees.

This qualitative analysis has been complemented with quantitative analysis if the relevant data were readily available (freely available from Internet database or from trade federations).

1.3.4. Response received

In total, 131 stakeholders have been contacted for the purposes of this study.

The response received has been very mixed.

Some stakeholders have accepted to be interviewed in depth, either in face-to-face meetings or by telephone. In other cases, detailed answers to the questionnaires were provided.

In other cases, the feedback received was very sketchy.

Moreover, 53% of contacted stakeholders never provided any feedback at all, despite numerous requests from the project team – in some cases, up to 5 reminders were sent.

This implies that, in some cases, the project team has not received any second opinion with respect to some bold statements made by specific stakeholders. We have therefore always taken care to present these statements "as such". The fact that these statements have been included in the report does not imply that we endorse these opinions.

Similarly, with respect to the description of recycling technologies and the claims that are made concerning their potential, it has not always been possible to obtain independent validation. Therefore, the sections on technology mostly quote directly the product description by the industry, and no claims are made with respect to their accuracy.

1.4. STRUCTURE

This report has been built up as follows.

Chapter 2 can be considered as a backgrounder, covering the state of the art in those topics of economic analysis that is relevant for our study. It contains a general discussion of market failures (including in technological innovation), of environmental externalities related to resource use and on the economics of waste collection and disposal.

[9] For a definition of Extended Producer Responsibility, see Section 2.3 .

Chapter 3 gives a general overview of the EU policy context. It first gives an overview of EU waste policy, and of transversal legislation. Next, it gives an overview of specific regulatory context for the 4 waste streams considered in this study, including voluntary commitments taken by EU-wide trade federations. Finally, it provides an overview of the most important Community initiatives taken to promote environmental technologies.

Chapter 4 provides the essential fact and figures on production and recycling of the considered waste streams in the EU.

Chapter 5 contains a description of the state of the art of collection and recycling technologies for the considered waste streams. Where possible, we also discuss challenges and potential.

In Chapter 6, we make a provisional first assessment of the market situation at the European level.

Chapters 7, 8, 9, 10 , 11 and 12 take a closer look at the situation in Flanders, the UK, France, Estonia, Poland and Spain respectively.

Chapter 13 provides a summary of the main lessons learned per waste stream, including policy implications.

2. THE ECONOMICS OF WASTE MANAGEMENT

2.1. OVERVIEW OF THIS CHAPTER

In this chapter, we provide an overview of the economic thinking that is relevant for the analysis.

We start with a general theoretical background on the issue of market failures (Section 2.2). Next, we provide an inventory of the environmental externalities linked to resource use (Section 2.3). In that Section we also explain why tackling market imperfections that are not related to resource can help reducing environmental externalities. Section 2.4 contains a discussion of the organisation of waste collection, and Section 2.5 does the same for waste disposal. Special attention is given to issues of competition. In Section 2.6, we provide a short discussion of the economics of Extended Producer Responsibility, a regulatory tool that has rapidly gained ground in the last two decades. Finally, Section 2.7 explains the market failures that can occur in technology adoption and diffusion.

2.2. GENERAL THEORETICAL BACKGROUND

It is a fundamental result in economic theory ("the first fundamental theorem of welfare economics") that, under a set of restrictive assumptions, a competitive market economy will exhaust all possibilities for mutually beneficial exchanges in equilibrium. In other words, when demand equals supply in all markets, then no economic agent can be made better off without making at least one other agent worse off.

In economic jargon, it is said that a competitive economy is Pareto efficient.

This result can be interpreted in two different ways.

One strand of literature considers that this result shows that there is no need for government intervention in the economy.

Another approach consists in analysing the assumptions underlying the theorem to understand under what circumstances government intervention might be justified in practice.

Thus, if, in reality, one observes that one of the assumptions is not met, one can conclude that a "market failure" is occurring. The task of the economist then consists in finding the regulatory instruments that would allow to correct this market failure.

We will now briefly survey the most important types of market failures and possible tools to correct for them. We will conclude this section by general considerations on the use of regulatory instruments in a "second best" world and on government failure.

This section is of course not meant as a substitute for a full text on the economics of market failure. The purpose of this section is to briefly summarize the main market failures that will turn out to be relevant for our analysis. We refer to standard textbooks for more background material[10].

[10] For instance: Mas-Colell, A; Whinston, M.D.; and Green J.R. Microeconomic theory. Oxford University Press. 1995; Myles, G.D, Public Economics, Cambridge University Press, 1995; Mueller, D, Public Choice III, Cambridge University Press, 2003.

2.2.1. Imperfect competition

The fundamental theorem relies on the assumption that all economic agents take the market prices as given when deciding how much to produce or demand.

In practice, some agents may, within limits, have some freedom to set their own prices. It is said that they have "market power".

In the extreme case of a single producer ("a monopolist") who cannot price discriminate, the producer will restrict his offer compared to competitive levels in order to extract higher prices from consumers ("static inefficiency"). Moreover, due to the lack of competitive pressures, the monopolist will face little incentives to reduce his costs or to improve his products ("dynamic inefficiency").

In the other extreme case of a single demander facing competitive suppliers ("a monopsonist"), the monopsonist will reduce his demand in order to drive down prices.

In practice, one observes markets with a few suppliers ("oligopoly") or with monopolistic producers who face competition from close, but not perfect substitutes ("monopolistic competition"). Also, producers can collude to behave collectively as if they were one single monopolist ("cartels").

Governments can intervene by prohibiting cartel agreements, by controlling mergers that would lead to excessive market power, or by fighting behaviour that would reduce competition in the long run (such as predatory pricing).

It is very important to realise that a high level of market concentration does not imply in itself that the incumbent firms will be able to exert market power. Indeed, abuse of market power will lead to higher than normal profits and should be expected to induce new entry in the market, thus lowering prices. Thus, abuse of market power can only be sustained if barriers to entry exist. The most important barrier to entry are sunk costs: costs that cannot be recovered if a firm decides to exit from the market. Examples of sunk costs are: R&D expenditures, advertisement expenditures, market specific assets… Other barriers to entry include intellectual property rights and long term contract between the incumbents and their clients. Thus, analysis of market power should not focus on indicators of market concentration, but on barriers to entry (see for instance Fingleton (2000)).

One particular issue arises when monopoly is due to the existence of economies of scale. This typically occurs in industry with large fixed costs and low variable costs. In this case, average costs decrease whenever production increases, and the technically efficient solution consists in having one single firm serving the whole market. This will also be the natural market outcome, as firms will merge in order to increase their profits by exploiting economies of scale. The market is then said to be a "natural monopoly".

The regulator then typically faces a dilemma.

If he splits up the firm, fixed costs will be duplicated and the solution will not be technically efficient.

The efficient solution then consists in regulating the price decisions of the monopolist.

One radical way to do so is to bring the monopolist under direct government control by nationalising it. There are however several disadvantages linked to this solution.

The monopoly will indeed no longer face the financial discipline imposed by capital markets, as it knows that any deficit will be paid for by taxpayers' money. Therefore, managers will pay less attention to optimising the functioning of the firm. Workers will tend to request wages and perks above competitive levels, certainly if they have tenure as civil servants.

Moreover, there is a significant risk that politicians will interfere with the daily functioning of the company and impose multiple tasks that are often incompatible with efficiency (for instance, providing employment to important constituencies).

An intermediate approach would be to retain the company under private ownership but to regulate it. However, this approach has also some problems of its own.

Indeed, a competitive firm will produce up to the point where its marginal cost[11] is equal to the (given) market price. However, under increasing returns to scale, average costs are declining when production increases. It can be shown that average costs are always larger than marginal costs in the range where average costs are decreasing[12]. Therefore, average costs will be higher than the competitive price and imposing competitive pricing will cause the firm to make losses.

Therefore, in order to prevent the firm from going out of business, the government will have to cover its deficit if it imposes competitive prices (or any prices higher than average costs).

The next question is then how the subsidy will be determined.

One possibility is to provide a fixed subsidy per unit of production. The advantage of this method is that it imposes a clear limit on the transfers from the taxpayers to the firms' shareholders. The drawback is that it provides no incentives for the firm to reduce its costs.

A possible alternative is to impose a maximum price on the firm and to compensate for any deficit it faces. This system provides high incentives for efficiency: each cost reduction will be translated in higher benefits! However, if the regulator has underestimated the potential for cost reduction, the transfers from the taxpayers can become excessive[13].

This clearly shows that, with increasing returns to scale, the issue is not private versus public ownership, but rather that the technically efficient solution requires taking away the powerful incentive of competition.

Some regulators tackle this issue by simulating competition.

One possibility is to make the subsidy dependent on the difference between a firm's performance and the average performance of similar firms ("yardstick competition"). The main difficulty then lies in finding firms that face sufficiently similar external conditions in order to make relative performance comparison meaningful.

Finally, instead of regulating the market, the government can choose to tender the market periodically. In this case, competition "in the market" is replaced by competition "for the market".

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[11] This is the cost linked to producing one additional unit.

[12] Technically: suppose a firm's production level is q, and its total costs is C(q). Its average cost is C(q)/q and its marginal cost is the first derivative of the cost function: d C(q)/dq. Decreasing average cost means that the derivative of average costs must be negative: $\left. d\,\frac{C(q)}{q} \middle/ dq \right. < 0$. It can easily be verified that this condition implies that $dC(q)/dq < C(q)/q$.

[13] We refer here to the controversy surrounding the regulation of Rendac in Flanders – see Section 7.9.5.5.

According to the OECD, a significant advantage of the tendering process is that it reveals key information about the costs of providing the underlying service[14].

However, there are important transaction costs linked to the writing, monitoring and enforcement of this type of contract. Because, in practice, no contract can foresee all possible future contingencies, a "hold-up" problem can arise when efficiency requires the contract to be renegotiated but one of the contractual parties owns transaction-specific assets[15].

The OECD argues that competitive tendering will not be appropriate for services (OECD (2000)):

- where there is a substantial sunk investment requirement (or equivalently where the value of the investment of the incumbent firm cannot be objectively verified ex post);
- where each tender is idiosyncratic and the incumbent firm is likely to have significantly better information about the costs of providing the service than are potential entrants;
- where some dimensions of the requisite service quality cannot be objectively verified and so cannot be specified contractually and/or aspects of the requisite service quality are politically sensitive so that small reductions in quality are politically unacceptable;
- where there is unlikely to be adequate competition in the tendering process.

The existence of sunk investments will in general discourage bidding. One possible approach to this issue consists in keeping the assets in public ownership and to limit the tendering to the management of the firm.

Whether or not there is enough competition in the tendering process does not directly depend upon the number of bidders, but rather on how easy it is for them to collude.

2.2.2. Externalities

The fundamental theorem is based upon the assumption that there exists a market for all goods and services that influence the welfare of economic agents. In practice, for some goods and services, there exists no market – they are called "externalities".

An externality can be defined as any good or service that influences (positively or negatively) the well-being of economic agents without compensation for (or by) those who have produced this good or service.

Pollution is a typical example of a (negative) externality: those who suffer from pollution cannot pay polluters to reduce their emission, or are not compensated by the polluters for the harm they suffer.

The textbook solution for this problem is for the government to create artificial markets (or at least prices).

For example, an emission tax creates a price for pollution. Therefore, the polluter will behave as if a market for pollution exists and, if the emission tax has been set correctly, he will reduce pollution to the optimal level.

[14] OECD (2000), Competition in local services: solid waste management, DAFFE/CLP(2000)13

[15] See for instance Williamson (1985), The Economic Institutions of Capitalism, New York: Free Press

Alternatively, the regulator can impose a cap on total emission and allow individual polluters to trade their allocated pollution permits. An equilibrium price for pollution permits will then emerge, again acting as an incentive for efficient reduction of pollution.

The main advantage of emission taxes and tradable permit system compared to uniform command and control systems is that they will induce pollution to be reduced where it can be done the most cheaply. In other words, they will allow to realise any environmental objective at a lower cost to society.

In theory, cost-effective reduction could also be obtained if the government had a perfect view on each regulated firm's abatement costs: it could then order each firm to reduce pollution up to the cost-efficient point. However, in reality, this information is not available. The advantage of economic instruments is then that they allow to obtain cost-effective reduction even if the government does not know the polluter's abatement costs.

2.2.3. Public goods

The fundamental theorem is based upon the twin assumptions of exclusion (each agent consuming a good can exclude other agents from consumption) and rivalry (one agent's consumption of a good reduces all other agents' consumption).

In practice, some goods do not fulfil these conditions: they are called public goods. The quintessential example is national defence: no citizen can be excluded from the protection offered by the national defence system, and the protection offered to one citizen does not reduce the protection offered to others.

In practice, there exist a lot of intermediate goods. For instance, the use of infrastructure such as roads or bridges can be excluded to citizens not willing to pay a toll, but, in the absence of congestion, there is no rivalry.

As the market will in general fail to provide public goods in sufficient quantities, the government will in general step in to supply them.

2.2.4. Information asymmetry and transaction costs

The fundamental theorem assumes that all relevant features of products and services can be observed perfectly and costlessly by all market parties.

In practice, it is possible that some features of the products can be observed by one party but not (or imperfectly) by the other.

If the informed party cannot influence these features by his actions, it is said that "adverse selection" occurs. Typical examples are a potential worker's abilities, an insurance buyer's previous medical record etc.

If, however, the informed party can take actions that cannot be verified perfectly by the uninformed party, it is said that "moral hazard" occurs. Typical examples are the actual effort a worker is putting in his job; an insurance buyer's eating and exercising habits etc.

In general, private markets find ways to cope with these problems.

The economic literature distinguishes the following instruments to cope with adverse selections:

- Signalling: This refers to situations where the informed party will take costly actions to signal that he has a high quality product on offer[16]
- Screening: This refers to situations where the uninformed parties take actions in order to distinguish the informed parties who have high quality on offer from those who have low quality on offer[17]
- Contracting: The uninformed parties can draft contracts that provide incentives to the informed parties that will induce them to reveal their hidden characteristics[18].

In the case of moral hazard, paying the informed party according to the outcome of his actions could be expected to provide incentives to provide efforts. However, this is not the case if the outcome also depends on factors that are outside anyone's control: in this case, a risk averse informed party will require to be at least partially "insured" against risk. This insurance will reduce the incentives for efficiency. Incentives provided to salesmen provide a typical example. Actual sales do not only depend on a salesman's effort, but also on general market conditions. A salesman's wage will thus be composed of a fixed part (to provide insurance against adverse market conditions) and a variable part (in order to provide incentives for increasing sales).

Although adverse selection and moral hazard do lead to less favourable outcomes than what would be obtained if information is perfect, it is not obvious how government intervention can improve upon market outcomes in these cases.

We will extensively come back upon this point when analysing individual waste stream, but we can already refer to the example above of natural monopoly regulation: clearly, if the regulator was perfectly informed of the monopolist's potential for cost reduction, regulation would be a trivial matter. This shows that governments face similar constraints as private parties when they are confronted with issues of asymmetric information.

Adverse selection and moral hazard are part of a more general category of issues that are usually being referred to as "transaction costs".

Transaction costs refer to all costs related to:

- The identification of potential counterparties in market transactions
- The costs linked to negotiating and enforcing the contract

A central issue is the impossibility to draft "complete contracts", these are contracts that foresee all possible future contingencies. Therefore, contract in the real world often need to be renegotiated – we have already referred to this in our discussion of monopoly regulation.

While it is not clear whether transaction costs can be considered as market failures, they do create "frictions" in the functioning of markets and it falls certainly within the scope of this study to investigate how this friction can be reduced.

[16] The textbook example is a worker who will take an education in order to show his ability to learn, even if this education adds nothing to his productivity in the actual job he is applying for.

[17] The textbook example is a firm who will require long working hours even if these add little to actual production.

[18] For instance, a regulated monopoly who knows that its potential for efficiency improvement will be more likely to prefer a price cap with a fixed subsidy to a subsidy per unit of production.

However, it is important to keep in mind that, in general, markets will find ways to reduce these frictions if profits can be made out of this. Typical examples are the use of professional intermediaries, exchanges etc.

2.2.5. Regulation in a second best world

In principle, regulation should be governed by the following principles:

- The number of regulatory instruments should at least be equal to the number of issues that the regulators want to tackle
- Each instrument should be as closely related to the problem as possible

A typical example would be the regulation of a polluting monopolist. A monopolist produces less and asks higher prices than a competitive firm, which is bad for consumers. However, because a monopolist produces less, he will also, in general, use fewer natural resources and pollute less than a competitive firm, which is good for the environment.

If the regulator tries to tackle both issues (market power abuse and environmental externalities) with just one instrument, he will run into trouble. Economic theory suggests using one instrument to tackle the issue of monopoly power (for instance, price caps and subsidies) and another to tackle the issue of environmental externalities (for instance, emission taxes).

In the real world, government will often not be able to solve all market failures. If, for some reason, a specific market failure remains unresolved, it is possible that the second-best solution involves changing other variables away from the ones that are usually assumed to be optimal.

In other words, it may be better to let two market imperfections cancel each other out rather than making an effort to fix either one.

Coming back to the issue of the polluting monopolist: if, for some reason, it is not possible to levy emission taxes, then the second best-solution may consist in keeping production levels close to the monopoly levels in order to protect the environment!

This point will be highly relevant for our analysis.

2.2.6. Government failure

When conducting real world policy analysis, it would be a fundamental error to confront the functioning of real-world, imperfect markets, with the functioning of a hypothetical omniscient, omnipotent, and benevolent government.

Clearly, if real world government would indeed satisfy these criteria, there would be no rationale for leaving any market activities at all.

However, in reality, governments are not omniscient. In general, in their dealings with regulated sector, governments are handicapped by serious problems of asymmetric information. We have already given some examples above. It is then important to use regulatory instruments that allow to cope with these asymmetries (for instance, economic instruments rather than command and control systems).

Moreover, governments are not omnipotent. Regulated agents will only comply if the expected sanctions for non-compliance are high enough. As enforcement is costly, this means that there will always be some agents for which non-compliance is the optimal solution. The design of policy instruments should take into account these issues.

Finally, it is not clear what should be understood by "benevolent government" if there are conflicting interests within society. Each conceivable procedure to aggregate individual preferences can be criticised from at least one angle.

Moreover, we should keep in mind that, just as private firms and consumers, both politicians and public servants will respond to incentives.

For instance, politicians generally want to be re-elected and will thus respond to the demands of well organised constituencies. In general, one can expect that policy reforms will be difficult if the losses are concentrated in one sector or geographical area, while the gains are spread out over society e*ven if total gains largely exceed total losses.*

The incentives faced by public servants are an ongoing discussion within the academic literature. The traditional approach has hypothesized that public servants will attempt to maximize their budgets (or at least their discretionary budgets). The underlying assumption is that higher budgets will lead to increased power and higher perks. More recent literature has cast doubt on these claims. If a government agency obtains higher budgets through "mission creep", the agency will lack focus, and will have more difficulties in showing its achievements. This will in turn affect negatively the promotion prospects of the public servants.

2.2.7. Approach

As already stated in Section 1.3.3, for the purposes of this study, we use the following definition of market failure:

> A market failure occurs whenever the outcome of the unregulated market can be improved upon (in the sense of potential paretian improvement) through a policy action undertaken by a government under reasonable assumptions concerning the public actor's cognitive capacities, available information and enforcement powers.

A potential paretian improvement occurs whenever, due the policy actions, the gains of the winners exceed the losses of the losers. Thus, if the winners would compensate the losers, both parties would be better off and a Pareto improvement would have been achieved. Because we do not require compensation to effectively take place, we refer to "*potential* paretian improvements".

2.3. ENVIRONMENTAL EXTERNALITIES OF RESOURCE USE

The EU has placed its waste policy in the general context of its resource policy. Following this logic, the Impact Assessment on the Thematic Strategy mentions the following impacts of resource use:

- Environmental impact from the extraction of primary raw materials.
- Environmental impact from the conversion of primary raw materials in production processes
- Reducing emissions from waste disposal

These cost categories can be further detailed as follows[19]:

[19] See for instance, OECD, "Analytical framework for evaluating the cost and benefits of extended producer responsibility programmes" ; Bartelings et.al., Effectiveness of landfill taxation, Institute for Environmental Studies, Free University of Amsterdam, 2005; http://www.methodex.org/ ; URS Australia Pty Ltd, Market failure in End-of-life Tyre Disposal

Table 1: Environmental costs of resource use

Virgin material extraction and processing:	• Noise • Disamenity and air and water pollution experienced by local residents near mines and reprocessing facilities; • Groundwater contamination, • Physical safety, • Subsidence damage to buildings and public infrastructure; • Land contamination; • Externalities linked to energy use.
Landfilling and incineration	• Health impacts (both from transport related emissions and from other processes) • Occupational accidents and diseases linked to waste collection, landfilling and incineration; transport related accidents • Crop and materials damage, • Disamenity effects (noise and congestion from trucks, annoying odours and visual pollution from landfill, increases or perceived increased health risk; noise and vibration from on-site activities) • Transport-related externalities (including congestion and accidents) • Global warming: methane emissions form landfills but also (depending on the efficiency of the incinerator and the composition of the burned materials) avoidance of CO_2 • Unsightly litter and debris from on- and off-site activities, which can also soil buildings and other man-made and natural assets; • Presence of pests (e.g. mosquitoes, rats, seagulls, etc.); • Visual intrusion. • Fire risk of end-of-life tyres • In the case of incinerators, the treatment and disposal of the solid residues of incineration
Recycling	• fuel consumption and transport congestion linked to the collection and transport of waste; • noise and nuisance caused by recycling collection facilities; • Pollution and energy-use externalities associated with recycling. • Time and efforts undertaken by households in sorting waste

The following table gives an alternative view on the selected environmental impacts of waste treatment options[20]:

Table 2: Environmental impacts of waste treatment options

	Landfill	Composting	Incineration	Recycling
Air	CH_4, CO_2; odours	Emission of CH_4, CO_2; odours	Emission of SO_2, NO_x, HCl, HF, NMVOC, CO, CO_2, N_2O, dioxins, dibenzofurans, heavy metals (Zn, Pb, Cu, As)	Emission of dust
Water	Leaching of salts, heavy metals, biodegradable and persistent organics to groundwater		Deposition of hazardous substances on surface water	Waste water discharges
Soil	Accumulation of hazardous substances in soil		Landfilling of slags, fly ash and scrap	Landfilling of final residues
Landscape	Soil occupancy; restriction on other land uses	Soil occupancy; restriction on other land uses	Visual intrusion; restriction on other land uses	Visual intrusion
Ecosystems	Contamination and accumulation of toxic substances in the food chain	Contamination and accumulation of toxic substances in the food chain	Contamination and accumulation of toxic substances in the food chain	
Urban	Exposure to		Exposure to	Noise

[20] Institute for European Enviironmenta Policy (2003), Applying Integrated Environmental Assessment to EU Waste Policy

areas	hazardous substances		hazardous substances	

From the analysis in Section 2.2.5, we know that, in a first best world, the government should introduce a single instrument for each resource impact it wants to affect, independently of whether these impacts occur during primary product extraction, in the process of landfilling or incineration, during transportation or in the recycling process[21].

The following external impacts should thus certainly be subject to a regulatory measure:

- Noise.
- Water pollution (both surface and groundwater).
- Air pollution.
- Land contamination.
- Occupational accidents and diseases
- Other accidents
- Other disamenity effects such as visual intrusion
- Traffic congestion
- GHG emissions
- Etc

It is less clear whether the following impacts should be the subject of government intervention:

- Depletion of non-renewable resources[22]
- User cost of landfill and incineration space[23]

Whilst these issues are beyond the scope of this study, they are not essential for our argument. Let us therefore ignore them.

[21] As explained above, in a world without perfect information on abatement costs of individual polluting activities, this would mean the introduction of an emission tax.

[22] The depletion of non-renewable resources is not in itself a market failure. Precisely because these resources are non-renewable, postponing their consumption does not affect the fundamental point that they will become unavailable for any future use after consumption. Increasing scarcity will be reflected in higher market prices, and these higher market prices will provide incentives to switch to substitute products. The issue here is thus not whether non-renewable resources will become exhausted – per definition, they all will be at some point in the future. The relevant question is whether the actual time path followed by the price increases corresponds to the optimal time path, taking into account the interests of future generations. In this case, market failures will occur if the private discount rates diverge from the social discount rates or if there are market failures in the development of substitute technologies.

[23] Land space is in a certain sense also a non-renewable resource. If land is sold on the open market, the value of land used for landfills or incinerations should be reflected in market prices. There are thus no prior grounds to assume that land use by landfills or incinerators reflect any type of market failure. Of course, the user cost of land use should not be confused with disamenity impacts. For a more detailed discussion, see: Pearce, Does European Union Waste Policy Pass a Cost-benefit Test?, in Environmental Assessment Institute, Rethinking the Waste Hierarchy, March 2005.

Suppose now that the government would indeed impose emission taxes on all individual sources of pollution.

If landfills and incinerators face the correct prices for the externalities they impose, they will, if possible, pass through the cost of these externalities in their gate fees, differentiated according to the environmental impacts of the waste that is being supplied. The waste collectors will pass this through to the waste owners – again, if it is possible for them to charge waste owners according to the characteristics and quantities of the waste they produce.

Waste owners will then in turn adapt their behaviour: switch to recyclable products, buy products with smaller environmental impacts linked to landfilling or incineration etc.

Due to these changes in demand, the producers will adapt the design of their products to take into account the environmental impacts in the disposal phase.

In the frictionless world we have described above, not all products will be recycled, but the choice between landfilling, incineration, recycling, re-use and prevention will indeed reflect the relative scarcity of natural resources.

Is this realistic? Clearly not. However, starting from this hypothetical example allows us to focus on the most important barriers to optimal resource use:

- Even if landfills and incinerators would face the correct prices for the externalities they impose and would have the freedom to adapt their gate fees, collected waste is not sorted perfectly according to its environmental impact in the landfilling and incineration phase. Actual gate fees would be an approximation of the external costs imposed by heterogeneous waste streams.
- Waste collectors are not always able to charge waste owners according to the environmental impacts of the waste they produce. For instance, in the case of household waste, local authorities may prefer for electoral reasons not to confront households with the real cost of their waste production[24]. Moreover, measuring the quantities of waste produced (as expressed in weight) requires the use of (costly) monitoring technology. But, even if weight is measured, it will never be possible to perfectly monitor the environmental characteristics of each individual garbage bin. Finally, high weight-based fees may induce waste owners to look for alternatives (such as illegal dumping or backyard burning) with even worse environmental impacts[25]. Therefore, although the practice of Pay As You Throw schemes is growing, one cannot assume that waste producers will ever be charged perfectly according to the cost they impose downstream.
- Waste services industry can be split in two distinct activities - waste collection and waste disposal. As pointed out by the OECD, waste collection services are little more than a form of delivery or transportation service, from the customer's property to the disposal site (OECD (2000)). At the disposal site the waste may be sorted or otherwise processed before being incinerated or landfilled. If transportation costs are relatively high, landfills and incinerators will enjoy some (local) market power (see Section 2.5). Similarly, in some cases, waste collection may be characterised by economies of scale or density (see Section 2.4). From the discussion in Section 2.2.1, we know that this will lead to abuse of monopoly power in an unregulated

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[24] A 2000 survey by the OECD concluded that most local authorities in OECD countries do no charge residential or small business producers by weight or volume of waste produced. (OECD (2000), p. 33).

[25] There is some evidence that these effects can be significant (OECD (2000), p. 34). For a recent evaluation of unit-based collection charges: see OECD (2006a), Impacts of Unit-based Waste Collection Charges, ENV/EPOC/WGWPRG(2005)10/FINAL, report prepared by Dominic Hogg.

environment. However, we have also learned in the Section that there is no silver bullet of government intervention that could solve these issues.

These factors are sufficient to understand why, in general, we cannot expect externality pricing to induce optimal resource use[26].

This justifies analyzing failures in recycling markets. The failures discussed in the 2005 OECD study are not always very specific to markets for recycled products. However, in a second-best world, improving the functioning of the recycling markets could, at least partially, compensate for the market and policy failures we have just described. Indeed, if demand for recycled products would increase, the relative price of the alternative options (landfilling and incinerations) would also change.

The analysis above also helps to understand the crucial role played by extended producer responsibility schemes.

In short, extended producer responsibility (EPR) imposes accountability over the entire life cycle of products and packaging introduced on the market. This means that firms, which manufacture, import and/or sell products and packaging, are required to be financially or physically responsible for such products after their useful life. They must either take back spent products and manage them through reuse, recycling or in energy production, or delegate this responsibility to a third party, a so-called producer responsibility organization (PRO), which is paid by the producer for spent-product management. In this way, EPR shifts responsibility for waste from government to private industry, obliging producers, importers and/or sellers to internalise waste management costs in their product prices (Hanisch, 2000).

In our thought experiment above, producers modify their production decisions and products design because they are confronted with the total final costs of disposal throughout a chain (landfill or incinerators, waste collector, waste owner, producer). An EPR scheme leapfrogs the intermediate steps and directly confronts the producer with these costs. A central theme throughout the analysis will therefore be how the introduction of an EPR will affect the functioning of the markets for recycling. The following points will have to be kept in mind:

- First, the incentives for a producer to design products that will have low waste management costs will be sharper if the waste management costs savings translate directly into lower contributions to the running costs of the PRO[27].
- Cost signals to a producer may be muted by the producer's ability to pass on the cost to the consumer and this issue may need to be addressed in the EPR program design. The absence of a link between producer choices and waste management costs arises fundamentally because households do not bear, directly and precisely, the costs of waste management of the products they purchase and discard because these costs are generally hidden in their general municipal tax[28].

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[26] It has been argued elsewhere that the main potential of waste policy to reduce the environmental impact stems from avoiding upstream externalities associated with the use of the substituted resources, and that the social cost of landfilling waste is less than 10% of the total social cost of production and consumption of goods - see McLennan Magasanik Associates Pty Ltd, BDA Group, The potential of Market Based Instruments to better manage Australia's waste streams, Report to Environment Australia, 2003. The study concludes that the focus of policy should be designing instruments to directly impact on upstream activities. It is beyond the scope of this study to tackle this specific issue.

[27] OECD (2005b), Working group on Waste Prevention and Recycling, Analytical Framework for Evaluating the Costs and Benefits of Extended Producer Responsibility Programmes, ENV/EPOC/WGWPR(200)6/Final, document prepared by Prof Steven Smith

[28] Ibid.

- According to Walls, EPR policies would also be preferred when there are illegal disposal problems and/or when poorly functioning recycling markets exist[29].

The discussion in this Section clearly implies that we should not analyse one market or policy failure in isolation of the others. Focusing on issues of asymmetric information in the market for the recycled product, for instance, does not make any sense if the organisation of collection does not result in sufficient supply.

One final thought here is that the analysis until now has been conducted with given technologies for collection and recycling. In reality, technologies change, and the rate and direction of changes are affected by incentives. However, technology adoption is plagued by specific market failures. Therefore, analysing the interaction between the market failures in environmental policy and in technology adoption warrants a section of its own.

2.4. MARKET ORGANISATION IN THE COLLECTION PHASE

2.4.1. Economies of density versus economies of scale

Economies of density and economies of scale are two closely related but distinct concepts.

Economies of density (ED) are the proportional increase in total costs brought about by a proportional increase, holding all input prices and the size of the network fixed. This is equivalent to the inverse of the elasticities of total cost with respect to output[30]:

$$ED_{TC} = \frac{1}{\partial \ln TC / \partial \ln Q}$$

Where TC is total cost and Q is output. There are economies of density when ED > 1. Economies of density exist if the average costs of a waste collection firm decrease as the volume of waste collected to a fixed length of network increases.

If economies of density exist, waste collectors operating in the same network would decrease their costs if they would merge (or split the market geographically), thus making competition impossible within the network.

In general, the marginal cost of collecting waste from an additional house is small when the house is already passed by a waste-collection vehicle, provided the additional waste collected does not exceed the capacity of the vehicle. If the collection frequency is at sufficiently spaced intervals that a waste is collected from virtually every house on each collection round, there are significant economies of density in household waste collection (OECD (2000)).

Empirical research confirms that it might not be possible to sustain conventional in-the-market competition in solid waste collection for residences and small businesses. Economies of density do not arise in the provision of collection services to large producers of waste, for the collection of unusual or

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[29] OECD (2004), Economic Aspects of Extended Producer Responsibility.

[30] Antionioli, B and Fillipini, M (2002), Optimal size in the Waste Collection Sector, Review of Industrial Organization, 20: 239-252.

exceptional waste where timeliness is valued, or for the collection of waste requiring special handling - these services can be supplied competitively (OECD (2000)).

Between the two extreme cases, there is a continuum of small and medium-sized enterprises that produce quantities of waste for which it is not possible to delay collection until a full truck load of waste has accumulated. In this market, competition is likely to be limited and imperfect (OECD (2000)).

In the case of selective collection of recyclable material, economies of density are likely to be even more important. First, there are the overhead costs of two collection systems. Moreover, the variable cost of collecting recyclables is much higher than the variable cost of collecting traditional solid waste. The difference in the cost per ton resides basically in the fact that you cannot compact the recyclable materials[31]. Separate collection is also more difficult to enforce, since sanctions against scarce commitment to recycling require the monitoring of individual behaviour. Empirical evidence suggests that appealing to civility and positive public spirit through information and educational campaigns can very reduce free-riding, but also that the provision of an easily accessible collective facility for separate collection is fundamental[32].

Economies of scale (ES) are defined as the proportional increase in total costs brought about by a proportional increase in output and the size of the network holding all input prices fixed (Antionioli, B and Fillipini, M (2002)):

$$ED_{TC} = \frac{1}{\partial \ln TC / \partial \ln Q + \partial \ln TC / \partial \ln N}$$

Where N is the size of the network. This measure is relevant for analysing the impact on cost of merging two adjacent waste collection firms.

According to the OECD, studies show that there are economies of scale in waste collection associated with the increasing utilisation of garbage trucks, up to a city size of around 50 000 inhabitants. For larger cities, cost increases proportionally to the number of inhabitants (OECD (2000)).

More recent work argues that in Europe some scale economies can be achieved for up to 200-300,000 inhabitants, whereas there is some evidence of diseconomies for larger urban areas due to congestion (Massarutto, A (2006)).

Public good dimensions in the collection phase arise from urban neatness and public health. Individuals can turn to illegal disposal, an activity that is difficult to deter. According to Massarutto, empirical evidence on the true relevance of these issues is not conclusive. While the cost of monitoring illegal disposal is high, individual benefits are also limited, since the monetary cost of the service is not particularly high, and illegal practices presume further complications (e.g. abandoning waste somewhere during the night) and social sanctions. This risk could be reduced if all households were compelled to choose among authorized operators providing evidence that they had done so (Massarutto, A (2006)).

[31] Porter, R (2005), Benefit-cost analysis and the waste hierarchy – US experiences, in: Environmental Assessment Institute (2005), Rethinking the Waste Hierarchy

[32] Massarutto, A (2006), Municipal waste management as a local utility: Options for competition in an environmentally-regulated industry, Utilities Policy 15 (2007), 9-19

2.4.2. Competition in the market

As argued above, with economies of density, competition in the collection phase will be neither efficient nor sustainable.

Moreover, with competition in the collection phase, individuals could free ride by not participating in any regular collection activity at all, an activity that is difficult to deter (Massarutto, A (2006)).

At the time of the OECD study on this subject, some US and Finnish cities had adopted a system allowing competition in the market. However, in Finland, a tendency could be observed to switch to competitive tendering organised by municipalities. The first reason for this change are the costs associated with enforcing the requirement on households to purchase waste collection services. Secondly, studies have shown that prices for waste collection in Finland seem to be higher for those municipalities which have competition in the market (OECD (2000)).

These points have to be kept in mind for our discussion of waste collection in Poland and Estonia.

2.4.3. Competition for the market

In Section 2.2.1, we have already briefly surveyed the fundamental options that are open for providing services in case of a natural monopoly.

The OECD has argued that waste collection services are a good candidate for competitive tendering (OECD (2000)):

- There is little or no sunk investment in the case of waste collection. There are no long-lived assets in waste collection and there is a ready second-hand market for the only assets of any importance (garbage trucks). There may be some investment by a firm in good customer relations, but to an extent this can be contractually verified.
- Waste collection is a sufficiently homogeneous service that potential bidders could, in principle, gain a good understanding of the costs involved in waste collection by direct experience in other city markets. The incumbent's information advantage is therefore likely to be weak.
- In the case of waste collection the basic service quality parameters (frequency of collection, services provided, levels of customer complaints) can be sufficiently well specified to allow effective quality regulation.

Other authors have also pointed out that the cost of service disruption is comparatively low.[33]

The OECD provides a survey of studies that attempt to measure the efficiency gains from competitive tendering. Generally, these studies suggest that tendering leads to significant efficiency gains without convincing evidence that this leads generally to lower quality of service (OECD (2000)). .

One should keep in mind here that the efficiency gains linked to tendering should not be confused with efficiency gains linked to privatisation. Bel and Costas (2006) have failed to find significant effects of the mode of production (public/private) on costs borne by municipalities. They put forward two hypotheses to explain this. First, progressive concentration and decreases in bidding competition may come to outweigh gains from privatization. Second, the threat of privatization may have stimulated public unit managers to search for alternative reforms. They point specifically to the emergence of inter-municipal

[33] Walls, M. (2003), How Local Governments Structure Contract with Private Firms: Economic Theory and Evidence on Solid Waste and Recycling Contracts, Resources for the Future Discussion Paper 03-62.

cooperation[34]. Other authors point out that, after competitive tendering, private and in-house companies are in fact comparable, arguing that efficiency gains arise from competition rather than ownership. When the tender encompasses the whole service (including disposal), the outcomes of tendering are even far less clear (Massarutto, A (2006)).

According to the OECD, in the tendering process, attention should be paid to (OECD (2000)):

- The geographic region over which collection services are to be provided should be large enough to allow successful firms to exploit economies of scale and density.
- Where the size of the city or district is much larger than the minimum efficient scale of collection, the OECD suggests breaking up the region into several smaller pieces and tendering each piece separately. This allows for performance comparisons between the firms serving the different regions, reduces the disruption associated with loss of service from a single firm and enhances the likelihood that several firms will be in a position to compete when the time comes for re-tendering.
- Successful collusion in the tendering process requires the ability to detect and punish deviations from the cartel agreement. Therefore, the OECD argues that, from the competition perspective, it is preferable to use sealed bid auctions, without disclosing the results. According to the OECD, concerns about political favouritism could be met by the establishment of an independent agency with responsibility for overseeing all public tenders and with access to all of the bids.
- If competition in disposal facilities is limited or non-existent, firms, which do not own disposal facilities, will be at a competitive disadvantage in the tendering process for waste collection. In these cases, the OECD argues that potential collection firms should be guaranteed access to disposal facilities on non-discriminatory grounds. An alternative and, according to the OECD, preferable solution is to separate ownership of disposal and collection facilities and/or to prevent owners of disposal facilities from participating in tenders for collection.
- In many cases, a division or subsidiary of the local government itself is in a position to provide the services, which are being purchased by tender. Competitive neutrality is ensured when public and private sector suppliers face identical regulatory, legal, financial and administrative arrangements.

2.5. MARKET ORGANISATION IN THE DISPOSAL PHASE

According to Massarutto, there is no evidence of increasing returns to scale in the European municipal waste management market, and the risk that a significant market power will be achieved in the national or European market is therefore limited. However, since waste is bulky and costly to handle, transport costs can reach 30-60% of the treatment cost. Therefore, long-distance transport is economical only in special cases. This explains not only why "waste tourism" has affected mostly congested areas, but also why the territorial range of market transactions increases when the value of the related materials is higher (Massarutto, A (2006)).

Due to high costs linked to the transportation of collected waste, geographic markets for waste disposal are often limited in scope, with limited competition between disposal facilities. The high cost of obtaining permission to open new landfills or incinerators further enhances economies of scale and raises barriers to entry in the waste disposal sector (OECD (2000)).

However, other factors also play a role, some of them policy-induced.

[34] Bel and Costas, Do Public Sector Reforms Get Rusty? Local Privatization in Spain, The Journal of Policy Reform, Volume 9, Number 1, March 2006 , pp. 1-24(24).

According to the self-sufficiency principle (SSP), trading of waste is severely constrained, while each regional area is required to be self-sufficient in the provision of disposal capacity. This had important consequences on the structure of the industry. The most important one has been the setting up of legal monopolies or oligopolies in the industry's key segments downstream of collection. Self-sufficient regional markets were established to prevent the migration of waste towards low-standard countries or regions. Massarutto argues that this is no longer justified: rules with respect to waste disposal are not only largely harmonised throughout Europe; but they are also far stricter than environmental regulations in other sectors. Air pollution limits for incinerators, for example, are significantly lower than those applying to any other plant, including energy or steel production[35]. If the handling of waste would be considered as a normal industrial activity, the trade of waste disposal services among areas could develop. Moreover, Massarutto argues that the highest risks of illegal disposal concern industrial waste and especially hazardous waste, and that one would therefore expect that the proximity principle and planning would give greater priority to this kind of waste than to MSW (Massarutto, A (2006)).

However, as our study has shown, the rigour of enforcement can be very different from one region to the other.

A specific issue here is the level of vertical integration in collection and disposal activities. Massarutto argues that the potential for private-sector involvement seems higher when the public sector is able to organize the system in detail and to ensure economies of integration through suitable planning solutions. In this case tenders can focus on simple, well-defined activities; economic risks are lower and sunk costs can be kept separate. According to Massarutto, tenders should not regard the vertically- integrated service but rather more specific activities along the value chain. In order to avoid discrimination among bidders, he follows the OECD position that disposal sites should be considered as essential facilities and equal access opportunities should be guaranteed (see Section 2.4.3). If waste disposal authorities are capable of ensuring valid disposal solutions, the unbundling of collection and the disposal market can proceed quite efficiently. However, if disposal authority planning is inefficient or ineffective, Massarutto reckons that integration should be achieved directly by operators, for example through publicly- owned vertically-integrated companies, public-private partnerships and similar mechanisms. Otherwise, control of disposal would raise barriers to competition in favour of incumbents (Massarutto, A (2006).)

Under vertical integration, planning of infrastructure will be easier since the same authority decides how much waste to dispose of and how much capacity to put in place. However, this happens at the expense of competition. Vertically-integrated MWM systems are not nearly as easy to liberalize, since they are unsuitable for tenders; there is also less incentive to engage in recycling efforts once investment has been made in sunk disposal infrastructure (Massarutto, A (2006)).

2.6. COMPETITION IN EPR

The OECD has recently provided an overview of the economics of EPR[36].The OECD concluded, amongst other points, that a more consistent measuring and reporting of performance and costs is needed. It pointed out the need for developing an analytical framework tailored to EPR schemes.

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[35] Industrial emissions are currently covered by the IPPC Directive, the Large Combustion Plants Directive, the Waste Incineration Directive, the Solvents Emissions Directive and 3 Directives on Titanium Dioxide. On 21 December 2007, the Commission formulated a proposal to recast the seven existing Directives related to industrial emissions into a single clear and coherent legislative instrument. In the current version of the draft, there are still specific emission limits for incineration plants – see COM(2007) 844 final.

[36] OECD (2004), Economic Aspects of Extended Producer Responsibility.

This analytical framework was provided in a separate publication.

A specific issue are the competition effects of PROs. As explained by Bracke and De Clercq (2005), the sector-based collective organisation entails several advantages:

Economies of scale can be exploited, bringing down the operational costs.

A collective system is by far the best way of dealing with historical waste and in particular with orphaned waste.

If the agreement is negotiated, it can provide an opportunity for all stakeholders to be involved in a process of consensus building.

The government's task of control and enforcement is reduced. If no agreements were signed, the authorities would have been faced with a huge pile of diverging waste management plans from individual companies.

The OECD analytical framework identifies a range of possible ways in which a particular EPR programme might give rise to effects on competition [37]

- Is participation voluntary or compulsory? If participation is voluntary, the possibility of free riding arises, by firms which choose not to participate. This is a particular issue where EPR programmes are established as a result of a voluntary agreement between government and an industry organisation.
- Are firms required to participate in a single PRO, or do they have a choice as to how they discharge their EPR responsibilities?
- Even though all firms may face the same set of charges for membership of the PRO, the effect of these charges may differ across firms. Any fixed cost element in PRO charges would be liable to have an adverse effect on the competitive position of small firms relative to large firms, and for this reason a flat-rate PRO charge per unit sold might seem the best way of avoiding effects on the pattern of competition. On the other hand, the costs of the PRO may not simply be a function of the number of units sold, and may include a significant element related to the number of producers (or product specifications) involved. In cases where PRO costs take this form, some large firms might choose to leave the PRO and operate individually, or by setting up a new PRO organisation which excludes small, costly-to-handle producers.
- The pattern of competition may be affected by post-contractual free riding, which arises where firms which have agreed to participate in the programme nonetheless subsequently evade some of their responsibilities under the programme.
- There will be an incentive to develop products that are favoured by the rules and charging tariff of the programme. This will tend to lead to greater convergence in the design of products by different producers, and hence to a reduction in competition through product differentiation. The rules of the programme may have further effects on competition by inhibiting certain types of product innovation. New products might be discouraged or penalised, not because of their waste characteristics per se, but because, given the products that other firms produce, the new products would increase the costs of waste management.

Moreover, PROs acquire a strong market power that can be exploited either against municipalities or by generating discrimination in the internal market against goods manufacturers (Massarutto, A (2006).)

[37] OECD (2005b), Working group on Waste Prevention and Recycling, Analytical Framework for Evaluating the Costs and Benefits of Extended Producer Responsibility Programmes, ENV/EPOC/WGWPR(200)6/Final, document prepared by Prof Steven Smith

The issue of free riding requires that producers are forced to contribute to the system. According to Massarutto, coercive measures, such as compulsory participation in a collective body, are necessary in the infant stage of the industry, but he questions whether such a market power is still justified after it has reached some maturity. Massarutto refers here to the system used in the UK as an alternative form of institutional arrangement to reach the targets (Massarutto, A (2006).)

2.7. MARKET FAILURES IN TECHNOLOGY ADOPTION

Unless stated otherwise, the analysis in this Section follows a recent survey on the interaction between market failures in technology adoption and in environmental policies[38].

2.7.1. General issues

Technical change requires the realization of two steps:

- Innovation involves scientific or engineering research to establish a new technical idea and to develop that idea into a commercial product or process
- Adoption (or diffusion)—is the process by which a new product or process gradually replaces older technology throughout many firms and applications.

Adoption is costly, because firms must learn about new technology, purchase new equipment, and adapt it to their particular circumstances.

However, innovation and diffusion are both characterized by several market failures.

- *Knowledge Externalities*: If a firm invests in or implements a new technology, it incurs all the costs while it cannot prevent others from also benefiting from knowledge and thus capture parts of the benefits of innovation. This reduces the incentives to invest in technology. The protection offered by patents and other institutions is moreover imperfect.
- *Adoption Externalities*. In some cases, the cost or value of a new technology to one user may depend on how many other users have adopted the technology. This benefit associated with the overall scale of technology adoption has sometimes been referred to as "dynamic increasing returns." Dynamic increasing returns can be generated by learning-by-using, learning-by-doing, or network externalities:
    - "Learning-by-using" refers to the fact that an important mechanism in the learning process is the observation of the adoption of a new technology by others. The adopter of a new technology thus creates a positive externality for others in the form of the generation of information about the existence, characteristics, and success of the new technology.
    - "Learning-by-doing," describes how production costs tend to fall as manufacturers gain production experience. If this learning spills over to benefit other manufacturers without compensation it can represent an additional adoption externality.
    - Network externalities exist if a product becomes technologically more valuable to an individual user as other users adopt a compatible product (telephone and computer networks are the typical example).
- *Incomplete Information*. Information about the prospects for success of given technology research investments is asymmetric, in the sense that the developer of the technology is in a

[38] Jaffe, A.B., Newell, R.G. and Stavins R.N., A Tale of Two Market Failures, Technology and Environmental Policy, RFF Discussion Paper DP 04-38, Resources for the Future, Washington DC, 2004.

better position to assess its potential than outsiders. Therefore, a firm attempting to raise investment capital to fund the development of new technology will find such investors sceptical about promised returns.

Other reasons for delays in technology adoption include:

- Users of a new technology may delay adoption because they expect reductions in the supplier's cost of production[39].
- Each technology may require skills that are specific to a vintage of human capital[40].
- The risks for individual R&D are higher than the risks to society from developing technologies in a particular direction. Indeed, firms face the risk both of their individual technology failing and of their technology succeeding but being less successful than competing technologies. Society as a whole faces a much lower risk that all potential technologies fail. Firms therefore invest less in R&D than society as a whole would invest[41].

2.7.2. Environmental technology policy

As pointed out by Jaffe et al (2004), one way to foster environmental technology is to foster technology in general, and allow the market to determine what portion of the stimulated development will be in the environment area.

In general, economic analysis argues against technology policy "picking winners". Jaffe et al (2004) argue that, there are, however, several interrelated reasons why technology policy narrowly focused on energy and environment is likely to be socially desirable under certain circumstances:

- The public good nature of the environment itself, which makes environment a suitable area for focused governmental technology efforts.
- Another is a second-best argument related to the practical limitations of environmental policy. For instance, in the absence of significant environmental policy intervention, a policy to foster environment-friendly technology may be one of the main policy levers available and can be justified on economic grounds so long as it has positive net benefits. As the benefits of policies subsidizing technologies tend to be focused and the costs dispersed, policies subsidizing technology are more likely to receive political support.

Another issue is how environmental policy itself affects the rate and direction of technological change. A recent paper prepared for the OECD concludes that environmental policy in general has an impact on at least the direction of technological change and this conclusion holds regardless of the type of instrument applied. Standard-setting through technology prescriptions is technology-forcing and binding; its most important effect is that it induces the dirtiest firms to exit the market. However, the financial incentives for technology development are usually stronger under market-based instruments. Moreover, technology-

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[39] Hoppe, H. (2002), The Timing of New Technology Adoption: Theoretical Models and Empirical Evidence, The Manchester School, Vol 70, N° 1, 1463-6786, 56-76.

[40] Ibid.

[41] European Commission, Commission Staff Working Document accompanying the Report from the Commission to the Council and the European Parliament on the Targets contained in Article 7(2)(b) if Directive 2000/53/EC on End-of-Live Vehicle.

related information requirements for public authorities are lower when using market-based instruments. Finally, market-based instruments allow for more flexibility from the regulated agent[42].

2.7.3. Innovation Policies

Governments can stimulate innovation through both sides of the market:

- On the demand side, the internalization of environmental externalities raises the demand for low-cost pollution-reduction methods and increases the return to developing such technologies. As reckoned by Jaffe et al, the spill over problem implies that firms can expect to capture only a portion of that return, but a portion of a large return is still more of an incentive than a portion of a small return.
- On the supply side, the government can either make it less expensive for firms to undertake research in this area, or perform the research in public institutions.

The advantage of subsidizing research in the private sector is that private firms may have better information than the government about the likely commercial feasibility of technologies. In areas where the public research institutions have specific expertise, joint industry-government research can be undertaken.

2.7.4. Adoption Policies

Jaffe et al argue that, because of the positive information externality associated with technology adoption (or if dynamic increasing returns are important), there is a valid analytical basis for considering public policy to speed the adoption of new technology.

However, if the government encourages the diffusion of a particular technology, it is possible that it could become so entrenched in the market place that it stifles, at least for a time, the development of some other, superior technology (technology "lock-in").

This creates a policy dilemma. The exploitation of dynamic increasing returns requires to focus on the development of a small number of promising technologies. However, in order to avoid accidentally helping to entrench the wrong technology, it is desirable for policy to be "technology neutral".

As with research, the government can encourage adoption both by public procurement and by subsidizing the efforts of others.

Jaffe et al point to some disadvantages of subsidy approaches:

- Adoption subsidies do not provide direct incentives to reduce utilization of polluting technology.
- Technology subsidies and tax credits can require large public expenditures per unit of effect, since consumers who would have purchased the product even in the absence of the subsidy (i.e., free-riders) still receive it.

Information provision could be used as a tool to deal with imperfect information as a market failure in technology diffusion.

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[42] OECD (2006b), Impact of environmental policy instruments on technological change, COM/ENV/EPOC/CTPA/CFA(2006)36/FINAL, Review written by Prof Herman Vollebergh, Erasmus University, Rotterdam.

Finally, command and control regulations can force the diffusion of particular technologies, by removing less expensive and less environmentally beneficial competing technologies from the market. The risk of such standards is that they can impose limits to product choice and undesirable costs.

2.7.5. Report of the Environmental Innovations Advisory Group

The UK Department of Trade and Industry and Department for the Environment, Food and Rural Affairs have set up an Environmental Innovation Advisory Group[43].

According to the first report of the EIAG, it is the lack of a clearly articulated demand that is at the root of the relative failure of innovation in the UK environmental goods and services, not any lack of research or innovation.

The most important proposal of the EIAG is the idea of "forward commitment" – a public body offers to buy in the future a product or service that delivers specified performance levels including environmental benefits at a defined level and at a cost it can afford. Once the product is in the market place, normal market forces would determine competition and price.

EIAG was particularly concerned at the significant barriers to innovation created by the definition of waste under EU Directives as they existed at the time of writing of the EIAG report:

- Materials that a layperson would not expect to be a waste are caught by the definition and cannot escape the definition even when they pose an insignificant risk.
- Being defined as a waste brings the need for controls on how properties are managed and the waste is processed or transported (e.g. waste management licenses).
- The stigma and burden associated with classifying a material as a waste means that it is more difficult and more costly to take the most environmentally beneficial option (e.g. reusing or recycling materials rather landfilling).
- The waste controls apply if it meets the definition regardless of the risk - consequently products made from recycled "waste" materials will be caught by these controls whereas a product made of a more hazardous or less sustainable virgin material will not.

The EIAG focused on two measures it believes would help mitigate some of the impacts on innovation. First, it argued that the point of recovery needs to be established in such a way that users of materials derived from waste do not incur a higher regulatory burden than those using virgin materials that pose a comparable environmental risk. Shifting the regulatory burden as far up the supply chain to those most able to handle it (e.g. to waste processors) should be encouraged. Secondly, business needs greater clarity on when a waste ceases to be a waste.

The introduction of clauses on "end-of-waste" criteria in the new Waste Framework Directive is a step in the direction request by the EIAG.

Another important point raised in the first report are the reason why innovator companies struggled to apply testing and certification successfully en-route to market. These included cost, a lack of testing equipment or standards or the inability to meet existing standards because the product was radically different.

EIAG believes a twin-pronged approach is needed to tackle this issue. First, by raising awareness of the importance of standards, testing and certification and providing better guidance and advice to help innovators to navigate this complex process and understand how it may be applied en-route to market.

[43] http://www.berr.gov.uk/sectors/environmental/EIAG/page10066.html

Secondly, by making the system itself more user friendly, including developing fit for purpose, low cost, rapid assessment for new environmental technologies – an "innovation assessment."

According to the EIAG, certification is often not the best assessment tool for innovators. For example, certification demands significant resources and time to obtain which may be wasted if the product or market changes. Or it may lock the product into a final design or application too early. It may also be more robust than needed for the intended short-term and limited application. Certification also requires the establishment of a manufacturing facility, which may not be appropriate in the earlier stages of commercialisation.

Rather what the EIAG thinks innovators need is a low cost, rapid assessment that can document product performance for the commercialisation challenge at hand rather than for the entry into mass market. Indeed, the EIAG reckons that testing and certification bodies have several types of assessments that can offer innovators such greater flexibility. The problem is that they are not formalised or promoted so neither innovators nor end users recognise them.

2.7.6. Fundetec

The 6FP project FUNDETEC[44] examined the lack of access to financing on terms that suit the needs of riskier, growth-oriented technology development enterprises. These financing difficulties are perceived to be much more salient regarding environmental technologies, which are often considered riskier than other technology investments, as they are more subject to regulatory risk and experience greater competitive disadvantages within current market structures.

Some of the recommendations concern the importance of driving final demand by using the legislative and regulatory framework. Barriers to accessing funding were examined, and some specific measures identified, such as guarantee funds and early-stage feasibility funding.

A very important issue is the so called "valley of death" – this refers to the fact that many technologies are not further developed because of a lack of funding in the demonstration and pre-commercialisation phase.

A point one should keep in mind is also that there are so many different funding schemes that technology developers find it difficult to find the instruments that suit their needs the best.

The following 7 recommendations have been given the highest priority:

- Driving final demand through an enabling regulatory and legislative framework integrated at the EU, national and regional levels.
- Overcoming the barriers to accessing funding by addressing issues such as high administrative barriers, project preparation problems, lack of management and communication skills, lack of capital, risk assessment, and lack of awareness.
- Support for 95% of the viable eco-innovation projects currently not eligible for venture capital and mezzanine investment, by means of a guarantee fund system. Moreover, public/private partnership will reduce risk and ensure greater alignment with public policy goals and market realities.
- Funding of clean energy and environmental technology more broadly should recognise the specific natural endowments and environmental challenges of the various European countries and regions.

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[44] Comparison and Assessment of Funding Schemes for the Development of New Activities and Investments in Environmental Technologies.

- Public funding should consider more strongly a burden-sharing approach, which avoids windfall profits and ongoing funding of already marketable technologies.
- Clear and measurable performance criteria, which allow the evaluation of the achievement of the overall goals, should be implemented in the public sector. Overall goals should focus on the dissemination of clean technologies and not on other desirable policy or economic targets.
- Emphasis should be put on early funding of the feasibility of technologies in the stage of pre-commercialisation.

3. EU POLICY CONTEXT

3.1. EU WASTE POLICY: GENERAL

3.1.1. General evolutions in waste treatment

The treatment of waste in the different member states of the European Union knows a rather comparable evolution through some major basic phases. When environmental awareness and care for health risks arose, the first step in the waste management is an evolution away from unmanaged and possibly polluting dumping in the neighbourhood of each settlement towards more central, bigger but well managed landfills where protective environmental measures can be taken on leachate, gas emissions, dispersion of waste, landscape, nuisance, health risks, dioxin emissions from fires … and where the capacity is enlarged by construction and by compacting techniques. To organise these investments and the management of the landfills bigger entities are created that take over a part of the communities' responsibilities. Often inter-municipal cooperation structures are founded.

The second step in waste policy consists of a transition from full landfill towards waste incineration. The advantages are a big reduction in size of the waste as ashes represent only 30% of the original mass of the incinerated waste. Through incineration the nature of the waste is changed especially in its health risks and its hazard properties. Incineration - as well as the use of landfill gasses - can lead to the generation of energy that sometimes can be considered as renewable. Incineration requests big investments – e.g. on air protection - and is only applicable for wastes with a certain caloric value. Incineration cannot fully replace landfill of inert wastes and of certain ashes.

The third step in the transition is an evolution towards recycling. Waste sorting at the source or at the waste treatment plant becomes a method to obtain good quality wastes. While landfill and incineration still are end-solutions for waste, recycling creates products that can be used again as a product (product recycling) or as a raw material (material recycling). Although recycling activities have as well an impact on the environment, still this is, in general, less than the impact of landfill and incineration, and it saves capacity and investments for landfills and incineration. Moreover recycling can be useful in preserving fresh raw materials and avoiding the quite often large environmental impact in winning these raw materials.

The fourth step is a growing focus on prevention. For waste production that can be prevented no waste treatment problems can occur. Prevention has an impact on consumption patterns, and on better and more efficient production techniques; produce more products with the same amount of raw material. Thirdly the aspect of dematerialisation is important, exchange products for services. E.g. no telephone answering machines but telephone answering services from the telephone operators. Also home composting is considered as a method of preventing some biodegradable garden and kitchen wastes.

Nowadays, within the European planning and decision processes, a new fifth step is in preparation in the form of a material flow policy. The focus is not only laid on the waste itself but on the effects of the product on the environment, from the winning of the raw materials, the production phase, the use phase towards the end-of-life phase ; a cradle-to-grave policy on materials which includes waste policy as one constituent. Often the environmental impact of winning new raw materials (mainly in southern countries) is bigger than the impact of the waste treatment. Waste evolved from a first generation environmental problem (local, direct impact, visible, fit for local solutions) towards a second generation environmental problem (global, indirect impact, hidden, fit for global solutions).

A further step, possibly a sixth step, is an evolution towards a wasteless society. Every generated waste is free of hazards and can either be absorbed by nature (e.g. like the tree leafs in autumn) or can fully be recycled, without harm or quality loss (downcycling), into the economical cycles. This sustainable solution will still produce waste, but not more than the natural absorption capacity of the environment.

Of course, this transition is not yet finished, and all steps do not have to take place consecutively as they happened in the historical evolution. There are also large differences between the member states and their waste policy. It is important in any stage of the transition, to take into consideration elements on recycling and on prevention. It is also important to realise that

- The fight against illegal landfilling and tipping will never end, as well as the care for soil pollution that will remain important for many years.
- Landfills, although they are in the long term a transitional technique, will remain important for quite a long time e.g. for wastes that cannot be recycled or incinerated.

In a situation with limited resources and a waste situation at the beginning of the transition process, as in many new member states, it is a good strategy to focus first on the first steps, because there the biggest first environmental benefits can be obtained. It is of no use to develop high quality recycling initiatives for specific waste categories, when this means there is no money left to solve the problem of illegal or unmanaged dumping of waste.

3.1.2. European legislative evolution

Within the first and second step, the first European legislation on waste was developed: The first Waste Framework Directive (75/442/EEC) and the different disposal directives: PCB and PCT 76/403/EEC, waste oils 75/439/EEC, titanium dioxide industry waste 78/176/EEC, toxic and dangerous waste 78/319/EEC… Specific instruments and principles were introduced to prevent environmental damage through waste.

The Waste Framework Directive defines waste as any substance or object in the categories set out in Annex I to the Directive which the holder discards or intends or is required to discard.

The polluter pays principle has been introduced from the very start to prevent pollution through disposal. At the end of the millennium the directives on disposal operations were updated and aspects of recycling and prevention are incorporated: Waste Landfill Directive 1999/31/EC; Waste Incineration Directive 2000/76/EC …

The five Recycling Directives were developed to reach the policy goals of this third step. Specific targets and instruments were introduced: pay-as-you throw and differentiated tarification systems, landfill and incineration prohibitions … The European Parliament, in its Resolution of 14 November 1996(7) asked the Commission to present proposals for Directives on a number of priority waste streams. This has lead to tailor-made directives for four waste streams

- ELV (end-of-life vehicles)
- WEEE (waste from electrical and electronic equipment) and RoHS (restriction of the use of Hazardous Substances in WEEE)
- Batteries
- Packaging waste

For other waste fractions, like construction and demolition waste, no Directive but only a communication was achieved.

Within the frame of the fourth step, instruments frequently returning in the Recycling Directives and in other policy instruments aim to stimulate prevention through ecodesign; take-back obligations, producer responsibility schemes, eco-efficiency measures… The Communication of the Commission on a Thematic Strategy on Waste Prevention and Recycling can be largely situated in the third and fourth steps.

Legal initiatives within the fifth step on material flow policy can be found in the Directive on Energy Using Products 2005/32/EC, the RoHS Directive 2002/95/EC, the REACH Regulation EC 1907/2006… The Communication of the Commission on a Thematic Strategy on the Sustainable Use of Resources and the activities of the EEA European Topic Centre on Resource and Waste Management are as well exemplary for this evolution. The Position of the European parliament in second reading of 17 June 2008 with a view to the adoption of a new Waste Framework Directive pays attention to prevention and in a lesser extent to material flows. Its goal is to revise Directive 2006/12/EC in order to strengthen the measures that must be taken on waste prevention and to introduce an approach that takes into account the whole life-cycle of products and materials and not only the waste phase, and to focus on reducing the environmental impacts of waste generation and waste management, thereby strengthening the economic value of waste. Furthermore, the recovery of waste and the use of recovered materials should be encouraged in order to conserve natural resources.[45]

No legal initiatives in step six have been taken yet at a European level, although some experiments in specific industrial branches do exist.

3.2. SPECIFIC PROVISIONS FOR COLLECTION

3.2.1. Focussing the issue of collection

Waste collection includes the logistics between the generation of the waste by the primary producer until the final recycling or the final disposal operation. It includes the issues of

- sorting at source
- different systems of collection, including kerbside collection, bring systems, collection rounds, collection on demand
- different collection markets:
    - household waste collection
    - collection from SMEs of waste comparable to household waste and the way it is collected together with the household waste or the way it is split up from it
    - industrial waste, larger fractions of more homogeneous waste
- different market players: public and private sector and PPPs
- waste trading
- waste import and export
- waste pre-treatment, changing it in nature and composition and quantity in order to make it fit for a further step in the waste treatment chain: grouping, sorting, temporary storage, cleaning, conditioning ...
- extended producer responsibility systems, take-back obligations and the reverse logistics connected with it.

[45] Position of the European Parliament adopted at second reading on 17 June 2008 with a view to the adoption of Directive 2008/.../EC of the European Parliament and of the Council on waste and repealing certain Directives, preamble (8)

It excludes the issues of waste prevention, waste treatment in the form of reuse, recycling or disposal, and trade of recycled products as a raw material or as a product.

3.2.2. European legal provisions

Legal destination of waste

Art 15 §1 of the new Waste Framework Directive as approved in second reading by the European Parliament describes the legal destinations that can be given to generated waste: "any original waste producer or other holder carries out the treatment of waste himself or has the treatment handled by a dealer or an establishment or undertaking which carries out waste treatment operations or arranged by a private or public waste collector." The destination of waste is thus limited to own treatment, a waste treatment plant or a waste trader or collector, which must of course be fully licensed or permitted. In order to use waste in another way, e.g. as a secondary raw material in construction or as a fertiliser on agricultural fields, it should first fulfil the requirements of the end-of-waste provision foreseen in the waste framework.

Sorting at source

Art 11 of the new Waste Framework Directive impose on the Member States the duty to take measures to facilitate or improve recovery by collecting it separately if technically, environmentally and economically practicable. Mixing of waste with other waste or other material with different properties is forbidden (Art 10). This is an overall approach applicable for all waste streams, insofar it is feasible from a logistical and economical point of view, and insofar it is environmentally desirable, not causing more environmental burden than if collected in a mixed way. An alternative for sorting at source is sorting out waste after the collection phase.

Waste collectors

In order to be allowed to collect waste a company must be registered, as stipulated in article 23 of the new Waste Framework Directive. The Member States can decide in which way responsibility for the waste can be handed over from one actor to another. If waste is transferred from the original producer or holder to an actor for preliminary treatment, the first one usually remains responsible for the complete recovery or disposal operation. Member States may however specify the conditions of responsibility and decide in which cases the original producer is to retain responsibility for the whole treatment chain or in which cases the responsibility of the producer and the holder can be shared or delegated among the actors of the treatment chain. (Art 15) For extended producer responsibility schemes Member States may decide that the responsibility for arranging waste management is to be borne partly or wholly by the producer of the product from which the waste came and that distributors of such product may share this responsibility (Art 14).

Waste collection, with actual handling and shipment of waste, and waste trading where the trader or broker never actually holds or manipulates the waste but merely undertakes arranging the recovery or disposal of waste on behalf of others are considered legally in the same way.

Import and export of waste

The Regulation on Transfrontier Waste Shipment 1013/2006/EC is the central legal instrument for regulating import and export of waste. From 12 July 2007 the Regulation entered into force, changing the existing Regulation EC/259/93 after a long and difficult reviewing process and search for compromises. The result is a Regulation that is definitely easier to understand and to enforce, as it reduces the amount of different administrative procedures. But still some difficulties are not solved, and some new articles are not easy to enforce. It remains a 64 articles and 98 pages Regulation, incorporating both the Basel Convention[46] and the OECD Decision[47].

The Regulation has provisions on the supervision and control of shipments of waste in a way which takes account of the need to preserve, protect and improve the quality of the environment. It applies to shipments of waste, both within and into or out of the European Union, to waste transported between Member States but routed through one or more third countries, and to waste transported between third countries but routed through one or more Member States.

The Regulation sets up a system of prior authorisation for the shipment of waste. This system draws a distinction between: waste for final disposal and waste for recovery and recycling. As far as waste for recycling is concerned, the Regulation distinguishes between waste on a "green" list (usually waste for which the shipment does not cause hazards, originally an OECD list, now converging with the Basel B-list) and waste on the "amber" list (converging with the Basel A-list). A procedure for prior authorisation is established for all waste for disposal, and amber listed waste for recycling. The common, compulsory notification system is based on a standard consignment note for shipments of waste, and authorisation by all involved competent authorities. The shipment may not be made until all competent authorities have granted authorisation.

The notifier must conclude a contract with the consignee for the disposal of the waste. The contract must oblige:

- The notifier to take the waste back if the shipment has not been completed or if it has been effected in violation of this Regulation.
- The consignee to provide a certificate to the notifier that the waste has been disposed of in an environmentally sound manner.

Export of waste intended for disposal is prohibited, except to EFTA (European Free Trade Association) countries which are party to the Basel Convention. An export-ban prohibits export of hazardous waste intended for recovery to non-OECD countries. Export to non-OECD countries of non hazardous waste for recycling is permitted under the conditions and the procedures communicated to the Commission and included in Regulation 1418/2007.

The more essential changes in the legislation introduced by regulation 1013/2006 are:

- Exclusion from the application of waste defined as animal by-products not intended for human consumption, thus avoiding duplication with Regulation EG/1774/2002 (see Section 3.5.3), and solving existing obscurity on the statute of this kind of waste.
- A clear definition of who can be notifier and therefore responsible for a waste shipment. A hierarchy is included that goes down from the original producer to broker. This enhances transparency of applications and clarity in responsibilities.
- Although still different procedures exist, they are better adjusted to each other and lesser in number.

[46] The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is a global environmental agreement on hazardous and other wastes. The Convention has 170 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. http://www.basel.int/

[47] OECD, Decision Of The Council Concerning The Revision Of Decision C(92)39/Final On The Control Of Transboundary Movements Of Wastes Destined For Recovery Operations, C(2001)107/FINAL

- Silent consent, that caused confusion and lack of clarity in the accompanying documents, has been abolished, except for transit countries. This makes it impossible for a notifier to hide a negative decision from a Member State and only to show a positive decision from another Member State when a waste shipment is controlled.
- More clarity is created in the code lists by replacing the OECD-green list by the Basel B-list, the OECD-amber list by the Basel A-list, and by deleting the OECD-red list. Nevertheless some exemptions and alterations in the Basel lists are introduced which makes the lists sometimes difficult to consult.
- Two waiting lists are to be filled up by comitology procedure. One for non elsewhere named mixtures of green listed waste for which the procedure of article 18 (green list procedure) is applicable instead of the procedure for not named wastes. And another list for candidate- green list waste, waiting for their adoption in the Basel B-list, for which also the green list procedure is available. Both lists are empty for the time being. This system makes consultation of lists more difficult and the lists themselves less stable.
- The reasons for negative decisions are expanded, e.g. for mixed urban waste, or for waste movements that repeatedly did not fulfil all reporting obligations in the past. This extends the possibilities of effective enforcement.
- Export for recovery can be refused if the proposed treatment operation does not comply with the requested treatment standards for recovery in the exporting country, except if it complies with European recovery standards. This could become important for shipment to third world countries, but exporting countries are not obliged to use this opportunity for refusal.
- The new regulation proposes a solution for the problem of pre-treatment of waste. It attempts to create certainty on the standards of the final treatment, even when a waste is pre-treated before in a third country. The solution in the regulation however is of a certain administrative complexity. It creates both opportunities and difficulties for more effective enforcement.
- A major change is introduced for non hazardous waste (green list) for recovery. A contract between the person who arranges the shipment and the consignee who recovers the waste is requested, and each shipment has to be accompanied with a standardised document. This will ease enforcement and create more transparency.
- The Commission has the possibility to create uniformity in the financial guarantees to ease the cooperation between Member States, but this has not been realised until now.
- Uniform and more clear rules are developed for take back operations, when e.g. a freight does not comply with the agreed upon criteria and the shipment cannot be completed as intended, or in the case of an illegal shipment.
- An important issue, both for administration and for enforcement, is the possibility to notify each individual shipment through electronic means. This allows projects like EUDIN, for international e-government on shipment of waste, to be realised that would accelerate the speed of data availability for enforcement.
- The Regulation addresses enforcement directly and creates a better frame for effective enforcement.

Next to the Regulation on Transfrontier Shipment of Waste, the new Waste Framework Directive introduces limits on import of waste for incineration with energy recovery in installations developed for treatment of solid urban waste (Art 16). The goal is to save capacity for the treatment of waste from the country itself. Export of waste oil to incineration and co-incineration plants can as well be limited (Art 21).

3.2.3. Extended producer responsibility

The new Waste Framework Directive offers a frame for the voluntary establishment of systems for extended producer responsibility (Article 8) – see Section 2.3 for the rationale behind this approach.

According the new Waste Framework Directive, Member States may take legislative or non-legislative measures to ensure that any natural or legal person who professionally develops, manufactures, processes, treats, sells or imports products (producer of the product) has extended producer responsibility.

Such measures may include an acceptance of returned products and of the waste that remains after those products have been used, as well as the subsequent management of the waste and financial responsibility for such activities. These measures may include the obligation to provide publicly available information as to the extent to which the product is re-usable and recyclable.

Member States may take appropriate measures to encourage the design of products in order to reduce their environmental impacts and the generation of waste in the course of the production and subsequent use of products, and in order to ensure that the recovery and disposal of products that have become waste take place in accordance with the Directive.

When applying extended producer responsibility, Member States shall take into account the technical feasibility and economic viability and the overall environmental, human health and social impacts, respecting the need to ensure the proper functioning of the internal market.

The Waste Framework Directive does not impose waste streams for which an EPR should be realised. Member states are free to apply this methodology. Through the recycling directives however EPR schemes have to be realised for different types of electrical and electronic equipment, end-of-life vehicles, batteries and packaging waste. Therefore extended producer responsibility shall be applied without prejudice to existing waste stream specific and product specific legislation.

As we have shown in Section 2.6, EPR raises very specific concerns with respect to the competition effects.

In 2003, the Competition DG decided to enter into a comprehensive dialogue process with the national competition authorities (NCAs) to identify key competition issues in the field of waste management systems and to ensure a coherent competition policy by the Commission and the NCAs in this area[48]. Discussions concerned in particular: (i) packaging waste, (ii) end-of-life vehicles or 'car wrecks' and (iii) WEEE.

As a result of this dialogue, the Commission DG published a paper on this issue in September 2005. [49]

The Competition DG has identified three principal competition concerns in the field of waste management systems:

- Anticompetitive practices such as market sharing, price fixing and the exchange of other sensitive information need to be prevented.
- It is important to ensure a legal environment that will allow for the existence of several competing waste management systems.

[48] European Commission, Report on Competition Policy 2005, http://ec.europa.eu/comm/competition/annual_reports/2005/en.pdf

[49] DG Competition Paper Concerning Issues of Competition in Waste Management Systems, http://ec.europa.eu/comm/competition/antitrust/others/waste.pdf

- Exclusive arrangements of all kinds are to be avoided without solid and convincing economic justification thus allowing for increased competition and lower prices.

The Commission identified at least three different levels of economic activities which are relevant for this Paper, namely (i) the organization of systems/solutions to fulfil the obligations under the respective Directive, (ii) the collection, sorting and treatment of waste, and (iii) recovery services and secondary material.

The Commission thinks that it is fundamental to clearly identify the environmental goals behind the Directives and determine the most efficient market instruments capable of achieving these goals. As an example, it refers to the "free take-back" and "producer responsibility" principles under the ELV and WEEE Directives. While these principles aim at supporting the achievement of the environmental goals provided for in the Directives, the Commission points out that they may also result in distortions of competition. For instance, "free take-back" or "producer responsibility" may be conducive to but may not be strictly necessary for the achievement of recycling targets and may be doubtful from a competition point of view.

In the case of packaging waste, the Commission thinks that a sub-market for the collection and sorting of household packaging waste may, depending on the specific circumstances in the Member States, be distinguished from a submarket for the collection of commercial packaging waste for two principal reasons:

- Logistical requirements of collection differ considerably, e.g., with regard to the number of collection points that have to be serviced, the average waste volume to be collected from each collection point, the number of containers required, and the intensity of the collection schedule[50].
- There are considerable differences in terms of the materials collected.

The Packaging Directive stipulates that Member States shall ensure that systems are set up to fulfil the environmental obligations. As we have already seen, in most Member States, the obliged companies cooperate in systems of some form in order to discharge their obligations concerning packaging waste. According to the Commission, such cooperation may give rise to competitive concerns.

For a detailed discussion of the issues that follow, we refer to the discussion paper of the Commission. We limit ourselves here to a discussion of the points that are most relevant for our analysis.

First of all, the Commission does not take for granted that comprehensive and collective systems established by economic operators will lead to any effects of economies of scale and the passing on of beneficial effects to consumers. It also requires the "indispensability" of the comprehensive or collective system to be clearly established.

The Commission reminds that the Member States are not to introduce or maintain in force measures which may render ineffective the competition rules applicable to undertakings. An example provided in the packaging waste sector could be a State measure that, in addition to providing for the establishment of collection and recovery systems, recommends or requires that producers of packaged products cooperate in their respective sectors in order to devise identical packaging for their competing products (leading to communality of costs and price alignment).

Article 86(1) EC imposes an obligation on Member States, as regards public undertakings or undertakings to which Member States grant special or exclusive rights, not to enact nor to maintain in force measures contrary to rules of the EC Treaty. An example in the packaging waste sector could be a State measure

[50] This is in line with the points made in Section 2.4.1

that would lead, e.g., to the application of discriminatory membership criteria vis à vis foreign participants by the dominant collective waste packaging system.

According to Article 86(2) EC, the EC Treaty rules do not apply to undertakings that are entrusted by a Member State with the operation of services of general economic interest if the application of EC Treaty rules would obstruct the particular tasks assigned to them. As an exception to the competition rules, the Commission takes the position that Article 86(2) EC is to be interpreted narrowly. In this context, e.g., exclusivity for operators of packaging waste management systems may be justified in situations that require State intervention to address a particular environmental problem.

3.2.3.1. Cooperation between obliged companies

In nearly all Member States, the obliged companies cooperate in order to establish a system for the management of packaging waste. Most of these systems are non-profit legal entities with the obliged companies as shareholders.

Obliged companies may be *competitors in the market for the packaged products*. Cooperation at the packaging waste level may potentially lead to (i) the development of a common design of the packaged product (or the packaging) and (ii) communality of costs as regards the packaged products through uniform costs of collection and recovery.

The Commission takes as a general principle that, to the extent that the cooperation on waste management would be "abused" by the participants to exchange sensitive information or to fix or align prices of the packaged products, Article 81 EC would be violated. However, with respect to the last consideration, the Commission notes that concerns would appear limited in cross-sectoral systems. In particular, as the relevant legal obligations concern all types of different packaged products, any cooperation is industry-wide and not sector-specific. Therefore, while certain obliged companies participating in a cross-sectoral system may be competitors in the markets for the packaged products, the cooperation would not seem sufficiently focused to create an appreciable risk of collusion in the markets of the packaged products.

The cooperation of obliged companies may also lead to a *bundling of the demand for collection and sorting services for packaging waste*. The market power of the system increases the more obliged companies with important market shares to participate in a system. The bundling of demand limits the choice of collection/sorting and recycling companies.

In the case of household waste, competition concerns may arise, for example, if a collective system covers not only packaging waste but also other types of waste because this may increase the effects of bundling of demand. Under specific circumstances, the Commission deems that it may also be appropriate to prevent a system with a de facto monopoly for household packaging waste from entering the market for commercial packaging waste, or vice versa. However, the Commission also recognizes that, as the collection of household packaging waste entails important network economies, a certain bundling of demand would seem to be the inevitable consequence of the creation of viable systems for the collection of household packaging waste. The Commission found in previous decisions that the contracts between a system and the collectors should be of limited duration, there should be a transparent, objective and non-discriminatory tender procedure, and the system must not prevent access of competitors to the collection infrastructure.

In the case of commercial packaging waste, as there are less network economies, it is easier to set up alternative waste collection structures with respect to commercial packaging waste. The justification for the setting up of collective and in particular comprehensive systems would therefore be more difficult.

3.2.3.2. Relationship between systems and obliged companies

As a general matter, the Commission takes the view that collective systems should apply objective, transparent and non-discriminatory conditions as regards membership criteria and with regard to fees levied by the system.

The various collective systems apply different rules as regards the determination of the level of fees paid by the obliged companies taking part in the system. Such fee arrangements may, under certain circumstances, also infringe competition laws – some examples are provided in the Commission's paper.

Some systems require that the participants transfer all of their obligations to the system, i.e., the members may either contract for all of their packaging or for nothing. The position of the Commission is that the all or nothing rule has the effect of restricting competition between systems and alternative solutions. It also prevents obliged companies from contracting only a certain amount of packaging of one material with an existing system and the remaining amount with a new entrant that cannot yet cover the entire amount. According to the Commission, the all or nothing rule therefore constitutes a practice of tying severable services.

3.2.3.3. Relationship between systems and collection/recovery (recycling) companies

In some cases collective systems may have as shareholders businesses active in the recycling of secondary materials. There may thus be a danger that collective systems privilege contracting with their own shareholder companies for the treatment/recycling of the materials. A possible way to mitigate this risk is to ensure that collective systems use transparent and non-discriminatory tendering procedures.

Many collective systems contract with only one collector for each collection district. This establishes an exclusive contractual relationship in favour of the collection/recovery companies.

In order to verify whether such agreements are acceptable, the Commission first refers to the conditions laid down in the Block Exemption Regulation on vertical agreements (BER verticals). If the BER verticals do not apply, a case-specific analysis is necessary taking into account the market conditions, the market position of the collective system and the duration of the collection agreement. The Commission accepts the point that the relevant market for the collection and sorting of household packaging waste is characterised by very specific supply-side conditions (strong network economies, disposal traditions of consumers, container instalment constraints). For this reason, the Commission reckons that efficiency gains, but also considerations of reliability and continuity favour contracting with only one collector. A certain duration of the agreement is necessary in order to enable the collectors to achieve an economically satisfactory return on their investment. For these reasons, exclusivity may be accepted under Article 81(3) EC if it must be regarded as indispensable under the specific circumstances of the case. In line with its other position in this field, the Commission thinks that such exclusivity would much less likely be justified for commercial packaging waste.

The Commission takes the very clear-cut position that collectors and recyclers should not be obliged to contract exclusively with one system.

As the relevant market for the collection and sorting of household packaging waste is characterised by very specific supply-side conditions, which in many cases render the duplication of existing collection infrastructures at households economically not viable, unrestricted access to and the unlimited sharing of the collection facilities of the collectors working for the dominant system is essential for competition on the down-stream market for organising the take-back and recovery of packaging waste. The Commission takes the view that collectors operating these facilities must not be prevented from offering the same facilities to competitors of the dominant system. In this context a question may also arise whether competing systems may cooperate in order to share certain costs (e.g., consumer information costs).

Finally, some systems enter into agreements which provide that the collector is not entitled to market the collected materials itself. The Commission may accept restrictions on marketing in cases in which the system retains ownership, i.e., the system may then be able to determine the recovery company to which the collector must deliver the collected packaging waste. Conversely, the Commission takes the position that collectors that are owners of the material should not be prevented from exploiting the material commercially. In systems where collectors obtain ownership, the Commission would only accept a restraint on commercialisation if there are negative market prices (e.g., due to lack of demand) for a particular material (e.g., plastic). In these cases, the collectors usually have little incentive to appropriately recycle the materials in question and the systems may thus be better placed to use or otherwise deal with the materials.

3.3. SPECIFIC PROVISIONS FOR PVC

The Packaging and Packaging Waste Directive (94/62/EC as amended by Directives 2004/12/EC and 2005/20/EC) and the Landfill Directive (99/31/EC) apply also to plastic waste[51]. The target for 2008 is to recycle 23.5% of plastic packaging, which includes PVC.

The Directive on the Incineration of Hazardous and Non-Hazardous Waste includes emission limits for dioxins, furans and heavy metals including Cadmium, Pb and Hg, all of which may be found in PVC.

As the ELV Directive covers recycling targets by weight, it is mainly the metal fraction of the vehicle that is pursued for recycling. The targets, however, are set to increase (to 95% recovery by 2015, of which 85% should be through recycling and reuse) and so plastics are likely to attract more attention as the targets tighten.

The WEEE Directive aims to reduce the amount of electric and electronic wastes going to landfill. The PVC content of WEEE is usually mixed with other plastics and so is limited to reprocessing into low quality materials.

Directive 78/142/EEC requires that the maximum vinyl chloride monomer level found in the final plastic product should not be more than 1mg per kg of final PVC. The maximum amount of vinyl chloride released (using the "headspace" method) should be no more than 0.701 mg/kg[52].

The REACH Regulation sets out to improve the protection of human health or the environment from certain chemicals which may be harmful. Recyclers need to register any substances which they handle – this includes stabilisers in PVC, such as lead or cadmium. Waste is excluded from the application of REACH, but once recycled products cease to be waste, the situation becomes murkier. The potential impact on PVC recycling is discussed in Section 6.2.

In 2000, the Commission published the Green paper on "Environmental issues of PVC" (COM(2000) 469 final)[53] , which had two main objectives:

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[51] See Section 3.6

[52] Council Directive 78/142/EEC of 30 January 1978 on the approximation of the laws of the Member States relating to materials and articles which contain vinyl chloride monomer and are intended to come into contact with foodstuffs.

[53] http://ec.europa.eu/environment/waste/pvc/en.pdf

- to assess on a scientific basis the various environmental issues including related human health aspects (use of certain additives in PVC, etc.) that occurred during the life cycle of PVC.
- to consider, in view of sustainable development, a number of options to reduce those impacts that needed to be addressed because PVC waste was expected to increase by about 80% over the next twenty years.

In order to address the concerns raised with respect to PVC waste in several studies for the Commission, the industry set up Vinyl 2010 as an alternative to the introduction of regulatory measures[54]. The following sections cover more in details the functioning of this, and related, industry initiatives.

3.3.1. Vinyl 2010[55]

The PVC industry (PVC manufacturers, PVC additive producers and PVC converters as represented by their European associations ECVM, ECPI, ESPA, and EuPC) has worked since September 2001 together with the Association of Cities and Regions for Recycling and Sustainable Resource Management (ACR+), PlasticsEurope and the European Plastics Recyclers to improve the recycling of plastic waste collected by local authorities. It has adopted an integrated approach to implement their concept of cradle to grave management, resulting in the signature in March 2000 of a 'Voluntary Commitment of the PVC Industry'.

A Brussels-based international non-profit association, Vinyl 2010, is the legal entity whose task is to put into practice the promises of the Voluntary Commitment. It brings together the entire European PVC industry[56] to implement the Voluntary Commitment.

The main commitments are:

- Compliance with ECVM Charters on PVC production standards.
- A plan for full replacement of lead stabilisers by 2015, in addition to the replacement of cadmium stabilisers that was achieved in March 2001.
- The recycling by end 2010 of 200,000 tonnes/year of post-consumer PVC waste
- The recycling of 50% of the *collectable* available PVC waste for windows profiles, pipes, fittings and roofing membranes in 2005, and flooring in 2008[57].
- A R&D research and development programme on new recycling and recovery technologies, including feedstock recycling[58] and solvent-based technology.
- The implementation of a social charter signed with the European Mine, Chemical and Energy Worker's Federation (EMCEF) to develop social dialogue, training, health, safety and environmental standards, including transfer to EU accession countries.

It includes a strict implementation monitoring process through certified annual reports. The PVC industry provides a financial support scheme, in particular for new technologies and recycling schemes, allowing up to 250 million EUR of financial contribution over the 10 year programme.

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[54] Information provided by EuPC and EuPR during interview on 30 April 2008.

[55] The information in this section has been obtained from the Vinyl 2010 website and from the Vinyl 2001 Progress Reports.

[56] According to the latest progress report, it now represents 99% of the PVC production capacity.

[57] The wording "collectable" is essential – see Section 4.2.1

[58] For a definition of feedstock recycling, see Section 5.2.4.

The Monitoring Committee, of Vinyl 2010 currently includes representatives from the European Parliament, the European Commission, trade unions and consumers' associations.

The partners of Vinyl 2010 are not yet fully represented in the new EU member states. However, Vinyl 2010 claims that efforts are underway to achieve membership of the PVC value chain. In 2007, all the Central European PVC manufacturers who were not members yet joined ECVM.

The overall commitment of 200,000 tonnes by 2010 has been maintained and extended to the new Member States, keeping in mind that, according to Vinyl 2010, experience has demonstrated that the available volumes of PVC waste are actually lower than the ones expected in 2001.

To spread the costs more fairly across the whole PVC value chain, a new initiative, the Vinyl Foundation, has been set up by EuPC with the assistance of Vinyl 2010 to collect funding contributions from all PVC converters .This will include those not represented in the industry associations.

Raw material producers provide data to an auditor on the tonnage of PVC sold to their customers. This auditor processes this data in complete confidentiality and issue payment requests to converters, compounders and traders on behalf of the Vinyl Foundation.

Packaging applications which are already covered by EU recycling schemes and export volumes are exempt from the contribution.

To encourage a steady supply of PVC waste for recycling, Vinyl 2010 launched two new pan-European collection projects in 2004:

- Roofcollect, a collection and recycling initiative for end-of-life roofing membranes;
- Recovinyl, a scheme to provide financial incentives to support the collection of end-of- life PVC products such as pipes, window profiles and shutters.

3.3.2. Recovinyl[59]

The main problem with post-consumer PVC waste is that of ensuring a steady supply of secondary raw materials to recyclers in order to justify their investments. In order to ensure a steady supply, recyclers and the PVC sector, vinyl producers and converters agreed to establish an association, RECOVINYL, to foster the collection and recycling of post-consumer PVC waste across Europe through a network of certified recyclers. It involves all stakeholders from end consumers, retailers, industries and municipalities to waste management companies and recyclers.

With the help of financial incentives from Vinyl 2010, the Recovinyl system aims to collect at least 75,000 tonnes of waste annually throughout Europe by 2010. Recovinyl does not collect or recycle itself, but utilises and motivates existing players in the market.

Recovinyl provides financial incentives to support the collection of PVC waste from the non-regulated PVC waste streams. The non-regulated streams are those not covered by any existing legislation like Packaging, ELV or WEEE directives. The types of plastics considered are window frames, shutters, profiles, cladding, cable ducts, and pipes (thus, mainly from the construction and demolition sector.). Until 2006, Recovinyl's programme only supported rigid PVC applications. But in 2007, this was extended to flexible PVC applications.

[59] Unless stated otherwise, the information in this section has been obtained from the Recovinyl website and from the Vinyl 2010 Progress Reports.

Recovinyl provides financial incentives to those parties collecting *post-consumer* PVC waste, which deliver it to Recovinyl's certified recycler or waste recovery company. They must provide Recovinyl with a proof or a receipt and other relevant data – such as the tonnage, origin and date of shipment – before the collector is paid but after he has accepted the external audit. The payments of incentive help to make up for the higher cost of recycling in comparison with other end-of-life solutions, such as landfill. The incentive system aims as well to encourage the recycling of PVC products on an industrial scale.

The general incentive level is decreasing through time as the chain deficit became less important. The incentives are differentiated according to the waste grade, the local legislation (ex landfill ban or active environmental policies) and the presence of a strong recycling network[60].

For instance[61], Recovinyl has introduced different grades within the concept of collection of post-consumer PVC. Since then, the waste quality is split into two different categories: grade A and grade B. Although officially not used in its external communication towards the authorities, Recovinyl differentiates the short-life (A grade[62]) and long-life (B grade[63]) material. The level of incentives for these two categories of material is different. It was required to differentiate the incentive level for the good quality material (frequently mixed with the post-industrial waste streams) returning from the installation process. It is up to the recycler to estimate the percentage of A grade material within the incoming waste stream. The Recovinyl auditors during their control will check the documents and perform a spot - check to inspect the defined percentages.

Any waste sorting party or collector can apply for Recovinyl's support. The only requirement is to bring the waste to a certified recycler or recovery company and provide a proof of shipment. The certified recyclers are listed on the Recovinyl's webpage.

Recovinyl is also actively involved in all stages of the PVC recycling pipeline:

- *Collection*: Recovinyl identifies points of collection of PVC waste and helps local authorities to facilitate the collection. Together with the waste collectors, Recovinyl helps spreading the knowledge and best practice regarding recovery and recycling solutions.

- *Sorting*: Recovinyl has developed several guidelines in order to help personnel in identification and sorting PVC waste. It also organises special training for collection centres. It also advises waste transfer stations and operators of local authorities' collection sites on how to proceed with the particular steps in the sorting and recycling process.

- *Recycling*: Recovinyl identifies suitable recovery and recycling facilities for PVC waste. To receive certification, waste recovery companies and recyclers must meet specific requirements and accept an external audit. Afterwards they will be added to Recovinyl's online database.

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[60] Information provided in e-mail from Antonino Furfari of EuPR on 28 May 2008.

[61] http://uk.recovinyl.com/grades

[62] A Grade is from appearance more mono-stream like, almost pure material, usually quite clean, mono-colour and not much present in general waste streams.

[63] B Grade PVC consists of more mixed material, different as well in application as in colour. The waste is usually dirty (products at the end-of-life cycle), full of mud, filth and other contaminants. B grade is, generally speaking, the more contaminated and more mixed material. It requires additional conditioning efforts (extra sorting e.g.) to finalise the recycling process as well by the collector-sorter as by the recycler.

Waste can be brought to a collection site, a transfer station managed by local authorities or a waste management company. It can be also delivered directly to a recycler.

It is important to emphasize that, as Recovinyl is a voluntary scheme, local authorities and waste collection companies are not obliged to segregate and transfer the PVC waste to a recycler: They may also export the waste, send it to a landfill or opt for another form of disposal. This is precisely why Recovinyl has decided to provide financial incentives for recycling.

There are also specific commitments from the EuPC sectorial associations:

- The plastics pipe and fitting producers, represented by TEPPFA, commit to mechanically recycle[64] increasing quantities of PVC pipes and fittings at their end-of-life.
- The window frame sector, represented by EPPA, commits to mechanically recycle increasing quantities of PVC window frames at the end of life of this application.
- The flooring sector is represented by EPFLOOR.
- The waterproofing membranes sector, represented by ESWA, commits to recycle increasing quantities of PVC waterproofing membranes at the end of life of this application.

In 2006, Recovinyl changed its legal status from a commercial activity to a non-profit association. It developed a website to communicate on its work and to provide tools for registering waste volumes online.

Recovinyl is now active in nine countries – Belgium, Denmark, France, Germany, Italy, Ireland, the Netherlands, Spain and the UK – and started evaluation activities in Central Europe (the Czech Republic, Hungary, Poland and Slovakia). Plans have been developed to extend its activity towards Austria and Sweden.

In 2007, Recovinyl started to develop its activities in Central Europe with an initial contribution of over 1,890 tonnes.

Recovinyl collects mixed PVC waste. After sorting, Recovinyl apportions the volumes of pipes, profiles, etc collected to the sectoral projects within Vinyl 2010, leaving only the residual mixed waste to be reported against Recovinyl.

3.3.3. Roofcollect

The Roofcollect system (recycling system for thermoplastic membranes) was introduced in 2003 by the roofing membranes sector represented by ESWA (see Sections 3.3.2 and 3.3.3). The objective was to collect end-of-life roofing and waterproofing membranes and to recycle at least 50% of the available and collectable quantities of postconsumer material by 2005[65].

According to the Vinyl 2010 Progress Reports, the commitment to recycle at least 50% of the collectable available quantity of waterproofing membranes waste by 2005 was missed but volumes are growing steadily.

The collection scheme works as follows:

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[64] For a definition of mechanical recycling, see Section 5.2.3.

[65] Unless states explicitly otherwise, all material from this section has been obtained from http://www.roofcollect.com/.

- The membranes are collected in big bags. Interseroh Entsorgungsdienstleistungs GmbH handles the collection of end-of-life PVC roofing membranes.
- Transportation from construction site to the recycling plant is now fully organised in Germany and the system is to be extended to the rest of Europe.
- The following conditions have to be met on the construction site:
    - Pre-cleaning of the membrane, as they should not contain residual particles of glue or bitumen.
    - Removal of the fastening elements of mechanically fastened roofing membranes, measuring and cutting the membrane into metre-wide strips - The old roofing membrane must be rolled up and fixed.
    - Stacking in big bags.

Roofcollect now also accepts waste from waste management companies, demolishers and municipalities, instead of being limited just to roofers. Although its core business is roofing and waterproof membranes, Roofcollect extended its collection system to non-roofing materials, and now collects all types of postconsumer waste of PVC membranes not covered by existing Vinyl 2010 projects.

The Roofcollect® collection system extended its geographic scope in 2007.

Partnership with several recycling plants is also part of Roofcollect's core activity – see Section 4.2.6.5.

3.3.4. APPRICOD[66]

The APPRICOD project was launched in December 2003 under the umbrella of the EU Life initiative. It was the follow-on from a pilot project by Vinyl 2010 and the Associations of Cities and Regions for Recycling and Sustainable Resource Management (ACR+) that started in 2001.

It has brought together 3 main groups of stakeholders concerned with plastic C&D waste management:

- The C&D sector.
- Local and regional authorities
- The European plastics industry and recyclers.

APPRICOD's main aim was to assess the potential of plastic recycling in the construction and demolition (C&D) sector which supplies the largest waste stream in the EU. In terms of weight, plastics in C&D waste are a small component, but in terms of volume they represent significantly more.

The results of the project, which was completed in May 2006, were published in the guide Towards Sustainable Plastic C&D Waste Management in Europe which is available in six language versions through the www.appricod.org website.

The guide aims to give technical, environmental and economic information on C&D waste management as well as sharing best practice from the pilot projects including insight into specific national legal and financial frameworks. It also makes recommendations for public authorities, especially local and regional authorities on the efficient sorting and recycling of plastic C&D waste. In addition to the guide, a European seminar was held in April 2006 in Brussels with over 100 participants. The key conclusions from the parties involved were presented and materials were disseminated. These materials can be found on the APPRICOD website.

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[66] Unless states explicitly otherwise, all material from this section has been obtained from the Vinyl 2010 or the APPRICOD website.

3.3.5. EPCOAT

The EPCOAT project is an initiative of the European PVC coated fabrics sector and is aimed at evaluating the feasibility of recycling waste from the European PVC coated fabrics sector (tarpaulins, tents, marquees, advertising panels and artificial leather) which is participating in the recycling targets of Vinyl 2010[67]. It includes investigation of collection and market aspects and screening and practical trials of collection systems and available recycling technologies.

3.4. SPECIFIC PROVISIONS FOR BATTERIES[68]

Context

The main legal instrument is the Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators[69].This Directive repeals and replaces Directive 91/157/EEC as from 26 September 2008.

The original Batteries Directive was somewhat weak because it only covered an estimated 7% of consumer batteries on the EU market. Therefore the proposal for a new Batteries Directive was made by the European Commission on 24 November 2003, covering all batteries (for environmental and trade reasons). Following negotiation, the new Directive was adopted on 6 September 2006 and came into force on 26 September 2006.

The Batteries Directive applies to all types of batteries irrespective of their shape, weight, composition or use, except those used in certain military or space applications (while Directive 91/157/EEC applied only to batteries containing mercury, lead or cadmium, and excluded "button cells").

It seeks to improve the environmental performance of batteries and of the activities of all economic operators involved in the life cycle of batteries, e.g. producers, distributors and end users and, in particular, those operators directly involved in the treatment and recycling of waste batteries.

Key provisions of the Directive are:

- Restrictions on the use of mercury and cadmium in batteries;
- Labelling requirements for new batteries to aid consumer choice and recycling;
- A 25% collection rate for waste portable batteries to be met by September 2012, rising to 45% by September 2016;
- A prohibition on the disposal by landfill or incineration of waste industrial and automotive batteries – in effect setting a 100% collection and recycling target;
- The introduction of "producer responsibility" obligations;

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[67] http://www.eupc.org/epcoat

[68] Information in this Section mainly originates from the SCADPlus summary of legislation http://europa.eu/scadplus/leg/en/lvb/l21202.htm .

[69] Directive 2006/66/EC 26.9.2006 28.9.2008 OJ L 266 of 26.9.2006

- The setting of recycling efficiencies to ensure that a high proportion of the weight of waste batteries is recycled (65% of lead acid batteries, 75% of nickel-cadmium batteries and 50% of other waste batteries); and

- The setting of waste battery treatment standards.

Key terms

"Battery" or "accumulator": any source of electric energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (non-rechargeable) or of one or more secondary battery cells (rechargeable).

"Button cell": any small round portable battery or accumulator whose diameter is greater than its height and which is used for special purposes such as hearing aids, watches, small portable equipment and back-up power.

Batteries of the "button" type or those composed of elements of the "button" type are excluded from the scope of the Directives.

Summary

The Directive prohibits the placing on the market of certain batteries and accumulators with a proportional mercury or cadmium content above a fixed threshold. In addition, it promotes a high rate of collection and recycling of waste batteries and accumulators and improvement in the environmental performance of all operators involved in the life-cycle of batteries and accumulators, including those involved in their recycling and disposal.

The aim is to cut the amount of hazardous substances - in particular, mercury, cadmium and lead - dumped in the environment; this should be done by reducing the use of these substances in batteries and accumulators and by treating and re-using the amounts that are used.

The Directive prohibits:

- batteries and accumulators, whether or not incorporated in appliances, containing more than 0.0005% by weight of mercury (except for button cells, which must have a mercury content of less than 2% by weight);
- portable batteries and accumulators, including those incorporated in appliances, with a cadmium content by weight of more than 0.002% (except for portable batteries and accumulators for use in emergency and alarm systems, medical equipment or cordless power tools).

To ensure that a high proportion of spent batteries and accumulators are recycled, Member States must take whatever measures are needed (including economic instruments) to promote and maximise separate waste collections and prevent post-consumer batteries and accumulators being thrown away as unsorted (municipal) refuse. They have to make arrangements enabling end-users to discard spent batteries and accumulators at collection points in their vicinity and have them taken back at no charge by the producers. Collection rates of at least 25% and 45% have to be reached by 26 September 2012 and 26 September 2016 respectively.

In principle, it must be possible to remove batteries and accumulators readily and safely. It is up to the Member States to ensure that manufacturers design their appliances accordingly.

Member States also have to ensure that, from 26 September 2009 at the latest, batteries and accumulators that have been collected are treated and recycled using the best available techniques. Recycling must exclude energy recovery. As a minimum, treatment must include removal of all fluids and acids. Batteries and accumulators must be treated and stored (even if only temporarily) in sites with impermeable surfaces and weatherproof covering, or in suitable containers. The recycling of battery and accumulator content to produce similar products or for other purposes has to reach the following levels by 26 September 2011:

- at least 65% by average weight of lead-acid batteries and accumulators, including the recycling of the lead content to the highest degree that is technically feasible;
- 75% by average weight of nickel-cadmium batteries and accumulators, including the recycling of the lead content to the highest degree that is technically feasible;
- at least 50% by average weight of other battery and accumulator waste.

If there is no viable end market, or if a detailed assessment of environmental, economic and social impact concludes that recycling is not the best solution, Member States may dispose of batteries and accumulators containing cadmium, mercury or lead in landfills or underground storage. Otherwise, it is prohibited to put waste from industrial and automotive batteries and accumulators into landfill, or to incinerate it; only residues from treating and recycling them may be disposed of in these ways.

Treatment and recycling may take place outside the Member State concerned or even outside the Community, provided EU legislation on the shipment of waste is respected.

The extended producer responsibility is realised through an obligation for the producers to bear the cost of collecting, treating and recycling industrial, automotive and portable batteries and accumulators, as well as the costs of campaigns to inform the public of these arrangements. Small producers may be exempted from this obligation if this does not impede the proper functioning of the collection and recycling schemes. All producers of batteries and accumulators have to be registered.

The Batteries Directive has a somewhat specific definition of a 'producer'. Producers are defined as any person in a Member State that, irrespective of the selling technique used, including by means of distance communication, places batteries on the market for the first time *within* the territory of the Member State on a professional basis.

The battery EPR requires (see article 8 of the batteries Directive): "*distributors to take back waste portable batteries or accumulators at no charge when supplying portable batteries or accumulators, unless an assessment shows that alternative existing schemes are at least as effective in attaining the environmental aims of this Directive. Member States shall make public such assessments*". Distributors shall not involve any charge to end-users when discarding waste portable batteries or accumulators, nor any obligation to buy a new battery or accumulator. A one-to-zero take-back obligation.

It should be emphasized that the Battery Directive leaves a lot of freedom to the Member States and their national legislation with respect to the organisation of collection systems.

It only specified that batteries can be collected (1) individually (2) by way of national battery collection schemes or (3) together with the WEEE collection schemes.

A similar freedom applies to the actual physical infrastructure that is used. For instance, in Belgium, schools are used as collection points (see Section 7.8 for more details), while in some other countries this is forbidden[70].

Provided that the objectives set out in this Directive are achieved, Member States may transpose the provisions on EPR by means of voluntary agreements between the competent authorities and economic operators concerned. Article 27 stipulates the requirements these voluntary agreements should meet:

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[70] This specific example was provided by Mr Craen (EPBA) in a phone interview on 26 June 2008.

- They shall be enforceable.
- They must specify objectives with corresponding deadlines.
- They must be published in the national official journal and transmitted to the Commission.
- The results achieved must be monitored regularly, and reported to the competent authorities and the Commission, and made available to the public under the conditions set out in the agreement.
- The competent authorities shall ensure that the progress made under such agreements is examined.
- In cases of non-compliance with the agreements, Member States shall implement the relevant provisions of this Directive by legislative, regulatory or administrative measures.

End-users are to be informed in various ways:

- through campaigns covering, among other things, the potential effects on the environment and human health of the substances used in batteries and accumulators, and the collection and recycling arrangements at the end-users' disposal;
- being directly informed by distributors that they can discard waste batteries and accumulators at sales points;
- visible, legible and indelible markings on batteries, accumulators and battery packs with the following information: the symbol of the crossed-out wheeled bin (in Annex II to the Directive); the capacity of the accumulator or the portable battery; the chemical symbols Hg, Cd and Pb if the batteries, accumulators or button cells contain over 0.0005% mercury, over 0.002% cadmium or over 0.004% lead. If the battery, accumulator or battery pack is too small, this information appears on the packaging.

Figure 1: marking on batteries

Relation with WEEE and RoHS Directives

The Battery Directive and the RoHS Directive have similar substance restrictions. The RoHS Directives restricts the use of heavy metals, such as mercury and cadmium in electrical and electronic equipment, but does not apply to batteries. The Battery Directive restricts the use of mercury and cadmium in batteries (the cadmium restriction only applies to portable battery applications). Batteries incorporated in WEEE will be collected on the basis of the WEEE Directive. However, after collection on the basis of the WEEE Directive, they will be removed from the electronic equipment and they will count for the collection targets of the Battery Directive. They also have to undergo the recycling requirements of the Battery Directive. A producer of electrical and electronic equipment (appliance producer) is also regarded as a battery producer under the Battery Directive, if the appliance producer puts an appliance on the market with a battery inside. This is to ensure that there will be a responsible producer for all batteries placed on the Community market. However, Member States should avoid any double charging of producers in case batteries are collected with the appliance on the basis of the WEEE Directive.

3.5. SPECIFIC PROVISIONS FOR FOOD WASTE

Food waste can be divided into different fractions and markets:

- Biodegradable kitchen waste, both from households and comparable waste from canteens, hotel and catering industry… Food waste from households can be approached using the EWL code 20.01.08 "biodegradable kitchen and canteen waste". The major recycling activity applicable to this kind of waste is composting (see Section 5.4.5).
- Edible oils (EWL 20.01.25) from households and from catering industry and food industry, which is the same kind of waste. Recycling can take place into technical oils, livestock feed or pet food.
- Harvest rests, agricultural waste" including plant-tissue waste (EWL 02 01 03), waste from the food processing industry and special wastes like champost (worn off mushroom compost), food processing sludges or other mainly vegetal food processing waste which is not connected with end-user catering will not be included, except if it is comparable with common kitchen waste. Waste and manure co-treatment or waste gasification for energy recovery is often applied on these fractions, but this is not considered recycling of food waste.
- Animal waste, like offal and carcasses/carrion often are excluded from the Waste Framework Directive because they are covered by the Regulation 1774/2002/EC of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption. The recycled product is often animal meal or high caloric animal oils and fats, destined for energy recovery (e.g. in cement kilns), pet food, gelatine for non-food applications. Recycling in the food chain is often forbidden.

Food waste thus restricted falls under the more general category of biodegradable waste.

3.5.1. Waste Framework Directive

Based on the 6th Environment Action Programme and the Thematic Strategy of the Commission on the prevention and recycling of waste[71] the Waste Framework Directive 2006/12/EC has been revised. On 17 June 2008, the European Parliament adopted a legislative resolution in which it approves the Council's Common Position as amended. This step marks the adoption of the revised Directive in second reading and the end of the negotiations. The final text of the Directive will be published in the Official Journal of the European Union, and will enter into force on the twentieth day following its publication. Member States will have to transpose the revised Directive into their national legislation within 24 months from its entry into force.

The new Waste Framework Directive foresees in its article 22 specific provisions on bio-waste, defined as "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants."[72] Member States are obliged to encourage the treatment of bio-waste following the waste treatment hierarchy by promoting separate collection with a view to the composting and digestion of bio-waste, by taking measures for the treatment of bio-waste in a way that fulfils a high level of environmental protection, and by stimulating the use of environmentally safe materials (e.g. composts) produced from bio-waste. The Commission is asked to carry out an assessment on the management of bio-waste with a view to submitting a proposal if appropriate. In this assessment the opportunity should be examined of setting minimum requirements

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[71] Communication from the Commission" Taking sustainable use of resources forward - A Thematic Strategy on the prevention and recycling of waste" COM/2005/0666 final.

[72] Art 3 point 4 of the of the common position in second reading of the Waste Framework Directive.

for bio-waste management and quality criteria for compost and digestate from bio-waste. This could end up in a Communication or in a specific bio-waste Directive or Regulation.

Article 11 introduces reuse and recycling targets. Bio-waste however is not included in the waste types that are to be collected separately[73] or for which recycling targets have been established[74]. However, Member States are allowed and encouraged to include more waste streams, to promote high quality recycling. To this end they can set up extra separate collection schemes of waste where this is technically, environmentally and economically practicable and appropriate to meet the necessary quality standards for the relevant recycling sectors. By 31 December at the latest the Commission itself shall examine the existing measures and targets and shall consider setting targets for other waste streams. As separate collection of bio-waste is common practice in some Member States, this could be one of the waste streams to be included in article 11 in the future. The higher the potential target, the more important composting and anaerobic digestion (AD – see Section 5.4.4) in future waste management strategies will be, given organics still represent the biggest fraction in Municipal Solid Waste (MSW) in most areas of Europe.

The new Waste Framework Directive introduces an important new element on energy recovery through anaerobic digestion of biodegradable waste. Article 2 point 1 f extends the exclusion of "other natural non-hazardous agricultural or forestry material" from the application of the Waste Framework Directive. In the old Waste Framework Directive 2006/12/EC this was limited to application of this waste for use in farming. The new Waste Framework Directive foresees an exclusion for "the production of energy from such biomass". This means that installation for composting do fall under the restrictions and obligations of the environmental permit for recycling activities[75] while competing installations for bio-methanisation and energy recovery are exempted.

Art 6 specifies that certain specified waste shall cease to be waste when it has undergone a recovery, including recycling, operation and complies with specific criteria to be developed in accordance with the following conditions:

- the substance or object is commonly used for specific purposes ;
- a market or demand exists for such a substance or object;
- the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and
- the use of the substance or object will not lead to overall adverse environmental or human health impacts.

The measures relating to the adoption of such criteria and specifying the waste shall be adopted using the comitology procedure. End-of-waste specific criteria should be considered, among others, at least for aggregates, paper, glass, metal, tyres and textiles.

Where criteria have not been set at Community level, Member States may decide case by case whether certain waste has ceased to be waste taking into account the applicable case law.

[73] At least paper, metal, plastic and glass

[74] Paper, metal, plastic and glass from households (50%) and construction and demolition waste (70%) by 2020.

[75] Art 23 of the common position in second reading of the new Waste Framework Directive

The Joint Research Centre (JRC) is working on a project to look at the scientific methodology that could be used to determine end of waste criteria. Three specific pilot case studies are used to analyse the criteria:

- Aggregates (recycled or secondary);
- Compost;
- Metal scrap (iron and steel, aluminium).

The report on the compost case study (Barth et al 2008) will be used extensively in the remainder of this section.

3.5.2. Landfill Directive

The major legal provision applicable on food waste can be found in the Landfill Directive 1999/31/EC. Article 5 states that Member States should set up a national strategy for the implementation of the reduction of biodegradable waste going to landfills by means of recycling, composting, biogas production or materials/energy recovery. This strategy should ensure that not later than five years after the date of implementation biodegradable municipal waste going to landfills must be reduced to 75 % of the total amount of biodegradable municipal waste produced in 1995. After eight years this must be reduced to 50 % of the total amount, and after 15 years to 35 %. Member States that landfill more than 80 % of their collected municipal waste may postpone the attainment of the targets by a period not exceeding four years.

These targets and measures are inspired on the goal to reduce the production of methane gas from landfills, inter alia, in order to reduce global warming, through the reduction of the landfill of biodegradable waste. And they should also aim at encouraging the separate collection of biodegradable waste, sorting in general, recovery and recycling.

The Report from the Commission[76] on the national strategies for the reduction of biodegradable waste going to landfills points out that all the strategies promote composting, recycling of paper and energy recovery. Most strategies stress the importance of using source segregated organic waste to obtain good quality compost. The level of detail of the strategies and the measures to achieve the targets vary considerably. Some Member States have chosen legally binding measures, while others have chosen voluntary measures and incentives. It is not possible to tell with any certainty from studying the strategies whether the reduction objectives will be met in those Member States which have not yet done so; however it seems that further effort must be made for the objectives to be achieved.

As no general provision is included for the destination of biodegradables, the way composting and anaerobic digestion shall be combined with incineration and Mechanical Biological Treatment (MBT) will be a matter of local strategies, and they factually vary widely from country to country (Barth et al (2008)).

[76] Report from the Commission of 30 March 2005 on the national strategies for the reduction of biodegradable waste going to landfills pursuant to Article 5(1) of Directive 1999/31/EC on the landfill of waste [COM(2005) 105 - not published in the Official Journal].

3.5.3. Regulation on animal by-products

As this Regulation lies on the boundary between waste policy and health policy, it imposes some constraints on the recycling of food. We therefore summarize its most important elements here. The specific relevance for compost is discussed in Section 3.5.6.5.

As explained in the SCADPlus Summary[77], it constitutes the cornerstone of the new European legislation on food safety.

Animal by-products are defined as the entire bodies or parts of bodies of animals or products of animal origin not intended for human consumption, including ova, embryos and sperm. They represent more than 10 million tonnes of meat. These materials are then disposed of or processed and re-used in the cosmetics or pharmaceuticals sectors and for other technical purposes.

Following the food crises of the 1990s, such as the bovine spongiform encephalopathy (BSE) epidemic, the role of these by-products in propagating transmissible animal diseases was brought to light. Composed of eight independent scientific experts, the Scientific Steering Committee then concluded that products derived from animals declared unfit for human consumption must not enter the food chain. Moreover, the administration to any animal of proteins obtained by processing carcasses of the same species - or cannibalism - may constitute an additional risk of disease propagation.

This Regulation sets out the measures to be implemented for the processing of animal by-products. Laying down minimum rules at European level, it gives the Member States the option of taking even more restrictive measures or measures covering products excluded from its scope.

Definitions

Regulation (EC) 1774/2002 prohibits many animal by-products (ABP) from being disposed of directly to landfill. The Regulation categorises ABP into three categories, according to risk:

- Category 1 - very high risk, i.e. animals suspected or confirmed as being infected by BSE (Bovine Spongiform Encephalopathy);
- Category 2 - high risk, i.e. condemned meat, fallen stock, manure, digestive tract content; and
- Category 3 - low risk, i.e. 'catering' wastes, former foodstuffs and raw meat/fish from food manufacturers and food retailers.

Some Category 3 wastes are suitable for composting and anaerobic digestion (AD). The EC has allowed flexibility for Member States to determine requirements for different Category 3 wastes, though this flexibility has some formal limits as laid down in Regulation 208/2006.

Category 1 material comprises the following animal by-products (Article 4):

(a) all body parts, including hides and skins, of animals suspected of being infected by a TSE or in which the presence of a TSE has been officially confirmed; animals killed in the context of TSE eradication measures; animals other than farmed animals and wild animals, including in particular pet animals, zoo animals and circus animals; experimental animals; and wild animals, when suspected of being infected with diseases communicable to humans or animals;

(b) specified risk material, and where, at the time of disposal, specified risk material has not been removed, entire bodies of dead animals containing specified risk material;

[77] http://europa.eu/scadplus/leg/en/lvb/f81001.htm

(c) products derived from animals to which prohibited substances have been administered and products of animal origin containing residues of specified environmental contaminants and other substances if such residues exceed the permitted level laid down by Community legislation or, in the absence thereof, by national legislation;
(d) all animal material collected when treating waste water from Category 1 processing plants and other premises in which specified risk material is removed, including screenings, materials from desanding, grease and oil mixtures, sludge and materials removed from drains from those premises, unless such material contains no specified risk material or parts of such material;
(e) catering waste from means of transport operating internationally;
(f) mixtures of Category 1 material with either Category 2 material or Category 3 material or both, including any material destined for processing in a Category 1 processing plant.

Category 2 material comprises the following animal by-products (Article 5):

(a) manure and digestive tract content;
(b) all animal materials collected when treating waste water from slaughterhouses other than slaughterhouses covered by Article 4(1)(d) or from Category 2 processing plants, including screenings, materials from desanding, grease and oil mixtures, sludge and materials removed from drains from those premises;
(c) products of animal origin containing residues of veterinary drugs and contaminants, if such residues exceed the permitted level laid down by Community legislation;
(d) products of animal origin, other than Category 1 material, that are imported from non-member countries and, in the course of the inspections provided for in Community legislation, fail to comply with the veterinary requirements for their importation into the Community, unless they are returned or their importation is accepted under restrictions laid down under Community legislation;
(e) animals and parts of animals, other than those of Category 1, that die other than by being slaughtered for human consumption, including animals killed to eradicate an epizootic disease;
(f) mixtures of Category 2 material with Category 3 material, including any material destined for processing in a Category 2 processing plant; and
(g) animal by-products other than Category 1 material or Category 3 material.

Category 3 material comprises animal by-products of the following description:

(a) parts of slaughtered animals, which are fit for human consumption in accordance with Community legislation, but are not intended for human consumption for commercial reasons;
(b) parts of slaughtered animals, which are rejected as unfit for human consumption but are not affected by any signs of diseases communicable to humans or animals and derive from carcases that are fit for human consumption in accordance with Community legislation;
(c) hides and skins, hooves and horns, pig bristles and feathers originating from animals that are slaughtered in a slaughterhouse, after undergoing ante-mortem inspection, and were fit, as a result of such inspection, for slaughter for human consumption in accordance with Community legislation;
(d) blood obtained from animals other than ruminants that are slaughtered in a slaughterhouse, after undergoing ante-mortem inspection, and were fit, as a result of such inspection, for slaughter for human consumption in accordance with Community legislation;
(e) animal by-products derived from the production of products intended for human consumption, including degreased bones and greaves;
(f) former foodstuffs of animal origin, or former foodstuffs containing products of animal origin, other than catering waste, which are no longer intended for human consumption for commercial

reasons or due to problems of manufacturing or packaging defects or other defects which do not present any risk to humans or animals;

(g) raw milk originating from animals that do not show clinical signs of any disease communicable through that product to humans or animals;

(h) fish or other sea animals, except sea mammals, caught in the open sea for the purposes of fishmeal production;

(i) fresh by-products from fish from plants manufacturing fish products for human consumption;

(j) shells, hatchery by-products and cracked egg by-products originating from animals which did not show clinical signs of any disease communicable through that product to humans or animals;

(k) blood, hides and skins, hooves, feathers, wool, horns, hair and fur originating from animals that did not show clinical signs of any disease communicable through that product to humans or animals; and

(l) catering waste other than as referred to in the definition of Category 1 material

Collection, transportation and storage

The Regulation requires that ("whereas" (10)) to "avoid any risk of dispersal of pathogens and/or residues, animal by-products should be processed, stored and kept separated in an approved and supervised plant designated by the Member State concerned or be disposed of in a suitable manner".

According to Article 7, animal by-products and processed products, with the exception of Category 3 catering waste shall be collected, transported and identified in accordance with Annex II of the Regulation.

During transportation, a commercial document or, when required by this Regulation, a health certificate, shall accompany animal by-products and processed products.

Article 4 also requires Member States to take the necessary measures to ensure that Category 3 catering waste is collected, transported and disposed of without endangering human health and without harming the environment.

Allowed uses of animal by-products

Chapter III of the Regulation contains detailed provisions on the approval of intermediate, storage, incineration and co-incineration, category 1 and 2 processing, category 2 and category 3 oleochemical, biogas and composting plants. All plants referred to in what follows need to be approved according to those provisions.

According to Article 4, Category 1 material can be:

(a) directly disposed of as waste by incineration;

(b) processed in an processing plant and finally disposed of as waste by incineration or by co-incineration;

(c) with the exclusion of animals suspected of being infected by a TSE or in which the presence of a TSE has been officially confirmed, or animals killed in the context of TSE eradication measures, processed in an processing plant and finally disposed of as waste by burial in a landfill;

(d) in the case of catering waste disposed of as waste by burial in a landfill;

According to Article 5, Category 2 material shall be:

(a) directly disposed of as waste by incineration;

(b) processed in an approved processing plant and:

(i) disposed of as waste either by incineration or by co-incineration in an incineration or co-incineration plant, or

(ii) in the case of rendered fats, further processed into fat derivatives for use in organic fertilizers or soil improvers or

(iii) for other technical uses, other than in cosmetics, pharmaceuticals and medical devices, in an approved Category 2 oleochemical plant

(c) processed in an approved processing plant using processing method 1, and:

(i) in the case of resulting proteinaceous material, used as an organic fertilizer or soil improver,

(ii) transformed in an biogas plant or in a composting plant, or

(iii) disposed of as waste by burial in an approved landfill;

(d) in the case of material of fish origin, ensiled or composted;

(e) in the case of manure, digestive tract content separated from the digestive tract, milk and colostrum, if the competent authority does not consider them to present a risk of spreading any serious transmissible disease:

(i) used without processing as raw material in a biogas plant or in a composting plant or treated in a technical plant,

(ii) applied to land

(iii) transformed in a biogas plant or composted;

(f) in the case of entire bodies or parts of wild animals not suspected of being infected with diseases communicable to humans or animals, used to produce game trophies in a technical plant

According to Article 6, Category 3 material shall be:

(a) directly disposed of as waste by incineration;
(b) processed in a processing plant, and disposed of as waste either by incineration or by co-incineration in an incineration or co-incineration plant;
(c) processed in a processing plant approved in accordance with Article 17 of the Regulation;
(d) transformed in a technical plant;
(e) used as raw material in a petfood plant;
(f) transformed in a biogas plant or in a composting plant;
(g) in the case of catering waste of Category 3, transformed in a biogas plant or composted;
(h) in the case of material of fish origin, ensiled or composted; or

Each category can be disposed of by other means, or used in other ways, in accordance with rules laid down in the Regulation, after consultation of the appropriate scientific committee.

Article 22 prohibits the feeding of a species with processed animal protein derived from the bodies or parts of bodies of animals of the same species (which is less stringent than the "feedban" decision[78]).

[78] The so-called "feedban" decision is Council Decision 2000/766/EC. It prohibits the feeding of processed animal proteins to farmed animals which are kept, fattened or bred for the production of food (exceptions are listed in the Decision).

As pointed out by Barth et al (2008, p.15), national flexibility with respect to composting and biogas plants that treat animal by-products is limited to non animal by-product (this is, non meat) processing, category 3 catering waste, manure and to a limited extent former foodstuff.

Restrictions on imports and exports

According to article 4, Category 1 material shall not be imported or exported except in accordance with this Regulation or with rules laid down under the procedure referred to in Article 33(2). However, the import or export of specified risk material shall take place only in accordance with Article 8(1) of Regulation (EC) No 999/2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies.

According to article 5, Category 2 material shall not be placed on the market or exported except in accordance with the Regulation or with rules laid down under the procedure referred to in Article 33(2).

3.5.4. Biowaste strategy

The new Waste Framework Directive defines bio-waste and offers in its article 22 the frame for an assessment that could lead to a proposal for more detailed legislation for bio-waste management and quality criteria for compost and digestate. In its article 11 point 4, the possibility is kept open to introduce recycling targets, although they are not introduced yet, while comitology procedures under article 6 can foresee end-of-waste criteria for composted bio-waste.

The Commission states on its website[79] that Member States can choose for a number of alternative treatment options for biodegradable waste, taking into account local conditions such as climatic conditions to the composition of the collected biowaste. These choices must be taken in a transparent manner. This is why the Commission introduced in the Waste Framework Directive the provision to require Member States to include these choices in their national waste management plans. Member States should also assess to what extent their choice of options for the management of biowaste contributes to the environmental objectives defined in the Directive.[80] To support the Member States in this future legal obligation, the Commission will provide criteria, in the form of a guidance document, to help with identifying the environmentally best option for the management of biowaste in the various countries and regions. It will take the Member States some time to implement environmentally sound management of bio-waste and the Commission will revisit the issue in the review of the Thematic Strategy on waste prevention and recycling in 2010. This review will assess the progress of the Member States and the need for additional measures, including additional legislative measures on top of the legislative measures already proposed in the Strategy package.

3.5.5. Interactions with other EU policies: miscellaneous

Barth et al (2008) provide an overview of other European legislation under progress or in the first stages of implementation that affect the organic waste streams.

- The EU Soil strategy, which shows 2 potentially contrasting drivers: on the one hand, compost is identified as a tool to fight the decline of organic matter in soils (identified as one of the "soil threats"); on the other hand, the need to prevent contamination calls for an increased awareness for high-quality standards. The draft Soil Framework Directive does not include any concrete

[79] http://ec.europa.eu/environment/waste/compost/index.htm

[80] Art 28 point 2 of the common position in second reading of the new Waste Framework Directive

incentive or driver for the use of compost or any other soil improver. It imposes however the obligation for member States to design programmes of measures to combat organic matter decline. Member States are requested to draw up, at the appropriate level, a programme of measures including at least risk reduction targets, the appropriate measures for reaching those targets, a timetable for the implementation of those measures and an estimate of the allocation of private or public means for the funding of those measures.[81]

- The European Climate Change Programme, which is considering the use of compost as a tool to reduce Greenhouse gases, through a set of possible mechanisms: Carbon sequestration in soils, improved workability and reduced use of fossil fuels, replacement of peat and mineral fertilisers, reduced release of Nitrous Oxide relative to mineral fertilisers, etc[82].

- Currently, the use of sewage sludge is governed by Council Directive 86/278/EEC of 12 June 1986[83] -, sewage sludge may be used in agriculture provided that the Member State concerned regulates its use. The Directive lays down limit values for concentrations of heavy metals in the soil (Annex IA), in sludge (Annex IB) and for the maximum annual quantities of heavy metals which may be introduced into the soil (Annex IC). Sludge must be treated before being used in agriculture but the Member States may authorise the use of untreated sludge if it is injected or worked into the soil. The use of sludge is prohibited on some types of crops or in grounds intended for the cultivation of some specific types of crops. Member States may take more stringent measures than those provided for in this Directive. The 2001 draft revision considered the implementation of "Pollution prevention programmes" as a key tool to ensure ever-improving quality of sludge as a feedstock for production of soil improvers. This may affect future compostability of sludge.

- Plans are underway to consider the possible inclusion of composting in the IPPC Directive (BREF for composting and anaerobic digestion of separately collected organic waste is in discussion, a Draft Factsheet is available). Even if Best Available Techniques (BAT) following the BREF requirements applies only to larger plants with > 50 t per day throughput, Barth et al argue that smaller plants would also become affected in the mid-term, in so far as licensing authorities would take the BREF as reference for all plants. Barth et al reckon that a binding BAT would impose a disproportionate burden upon composting and therefore constitute a significant handicap for the implementation of cost effective and environmentally sound systems in many Member States where biowaste treatment is still in its infancy. According to Barth et al, this development would affect especially those countries which require decentralized small scale low-tec solutions (often in conjunction with agriculture) on account of the rural settlement structure like most of the new Member States, Scandinavia, Ireland and parts of UK, Germany, Austria, Central Spain etc[84].

- Council Directive 91/676/EEC, the Nitrate Directive, imposes limits on N loads on farmlands. Barth et al point out that this in general may impose a constraint on the use of soil improvers,

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[81] COM(2006) 232 final, proposal of 22.9.2006 for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil, article 8.

[82] See http://ec.europa.eu/environment/climat/pdf/second_eccp_report.pdf for more details.

[83] See http://europa.eu/scadplus/leg/en/lvb/l28088.htm.

[84] For more details on the ECN position see:

http://www.compostnetwork.info/download2/070804_IPPC_comments_ECN_PART_A.pdf but may also trigger a greater application of compost as a replacement of mineral fertilisers, given the lower N availability and the fact that compost is a slow-release source of N. Some EU Member States have already enforced related provisions that recognise such an important feature of compost, thereby driving a higher application of it instead of liquid slurries or mineral fertilisers.

- The EU Policy for Renewable Energy and Directive on Renewable Energy Sources RES 2001/77 (amended by Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market) may also establish competing trends for anaerobic digestion or direct thermal exploration of biomass.

- On 26 June 2003, EU farm ministers adopted a fundamental reform of the CAP, based on "decoupling" subsidies from particular crops. The new "single farm payments" are subject to 'cross-compliance' conditions relating to environmental, food safety and animal welfare standards ('cross-compliance'). Some countries have included the principles of "humus/organic matter management" in these requirements and check it in the frame of the cross compliance obligations. This might include the use of more compost by the farmers.

Finally, in order to use waste compost as a fertilizer, one has to comply with Fertiliser Regulation 2003/2003. The compost must be analysed and registered in the Fertilizer Registry. Otherwise it is not considered as a fertilizer, and it cannot be sold as a fertilizer[85].

3.5.6. Compost

Barth et al (2008) provide an overview of the different regulations existing in the Member States with respect to the production and the use of compost. They point out that biological waste treatment provisions are embedded in national waste policy and that all of them differ.

3.5.6.1. Compost classes

Barth et al distinguish between:

- precautionary criteria intended to protect the environment and the consumer from any not acceptable negative impact from using the compost; these are typically found in statutory frame work legislation

- those which relate to certain use aspects in specific application areas and which are rather elements of voluntary standards and market related quality assurance schemes

It should be pointed out that, according to Barth et al, most new Member States are not fully aware of these issues.

3.5.6.1.1. Precautionary compost classes

Barth et al (2008) list the following precautionary parameters:

- Maximum concentration levels of the seven classical heavy metals (Cd, Cr, Cu, Hg, Ni, Pb and Zn)

- Impurities (physical constraints such as visible particles of metals, plastics and glass)

[85] Information provided per e-mail by Mait Kriipsalu (Estonian University of Life Sciences) on 07 July 2008.

- Pathogenic indicator organisms such as Salmonella ssp., E. coli, Enterococcae etc..

Organic pollutants are only part of compost criteria where sludge or mixed waste is ruled in as potential source material. For instance, in France, compost can be produced from mixed waste (see Section 9.9).

As explained by Barth et al, provisions for the exclusion of potential pathogenic micro-organisms within process and quality requirements are established on two levels:

- direct methods by setting minimum requirements for pathogenic indicator organisms in the final product
- indirect methods by documentation and recording of the process showing compliance with required process parameters (HACCP concepts, temperature regime, black and white zone separation, hygienisation/sanitisation in closed reactors etc.).

On the European level today, the key reference is the Animal By-Products Regulation (EC) n° 1774/2001 (ABPR) providing detailed hygienisation rules for composting and biogas plants which treat animal by-products as defined in the regulation. The Regulation has been discussed in Section 3.5.3. Its implications for compost production are discussed in Section 3.5.6.5.

3.5.6.1.2. Identification of the input materials that may be used to produce compost

Another important aspect is the definition of input materials which may be used for the production and marketing of compost. Barth et al have identified 9 compost types according to the input material used: biowaste compost (source separated collection of organic household waste), green waste compost, VFG compost (vegetable fruit and garden waste without meat), biomix compost (including sewage sludge), bark compost, manure compost, sludge compost, MSW compost or stabilised biowaste (produced in MBT plants from mixed residual household waste).

For instance, in Flanders, municipal sewage sludge and mixed MSW are excluded from compost production. In France, municipal sewage sludge is also excluded.

Barth et al have found the following schemes of ruling in input materials for compost production:

- Distinct positive list within statutory regulations. This is for instance the case in Belgium and Spain.
- No general list but licensing rules. This is for instance the case in France.
- Voluntary principles or lists within quality protocols and standards. This is for instance the case in the UK
- No regulatory definitions or positive lists. This is for instance the case in Estonia and Poland.

It is noteworthy that Barth el al recommend to widen the European Waste Catalogue with a precise qualitative description of the individual type and origin of material for a common understanding and interpretation.

Barth et al also point out that it is important to differentiate materials with respect to Animal by Products[86] because additional process and even final product criteria may apply based on national implementation rules for the treatment of ABP in composting plants.

3.5.6.2. Compost uses

Barth et al classify the potential uses for compost as in the table below. In some cases use types are also linked to quality classes.

Table 3 Compost use types

Compost for biological agriculture	This use type is characterised by two criteria: • For the use of the *compost type BIOWASTE COMPOST* from source separated organic household waste limit values for heavy metals have to be respected [Reg. (EC) 2092/91] There are no such quality criteria for other compost types like green waste compost. • Any compost produced from municipal sewage sludge is forbidden in biological agriculture
Compost for food production	Restriction of certain heavy metal or impurities related *compost classes*(e.g. class '2' or 'B') for the use in agricultural or horticultural food and feeding stuff production
Substrate Compost	Compost providing specific performance characteristics such as particle size, salt content, stability, plant response, nutrient availability etc. in order to be successfully used as constituent in growing media and potting soils.
Mulch compost	Compost of generally coarse structure (higher portions of wood chips with a maximum particle size > up to ca. 35 mm) and with less demands regarding maturity
Mature compost	Fully humified compost, generally utilised and recommended in all – also sensitive – applications; Identification is done by test methods testing the plant response or measuring the biological activity of the compost (e.g. *oxygen consumption, CO_2evolution, self heating test)*
Fresh compost	Half matured compost but having passed thermal sanitisation (thermophile phase) with still a relatively high biological activity to be used in less sensitive applications like arable land

3.5.6.3. End of waste criteria

Barth et al (2008, p 15) point out that, for an end of waste regulation for compost on EU level it would seem a major challenge to overcome the individual and considerably varying process requirements for biowaste (catering waste) composting as implemented by MS. They question whether countries with very strict rules would accept compost products from other MS with more relaxed requirements.

According to Barth et al (2008, p 15), the possibility for compost produced from waste and within the waste regime to be marketed and used under the product regime is mainly rolled out under either the fertiliser or the waste legislation. A distinct end of waste legislation under the waste act exists only in one MS (Austria). In several countries, more than one solution is possible for the marketing of the compost. Often, a producer can choose to register the compost under a product or fertiliser regime if certain

[86] As defined under Category 2 and 3 of the Animal By-Products regulation (EC) no. 1774/2002

criteria are fulfilled. Otherwise, the compost can be used under a waste regime. This is clarified in the table below.

Table 4: End of waste criteria for compost

Compost may become a PRODUCT	
Specific compost regulation within waste & environmental legislation with **extensive QM and external approval scheme** for compost	AT
Compost related regulation within the waste and environmental legislation or based on standards but with **simple registration scheme**	LT, FR, SK
Regulation within the waste and environmental legislation rolled out by the way of the **licensing procedure**	IE, LU (+ obligatory QAS); UK (only with voluntary QAS)
(Simple) **fertiliser registration** within the fertiliser legislation	CZ, ES, FI, GR, HU, IT, LV, NL, PL, PT, SI
Compost remains WASTE	
Specific compost standards available Compost derived from source-segregated or 'residual waste' animal by-products that does not meet 'product' requirements, but is spread on land (ABP and waste management licensing regulations apply).	BE/Fl (+ obligatory QAS), DE (+ voluntary QAS) UK
No specific compost legislation Compost derived from source-segregated, non-ABP biowaste that does not meet 'product' requirements or 'Compost-Like-Output' from Mechanical and Biological Treatment of residual waste that is disposed of (not spread on land).	BG, CY, CZ, DK, EE, HU, MT, PL, RO, SE UK

As far as end of waste compost registration and certification schemes are concerned they distinguish 4 typical options:

- Simple fertiliser registration without external inspection and sample taking; this is for instance the case in Spain, France and Poland
- Registration under fertiliser or waste regime involving external inspection of documentation and process management by accredited laboratory (third party inspection but no full QAS); this is for instance the case in Spain
- End of Waste regulation involving a full scale third party QAS. Compost ceases to be a waste when the external inspection of the composting process and final product investigation allows for product certification by an acknowledged certification body (QAO); this is for instance the case in Flanders.
- Similar to previous regime but extensive documentation on purchase contract down to dispatch as well as proper application has to be provided in the case of agriculture and land grown horticulture; this is the case in the UK (Compost Quality Protocol – England and Wales). The crucial point here is that a comprehensive documentation of compost use must be kept by land manager in the case of use in agriculture and soil-grown horticulture – otherwise the compost remains waste.

Barth et al (2008, pp 110-111) point out that, except in the UK, product status is achieved after certification and declaration of a compost batch. They argue that the objective of the creation of an end-of-waste provision is the equal treatment and trading of the secondary product – establishing the end-of-waste property after approval that the compost has been used for the recognized purpose (as in the UK) would counteract the free movements of goods. Their position is that the responsibility of the compost producer ends with providing all necessary information for a correct application and that it is the responsibility of the user to apply the compost correctly (for instance by not exceeding maximum quantities per area unit).

3.5.6.4. Legal provisions applying to the use of compost

Utilisation restrictions exist for different end-use applications. Barth et al (2008, p. 16) distinguish between:

- Direct regulations like dosage restrictions (admitted quantity of compost per ha)
- Indirect regulations such as Good Agricultural practice (GAP) protocols and the so called Cross Compliance requirements in agriculture.

They also point out that:

- For regular compost application in agriculture, the quantitative limitations are determined by the nitrogen and phosphorous supply and by the organic matter substitution potential.
- Direct load restrictions for heavy metals on soils mainly stem from regulations on the use of sewage sludge in agriculture and from fertiliser application rules (fertiliser ordinances). With the exception of Flanders and France, those rules are commonly not provided in specific compost regulations.

3.5.6.5. Requirements of Animal By-Products Regulation relevant for compost production

Only the following animal by-products may be transformed in a biogas or composting plant:

(a) category 2 material, when using processing method 1 in a Category 2 processing plant;

(b) manure and digestive tract content;

(c) category 3 material.

The general requirements for composting of Category 3 materials are:

- Animal by-products referred to in paragraph 4 of Annex VI of the ABPR must be transformed as soon as possible after arrival. They must be stored properly until treated.
- Containers, receptacles and vehicles used for transporting untreated material must be cleaned in a designated area. This area must be situated or designed to prevent risk of contamination of treated products.
- Preventive measures against birds, rodents, insects or other vermin must be taken systematically. A documented pest-control programme must be used for that purpose.
- Cleaning procedures must be documented and established for all parts of the premises. Suitable equipment and cleaning agents must be provided for cleaning.
- Hygiene control must include regular inspections of the environment and equipment. Inspection schedules and results must be documented.

- Installations and equipment must be kept in a good state of repair and measuring equipment must be calibrated at regular intervals.

- Digestion residues and compost must be handled and stored at the biogas respective composting plant in such way as to prevent recontamination.

Regulation (EC) 208/2006 introduced two important amendments:

- the process validation as alternative treatment to a fixed time-temperature regime

- new indicator organisms for the approval of the hygienisation process and the final product.

A detailed discussion of the technical requirements can be found in Bath et al (2008, pp 88-89).

Catering waste[87] is exempted from the special requirements for collection, transportation and storage as well as from the requirements for composting and biogas plants of Annex VI by the stipulations of article 6(2)(g) and article 7(1) respectively. This covers any catering waste stemming from separate collection of organic waste from households and central kitchens.

Thus catering waste may be processed in accordance with national law until the Commission determines harmonised measures following the comitology procedure of Art. 33(2) ABPR.

Following the wording of par (14) of chapter II C in Annex VI this also applies when catering waste is processed together with manure, digestion tract content, milk or colostrum.

As no harmonised process requirements have as yet been proposed by the Commission, the Member States can still regulate the treatment of catering waste in compost and biogas plants.

In April 2004 the Commission published the "Guidance on applying the new Animal By-Products Regulation (EC) No 1774/2002" where it clarifies that the regulation abstains from a detailed provision for catering waste in favour of foreseen environmental legislation (provision for biowaste) or national rules[88].

According to Barth et al, many other Member States up to now misinterpreted the possibility to introduce more relaxed rules for composting of catering waste at least from source separated organic household waste and have taken over the full set of requirements of Annex VI of the ABPR in national licensing and plant approvals.

Annex VI, even now, does not affect the exemption for national regulation on category 3 catering waste in Art. 6(2)(g). Here Member States may still apply national rules independent from licensing procedures following Art. 15 and subsequent treatment and hygienisation requirements of Annex VI!

Barth et al conclude that, although a reasonable approach has been developed in last years, which acknowledges the nature of food waste as "low risk" waste, the nature of detailed and specific sanitary provisions may still influence (rather negatively) the practicability of composting/AD initiatives in many ways. They point out that for an end of waste regulation for compost on EU level it would seem a major challenge to overcome the individual and considerably varying process requirements for biowaste (catering waste) composting as implemented by MS.

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[87] Annex I par. 15 of the Regulation defines 'catering waste' as all waste food including used cooking oil originating in restaurants, catering facilities and kitchens, including central kitchens and household kitchens.

[88] ec.europa.eu/food/food/biosafety/animalbyproducts/guidance_faq_en.pdf

3.6. SPECIFIC PROVISIONS FOR CARDBOARD

Specific European legal instruments, focussing merely on cardboard, cannot be found. The major provisions applicable on cardboard can be found in the Landfill Directive 1999/31/EC and in the Directive on Packaging and Packaging Waste 94/62/EC as amended by Directives 2004/12/EC and 2005/20/EC. The recycling of cardboard is also affected by Regulation No 1935/2004/EC on materials and articles intended to come into contact with food and Regulation No 2023/2006/EC on good manufacturing practice for materials and articles intended to come into contact with food. Finally, one should also take a look at the voluntary commitment taken by the paper industry and at the existing paper standards.

Landfill Directive

In the Landfill Directive 'biodegradable waste' is described as "any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard". Cardboard thus forms a part of the biodegradable waste for which landfill should be limited beneath the thresholds mentioned in paragraph 3.5. The Member States are encouraged into the separate collection of this waste, sorting, recovery and recycling.

The main application of cardboard in the European Union is as a packaging material or a constituent of packaging material, both for primary, secondary or tertiary packaging, for B2C and for B2B shipments.

Directive on Packaging and Packaging Waste

The Directive on Packaging and Packaging Waste covers all packaging placed on the market in the Community and all packaging waste, whether it is used or released at industrial, commercial, office, shop, service, household or any other level, regardless of the material used.

The objectives of the Directive are:

- To minimise the impact of packaging waste on the environment
- To ensure free movement of goods within the EU and avoid obstacles to trade
- To harmonise national legislation of 27 countries

It requires Member States to take measures, which may include national programmes, to prevent the formation of packaging waste, and encourages them to develop packaging reuse systems. Systems must be introduced for the return or collection of used packaging to attain specific targets:

	Recovered including incineration with energy recovery	Totally recycled	Recycled for each packaging material
30 June 2001	50-65%	25-45%	+15%
31 December 2008	+60%	55-80% Paper and cardboard: +60%	

Table 5: Recovery and recycling targets in the packaging directive

The Directive is not specific on how these collection systems should be organised; this is left to the discretion of the Member States.

In practice, all but one EU countries[89] have established recovery organisations that implement producer responsibility on the part of manufacturers and the fillers. Although all these systems have their own specificities, most of them use a uniform financing model (or "Green Dot system") [90]. We will detail later how they function in Belgium, Estonia, France, Poland and Spain. Finland[91], Italy[92], the Netherlands[93] and the United Kingdom (see Section 8.4.5.1) have one or more recovery organisations that are not part of the Green Dot System (or who do not use the "Green Dot" trademark even though they are members of PRO-Europe).

Packaging waste exported out of the Community shall only count for the achievement of these obligations and targets if there is sound evidence that the recovery and recycling operation took place under conditions that are "broadly equivalent" to those prescribed by the Community legislation on the matter.

Directive 2005/20/EC sets a later deadline for the 10 new Member States (the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia) to meet the targets of the revised Packaging Directive. The extensions are until 31 December 2012. Greece, Ireland and Portugal, because of the large number of small islands, the presence of rural and mountain areas and the low level of packaging consumption respectively, are not be bound by the targets until 2011.

Where energy recovery is preferable to material-recycling for environmental and cost-benefit reasons, member states may deviate from the waste treatment hierarchy, and therefore foresee a sufficient margin between national recycling and recovery targets.

The instruments that Member States can use to enhance compliancy with the above mentioned targets, or to obtain a more sustainable packaging policy, are:

- Encourage the use of materials obtained from recycled packaging waste for the manufacturing of packaging and other products by improving market conditions for such materials, or by reviewing existing regulations that may prevent the use of those materials.
- Prevention measures to reduce the use of packaging and the environmental impact of packaging as far as possible without compromising its essential functions. E.g. through packaging waste prevention plans.
- Strengthen and complement the enforcement of the essential requirements of packaging placed on the market.
- National programmes, projects to introduce producer responsibility, including its financial aspects, to minimise the environmental impact of packaging.
- Encouragement of reuse and, in particular, comparison of the costs and benefits of reuse and those of recycling.

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[89]Denmark has decided to implement the European Packaging Directive not by introducing Producer Responsibility but by introducing a mandatory deposit for beverage containers for beer and carbonated sort drinks and by having a tax on certain packaging for certain goods - http://www.pro-e.org/Denmark. Norway and Turkey have also set up recovery organisations.

[90] Packaging Recovery Organisation Europe, Uniformity in Diversity - http://www.pro-e.org,

[91] http://www.pyr.fi/en/index.htm

[92] http://www.conai.org/

[93] http://www.vrom.nl/pagina.html?id=9176

- Reduction and phase out of heavy metals and other hazardous substances in packaging.

According to article 6 point 10, Member States programmes that go beyond the maximum targets mentioned above and that provide to this effect appropriate capacities for recycling and recovery shall be permitted to pursue those targets in the interest of a high level of environmental protection, on condition that these measures avoid distortions of the internal market and do not hinder compliance by other Member States with the Packaging Directive. They may not constitute an arbitrary means of discrimination or a disguised restriction on trade between Member States.

Practically, this means that the higher targets must be notified to the Commission, who will accept them if other Member States do not oppose them on the ground that it will affect their own recycling.

Member States have added the following additional requirements[94]:

- Higher recycling targets than EU legislation e.g. in Austria, Belgium, Germany, Sweden, Norway
- Additional recycling targets e.g. for beverage cartons in Austria, Germany, Hungary, Norway
- Examples for other additional requirements
    - Promotion of environmentally favourable packaging such as in Germany
    - Deposits for beverage packaging such as glass, PET and cans (e.g. Scandinavia and Germany)

Systems for collection and reuse, recycling and recovery of packaging waste must be open to the participation of the economic operators of the sectors concerned and to the participation of the competent public authorities. They should also apply to imported products under non-discriminatory conditions, including the detailed arrangements and any tariffs imposed for access to the systems, and should be designed so as to avoid barriers to trade or distortions of competition in conformity with the Treaty.

Packaging may be placed on the market, only if it complies with essential requirements defined in annex II of the Packaging Directive.

Regulation on materials and articles in contact with food

This Regulation applies to all materials and articles which in their finished state:

(a) are intended to be brought into contact with food; or

(b) are already in contact with food and were intended for that purpose; or

(c) can reasonably be expected to be brought into contact with food or to transfer their constituents to food under normal or foreseeable conditions of use.

According to “whereas” (24), the use of recycled materials and articles should be favoured in the Community for environmental reasons, provided that strict requirements are established to ensure food safety and consumer protection. Such requirements should be established taking also into account the technological characteristics of the different groups of materials and articles mentioned in Annex I.

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[94] Information provided during face to face interview of ACE of 30 May 2008

Annex I of the Regulation includes paper and board as examples of food contact materials.

Article 17 of this regulation requires that, for materials and articles in contact with food, the traceability shall be ensured at all stages in order to facilitate control, the recall of defective products, consumer information and the attribution of responsibility.

Examples of food applications include: bags for confectionery, pizza boxes, bread wrap, chocolate interleaving, frozen food containers, sugar bags, beverage cartons and food service boards[95].

Regulation on good manufacturing practice for materials and articles intended to come into contact with food

This Regulation lays down the rules on good manufacturing practice (GMP) for the groups of materials and articles intended to come into contact with food (hereafter referred to as materials and articles) listed in Annex I to Regulation (EC) No 1935/2004 and combinations of those materials and articles or recycled materials and articles used in those materials and articles.

This has led Flexible Packaging Europe (FPE), the European forum for the flexible packaging industry, to develop a Code for Good Manufacturing Practices for Flexible and Fibre-Based Packaging for Food[96].

Note: In practice, the demand for recycled fibre is so high that these two Regulations do not constitute a constraint on the amounts of cardboard that can be recycled[97].

European Declaration on Paper Recycling

The European Declaration on Paper Recycling sets out measures aimed at optimising the management of recovered paper throughout the value chain from paper and board manufacturing, converting and printing through to the collection, sorting and transportation of used paper and board products.

The Declaration contains a series of commitments with respect to waste prevention, collection, recycling, research and development and education and information. These commitments include:

- exchanges of information on national initiatives and experiences with respect to collection systems
- the determination and development of guidelines of recovered paper quality control
- guidelines and methods of assessments to promote good recyclability (including recommendations on promoting deinkability, the development of availability of printing inks and glues that do not hamper recycling and deinking processes…)

The industry commits to take measures that by 2010 66% of paper and board products consumed in Europe will be recycled. This is the only quantitative target, and it is not specified how it is to be achieved.

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[95] See: Industrial Guidelines on Traceability of Materials and Articles for Food Contact, p. 69, paper provided by FETRA.

[96] http://www.flexpack-europe.org/upload/Documents/GMP_FPE_version_28.11.2007.pdf

[97] Phone interview of Ilse Vervloet, Environmental Advisor of FETRA on 26 May 2008.

In 2006, the Confederation of European Paper Industries, CEPI, published two documents on responsible management of recovered paper[98]:

1. Guidelines for responsible sourcing and supply of recovered paper.

2. Best Practices for the global inspection of recovered paper.

CEPI also investigated its guidelines on responsible sourcing and quality management of recovered paper.

Paper standards

In its list of definitions[99], CEPI uses CEN standard EN643, the "European List of Standard Grades of Recovered Paper and Board".[100]

Specific provisions on beverage cartons[101]

Just as other types of packaging, beverage cartons are affected by the Packaging and Packaging Waste Directive (1994/62/EC), the Landfill Directive (1999/31/EC), the Incineration Directive (2000/76/EC) and the Regulations 1935/2004/EC and 2023/2006/EC on food contact.

In the Packaging and Packaging Waste Directive, beverage cartons follow the 'general rule' as applied to laminates[102], i.e. they are included in the recycling target for the "dominant material" (this is, paper).

ACE claims that it does not have any sense to have specific targets for laminates instead because generally the different types of polylaminates have more in common with their dominant material than with other laminates that may consist of combinations of totally different types of materials.

Norway has a specific target for beverage cartons.

3.7. COMMUNITY INITIATIVES IN THE FIELD OF ENVIRONMENTAL TECHNOLOGY

3.7.1. Environmental Technologies Action Plan

The potential of technology to create synergies between environmental protection and economic growth was recognised by the October 2003 European Council.

The Environmental Technologies Action Plan (ETAP) defines environmental technologies as all technologies whose use is less environmentally harmful than relevant alternatives[103].

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[98] CEPI Sustainability Report 2007, p. 31, http://www.cepi.org/

[99] http://www.cepi.org/Content/Default.asp?PageID=105

[100] http://www.paperrecovery.org/files/EN-643-154434A.pdf

[101] Information provided during face to face interview with ACE of 30 May 2008

[102] Commission Decision of 22 March 2005 establishing the formats relating to the database system pursuant to Directive 94/62/EC of the European Parliament and of the Council on packaging and packaging waste (2005/270/EC)

[103] European Commission, Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union, COM(2004) 38 final.

They encompass

- technologies and processes to manage pollution (e.g. air pollution control, waste management),
- less polluting and less resource-intensive products and services
- ways to manage resources more efficiently (e.g. water supply, energy-saving technologies).

The ETAP sets out a series of measures to encourage the choice of advanced environmental technologies in all investment and purchasing decisions, thus widening their market and reducing their cost. These measures require a concerted effort by the Commission, Member States and partners in the research community, industry and civil society.

The Action Plan's objectives are:

- to remove the obstacles so as to tap the full potential of environmental technologies for protecting the environment while contributing to competitiveness and economic growth;
- to ensure that over the coming years the EU takes a leading role in developing and applying environmental technologies;
- to mobilise all stakeholders in support of these objectives.

This Action Plan is based on the results of extensive stakeholder consultation[104].

The following factors underpin the action plan:

- There is potential to promote environmental technologies in all economic sectors. Therefore, the ETAP will not seek a "one size fits all" solution.
- Many potentially significant environmental technologies exist but are underused. Contributing factors mentioned by the Commission are lock-ins to existing technologies, wrong price signals, difficult access to finance and low consumer and purchaser awareness.
- Targeted and effective incentives to the introduction of environmental technologies can pave the way for lasting success.
- Reducing uncertainty about future market developments will help to boost investment in environmental technologies. Possible factors include: legislation[105], standards and targets; trends in consumer behaviour; law enforcement; reliable information; public sector demand.
- It is important to build on the experience and commitment of different stakeholders.
- There is a need to optimise the use of different policy instruments.
- Some of the measures may take time to affect investment decisions; therefore, there is a need for immediate action.

The following priority actions have been proposed:

- Getting research to the markets through:
    - *Increased and focused research, demonstration and dissemination*: it is proposed to improve co-ordination in order to go beyond what could be achieved through the Framework Programme alone. More funding would be made available for pilot, demonstration and dissemination actions. Apart from the Framework

[104] An overview of the preparatory work carried out by the Sustainable Production and Consumption Issue Group can be found in: European Commission (2004), JRC, IPTS, Promoting environmental technologies: Sectoral analyses, barriers and measures, EUR 21002 EN. The document contains a chapter on barriers in waste management.

[105] The Communication explicitly refers to the definition of Waste Recovery and Disposal in the Waste Framework Directive.

Programme, the Commission will use other financing programmes such as the Structural Funds and the LIFE programme.

- *Shaping a common vision through technology platforms*. Technology platforms are mechanisms to bring together all interested stakeholders to build a long-term vision to develop and promote a specific technology or solve particular issues.
- *Improve testing, performance verification and standardisation related to environmental technologies.* The main objective is to increase purchasers' confidence in new environmental technologies through the establishment of a validation mechanism.

– Improving market conditions:

- *Setting performance targets*: These targets would be based on environmental performance, while being realistic from an economic and social efficiency point of view, as well as different regional conditions.
- *Leveraging investment*. A series of measures are proposed to develop further Europe's risk capital market, in collaboration with the EIB Group, the EBRD and Member States. Cohesion policy would also lay a vital role in the promotion of environmental technologies.
- *Creating incentives and removing economic barriers*. In order to ensure that guidelines would unduly distort competition in the international markets, the ETAP proposed reviewing the guidelines for environmental state aid. Other actions included the identification of environmentally harmful subsidies[106] and the analysis of market-based instruments for environmental protection.
- *Public procurement*. Proposed actions include the setting of performance-based requirements in public procurement procedures and the use of life-cycle costing.
- *Building support for environmental technologies in civil society* – business and consumer awareness, training and education. Proposed instruments included product labelling, Environmental Product Declarations, EMAS…

– Acting globally

- *Promotion of environmental technologies in Developing Countries*
- *Diffusion of environmental technologies through responsible investment and trade*.

Other actions listed included:

– To develop an EU catalogue of existing directories and databases on environmental technologies
– To ensure that new and revised standards are performance-related

On 27 January 2005, the Commission adopted the First Report on the implementation of ETAP

A Second Report on the implementation of ETAP was released in May 2007. It detailed the achievements over the 2005 – 2006 period and the priority actions for the future.

The following points are noteworthy in the context of the current study:

– Under the 7th Framework Programme, it estimated that 30% of the €32 billion budget will address environmental technologies, including soil and waste management.

[106] In 2006, DG ENV commissioned a study on this issue. It was made available in March 2007 http://ec.europa.eu/environment/enveco/others/index.htm#ehs.

- 30 Technology Platforms had been launched, part of which include environmental technology[107]
- Work on Environmental Technologies Verification System was progressing. The principle of environmental technology verification (ETV) schemes is to provide technology users with reliable information about environmental performance so as to accelerate market acceptance of innovative technologies.[108]
- Studies have been conducted to set up a performance target scheme in the EU, including for manure treatment
- Several sources of finance had been mobilised (including from the EIF, the EIB, Cohesion Policy and LIFE). A new funding opportunity, the Competitiveness and Innovation Programme (CIP), was created to support renewable energies and energy efficiency on the one-hand and eco-innovation on the other hand - see Section 3.7.2.
- The Commission adopted a Green Paper on market-based instruments[109]
- A Community Framework for State Aid for Research, Development and Innovation has been adopted - the review of the Guidelines on Environmental State Aid was still in progress at the time the progress report was published[110].
- Awareness raising measures include a new ETAP website and Newsletter

The Commission Staff Working Document accompanying the report pointed out that while almost all Member States cater for and put emphasis on the supply side (this is, promoting environmental technologies), demand oriented activities are carried out less consistently. Putting in place new forces to encourage the diffusion and take up of eco-innovation on a broad scale, has been identified as priority for the future. The report calls for the Commission and the Member States to actively pursue those ETAP actions that further create demand in a systematic, coordinated manner:

- Further Green Procurement (including the publication of a Communication on public procurement in 2007[111], the setting of targets, giving guidance on indicators and monitoring)
- Mobilise greater financial investments
- Establish Technology Verification and Performance Target Systems, including the preparation of legislative proposals for environmental technology verification and a communication on performance target schemes.
- Benchmarking and diffusion of most effective national schemes
- Focus on sectors with high gains (including recycling industries); the report points here to the opportunity to bring the used approaches to bear on the formulation of lead markets (see Section 3.7.3).
- Ensure an effective, strategic knowledge resource on eco-innovation that would provide relevant statistics, and identify trends and global business opportunities.
- Promote awareness and active participation, including through the use of LIFE+ (see Section 3.7.4) and the European Forum on eco-innovation[112].

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[107] See http://cordis.europa.eu/technology-platforms/home_en.html for more information.

[108] For more details: http://ec.europa.eu/environment/etap/pdfs/oct07_technology_verification.pdf

[109] COM(2007) 140 final of 28 March 2007 http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0140en01.pdf

[110] The new Community Guidelines on State Aid for environmental protection entered into force on 2 April 2008. http://ec.europa.eu/comm/competition/state_aid/reform/environmental_guidelines_en.pdf

[111] The proposal was actually presented on 16 July 2008. See COM(2008) 400/2, http://ec.europa.eu/environment/gpp/index_en.htm

- Channel future research themes of the 7th Framework Programme based on ETAP priorities and future lead markets.

3.7.2. The Competitiveness and Innovation Programme

The CIP places the same emphasis as LIFE+ on the innovation character, the replicability and the maturity of the technology. It is however more focused on SMEs, voluntary approaches, and new products and business. Project where public bodies have a leading role are more within the field of LIFE+.

The 2008 Call for Proposals of the CIP[113] includes support for the following type of actions:

- Better sorting processes and methods for waste materials, construction waste, commercial/industrial waste, potential recyclables or waste from electrical and electronic equipment and end-of-life vehicles.
- Innovative products using recycled material or facilitating recycling, matching international products' standards, advanced design requirements and high quality consumer needs.
- Business innovations to strengthen the competitiveness of recycling industries, such as new market structures for recycling products, supply chains or harmonised manufacturing and recycling processes.
- Green building services supporting the usage of materials from local sources or renewable plants, non-toxic, reusable, or recycled materials, system optimization including waste reduction, zero net waste at construction site level or generation of on-site renewable energy.
- Cleaner and innovative products in the food and drink sector, including packaging methods and materials, processes and services aiming at higher resources efficiency. Full raw material utilisation in the food sector, which increases resource efficiency and productivity, reduces bio-degradable waste, and supports the transition to a bio-based economy.
- Cleaner and innovative products, processes and services in the food and drink sector aiming at a reduction of waste, or/and increasing recycling and recovery.

3.7.3. Lead market initiative

In December 2006, the Competitiveness Council invited the European Commission to prepare an initiative on Lead Markets that would aim to foster the emergence of markets with high economic and societal potential.

The initiative aims to identify promising emerging market areas which could be enhanced by a coherent mix of policy measures at European level, speeding up development without interfering with competitive forces.

The Lead Market Initiative aims to bring together and focus a range of existing policy mechanisms (such as regulation, public procurement, standards…) to act on a set of selected markets in a coherent way.

The basic assumption underlying the "Lead Market Initiative"[114] is that public authorities can enhance the quick take-up of innovations, thus giving industry the opportunity to turn these innovations into world-

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[112] The European Forum brings together business and policy perspectives in a series of events that explore strategic orientations for eco-innovation and environmental technologies, in support of the ETAP. For more details, see:

http://ec.europa.eu/environment/ecoinnovation2007/2nd_forum/index_en.htm

[113] http://ec.europa.eu/environment/etap/ecoinnovation/docs/call_en_08.pdf

wide leading products or services in new high-growth markets ("lead markets") on the basis of the Union's industrial dynamics.

The Council endorsed the Commission's proposal to develop an appropriate approach in a limited number of potential lead markets. Key features of such markets and of the initiative are:

- The aim is not "to pick winners", nor to artificially create a market for a given technology or pre-empt the development of other competing options;
- The assessment of the market potential and of the demand side (including of users' needs) is a crucial point;
- The added-value of the initiative is about developing a prospective, concerted and focused approach of regulatory and other policy instruments to allow a varied set of technologies and of innovative business models to meet rapidly the demand and to benefit from a mobilising effect generated by this initiative.

Six markets have been identified for the initial stage of the initiative including recycling. These six market sectors have been included, because they are (1) highly innovative, (2) supported by well characterised customer needs and (3) a strong technological and industrial base in Europe and (4) depending more than others on the creation of favourable framework conditions as a result of public intervention.

The Lead Market Initiative ("LMI") consists of coordinated priority actions in each market area, deploying a core set of policy instruments:

- **Legislation**. The LMI constitutes an opportunity to improve the coordination of various sets of regulations across different policy areas that affect markets for innovative products and services.
- **Public procurement**. The action plans often include mobilising public authorities to act as 'launching customers' by promoting the use of innovation-friendly procurement practices.
- **Standardisation, labelling and certification**. More consistent technical, performance and product standards along the whole production chain, from raw materials to end products, could make standardisation more innovation-friendly.
- **Complementary instruments.** In certain market areas, measures to provide business and innovation support services, training and communication are deemed a necessary complement to the above policy instruments. In some instances, financial support and incentives which aim at facilitating the interaction of customers with the innovating companies and their solutions are considered advantageous. Such schemes could involve Structural Funds and State aid funding.

More details can be found in the Communication "A lead market initiative for Europe"[115] and its Annexes.

Annex I contains short descriptions of the first six market areas.

We briefly summarize here the Section on the lead market for recycling; it places a focus on technologies and processes of waste products related to the directives such as Electrical and Electronic Waste (WEEE) and End-of-life of vehicles (ELV).

3.7.3.1. Selected pieces of EU legislation promoting recycling

The following actions were proposed:

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[114] http://ec.europa.eu/enterprise/leadmarket/leadmarket.htm#1

[115] COM(2007)860 (21.12.2007).

- Enhance market, technology and innovation aspects as part of review of the Thematic Strategy on the prevention and recycling of waste.
- Enhance market aspects in the review of WEEE Directive, if appropriate
- Complete input to discussions and definitions of end of waste criteria as part of the revision of Waste Framework Directive.

3.7.3.2. Standards, Labelling

The initiative proposes the establishment of common EU standards, labels and certificates as a way to reduce uncertainty on the product properties and to enhance market transparency:

- Develop relevant forms of international standards, by cooperating with international standards agencies, such as CEN to deal with standardisation topics relevant to recycling.
- Allowing in the new Framework Directive the possibility for end of waste criteria to be set would create de facto standards for a number of secondary raw materials[116].
- Develop dynamic performance requirements for recycling processes, or efficient use of natural resources, for instance as part of the Sustainable Consumption and Production Action Plan.
- Contribute to development of EU wide Verification Systems for environmental technologies, with consideration of recycling technologies and processes in particular (see also Section 3.7.1).

3.7.3.3. Public Procurement

At the time COM(2007)860, was published, the Commission was working on a Communication on Green Procurement to give guidance on environmental criteria and propose ways of approaching voluntary or mandatory target setting. The proposal was actually presented on 16 July 2008. See COM(2008) 400/2, http://ec.europa.eu/environment/gpp/index_en.htm

3.7.3.4. Financing

The following actions were proposed to improve financing for up-take, upgrading, research and development and innovative demonstration projects in order to ensure continues improvements in the take-up and advancement of recycling technologies and improved knowledge capacity.

- Improve levels of financing for investments in recycling industries, innovations and technologies, both from public and private sources.
- Harness research and development projects under the themes of recycling or green manufacture. Work to include recycling topics and targets in future calls for proposals, such as on improved technologies for the sorting processes of waste materials.
- Work to ensure that financing for demonstration projects under CIP, the Competitiveness and Innovation Programme, will also be earmarked for business innovations in the recycling area.

3.7.3.5. Knowledge Sharing

In order to improve knowledge diffusion about recycled products, the following actions were proposed:

- Provide better strategic knowledge about innovation and recycling markets
- Establish better knowledge resources on recycled products

[116] The version approved in second reading by the European Parliament contains an article on end-of-waste criteria – see Section 3.5.1 for more details.

- Launch a scheme to champion best policy exchanges across Member States relating to efficient use of natural resources and recycling

3.7.3.6. International Aspects

As EU waste legislation on WEEE, RoHS and on ELV has an influence on world markets and legislation, there is potential for export of recycling technologies, industrial processes and European know-how. EU companies can have a first-mover advantage in this regard.

The following actions were proposed:

- Develop strategies to further build on EU leadership of WEEE and ELV at global level.
- Maintain a strategic position with respect to international strategies on Recycling and Waste Management
- Work towards better international trade agreements on environmental goods and services, by keeping abreast of the bilateral trade agreements on trade in environmental goods.
- Launch or follow studies of barriers to environmental goods, in particular such as those of the OECD[117]. Include the topics of trade barriers, recycled materials and recycling as topic for the UNEP Panel on Sustainable Resources[118], if appropriate.

Appropriate external trade measures related to the standardisation formulation and enforcement are possible ways to adequately address the risk of circumventing the Union's waste management dispositions by exploiting different regulatory frameworks in other regions of the world.

3.7.4. LIFE

LIFE+ is a limited but focused funding instrument providing specific support for the development and implementation of Community environmental policy and legislation, in particular the objectives of the 6th EAP (Decision 1600/2002/EC) and resulting thematic strategies. It comprises three components:

- LIFE+ Nature & Biodiversity
- LIFE+ Environment Policy & Governance
- LIFE+ Information & Communication

At least 78% of LIFE+ will be for the co-financing of project action grants, of which at least 50% will be for nature and biodiversity projects. The European Commission will use the remaining sum for operational expenses.

Member States will forward the project proposals to the Commission, may set national priorities and objectives (from 2008 onwards) and may prepare comments on proposals, in particular in relation to national annual priorities.

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[117] http://www.oecd.org/document/24/0,3343,en_2649_34183_36629272_1_1_1_1,00.html

[118] The International Panel for Sustainable Resource Management, or Resource Panel for short, was officially launched in November 2007. It is expected to provide the scientific impetus for decoupling economic growth and resource use from environmental degradation. The overall objective of the Resource Panel is therefore to provide independent scientific assessment of the environmental impacts due to the use of resources over the full life cycle, and advise governments and organisations on ways to reduce these impacts. http://www.unep.fr/scp/rpanel/

In the waste sector, LIFE projects play an important role in developing and testing solutions to specific technological challenges, particularly with regard to waste treatment in the manufacturing sector. Integrated methods for better waste management, awareness-raising campaigns, better ways of using resources and treating waste are just some of the issues addressed by LIFE.

An example is the APPRICOD project which was established to assess the potential for plastic recycling in C&D activities – see Section 3.3.4.

4. GENERAL FACTS AND FIGURES

4.1. WASTE COLLECTION

The quantity of waste collected in a Member State can be defined as the quantity of waste generated and handed over to a third party who is professionally active in the market of waste shipment and who selects a further destination for the waste, either by treating the waste itself or by delivering it to a waste pre-treatment or treatment plant. This quantity is not assessed directly through the OECD/EUROSTAT joined questionnaire, and not through the Waste Statistics Regulation.

Theoretically it can be obtained by assessing the waste generated and subtracting the waste that is treated at the same site of its generation, e.g. by direct recycling in the same or another production process of the waste generator. This waste sometimes is not reported and not always included in the waste generation figures. Also the waste generated and shipped by the generator itself to a third party for recycling or disposal is not available on the waste collection market and should be subtracted from the waste generation figures. However, by shipping its own waste the waste generators are often active in the same market as the waste collection sector. The quantity of waste available for collection can thus be assessed by the figures for waste generation, but this figure is larger than the quantity of waste actually collected.

The first reporting in the frame of the Waste Statistics Regulation 2150/2002/EC gives following indicators:

Table 6: Quantity of waste generated in 2004

	Hazardous (kton)	Non- Hazardous (kton)	Total Waste (kton)
EU-27	74 056	2 693 230	2 767 290
EU-15	58 841	1 855 488	1 914 332
Belgium	5 197	47 612	52 809
Bulgaria	528	251 530	252 058
Czech Republic	1 446	27 830	29 276
Denmark	322	12 492	12 814
Germany	20 000	344 022	364 022
Estonia	7 333	13 527	20 861
Ireland	724	23 789	24 513
Greece	278	28 518	28 796
Spain	3 116	157 552	160 668
France	7 553	399 170	406 723
Italy	6 134	133 672	139 806
Cyprus	77	1 450	1 527
Latvia	17	1 240	1 257
Lithuania	87	5 174	5 261

Luxembourg	124	8 188	8 313
Hungary	1 365	23 296	24 661
Malta	2	2 480	2 482
Netherlands	1 876	85 869	87 744
Austria	1 014	52 007	53 021
Poland	1 593	136 214	137 807
Portugal	773	37 515	38 288
Romania	2 238	359 091	361 329
Slovenia	108	5 663	5 771
Slovakia	422	10 246	10 668
Finland	2 508	71 854	74 361
Sweden	1 249	103 659	104 910
United Kingdom	7 973	349 571	357 544

In these figures the quantity of waste exported is included in the figures of the country of origin, although the collection activity is an international activity. For specific waste type the amount of export to other Member States or to non-EU countries can be considerable.

For household and municipal waste, the actual market for waste collection is related to the coverage of the municipal waste collection systems. Table 7 presents the most recent publicly available figures included in the EUROSTAT database on waste statistics.

Table 7: Municipal waste collection coverage

	Municipal waste generated (kton)	Population served (%)	Year
Belgium	4.615	100	2003
Bulgaria	3.916	82	2003
Czech Republic	2.857	100	2003
Denmark	3.634	100	2003
Germany	52.627	100	2003
Estonia	567	79	2003
Ireland	2.724	90 (% collected/generated)	2002
Greece	4.710	100	2003
Spain	26.596 (collected)	:	2002
France	33.024	100	2002
Italy	29.929	100	2002
Cyprus	518	100	2003
Latvia	843	60	2003

Lithuania	909	100	2003
Luxembourg	285	100	2001
Hungary	4.646	88	2002
Malta	218	100	2003
Netherlands	9.697	100	2003
Austria	4.634	100	2003
Poland	9.925	100	2003
Portugal	4.701	100	2003
Romania	8.365	90	2002
Slovenia	956	93	2002
Slovakia	1.524	100	2002
Finland	2.344	100	2003
Sweden	4.211	100	2003
United Kingdom	35.535	100	2002

4.2. PVC

4.2.1. General issues

As explained in ACRR (2004) and Ingham (2005), polyvinyl chloride (PVC) is the most widely used of all vinyl polymers. The purest PVC is produced by bulk polymerisation in an inert atmosphere.

It is a synthetic resin produced from ethylene (derived from crude oil) and chlorine (derived from salt). Due to the fact that chlorine makes up 57% of the input material, PVC is a low cost polymer with less reliance on oil than other plastics. PVC production accounts for 35% of the worlds' chlorine consumption.[119] The first PVC was made in the 1930's, but large scale production did not start until the 1950's and 1960's.

PVC is an especially interesting plastic due to the high level of controversy surrounding the use of this polymer (or, more accurately, the associated plasticizers or stabilizers used in its production). Pure PVC is rigid and resistant to water, electricity and chemicals but it is unstable to heat and light. The addition of stabilizers, which are derived from the salts of various metals, can prevent this.

In the past, metals such as lead or cadmium were often used, resulting in associated problems in disposal. To increase the flexibility of PVC, plasticizers such as phthalates or adipates can be added. In recent years several reports have investigated the possible health implications of the use of PVC in applications which have close contact with humans due to leaching of the stabilizers (including children's

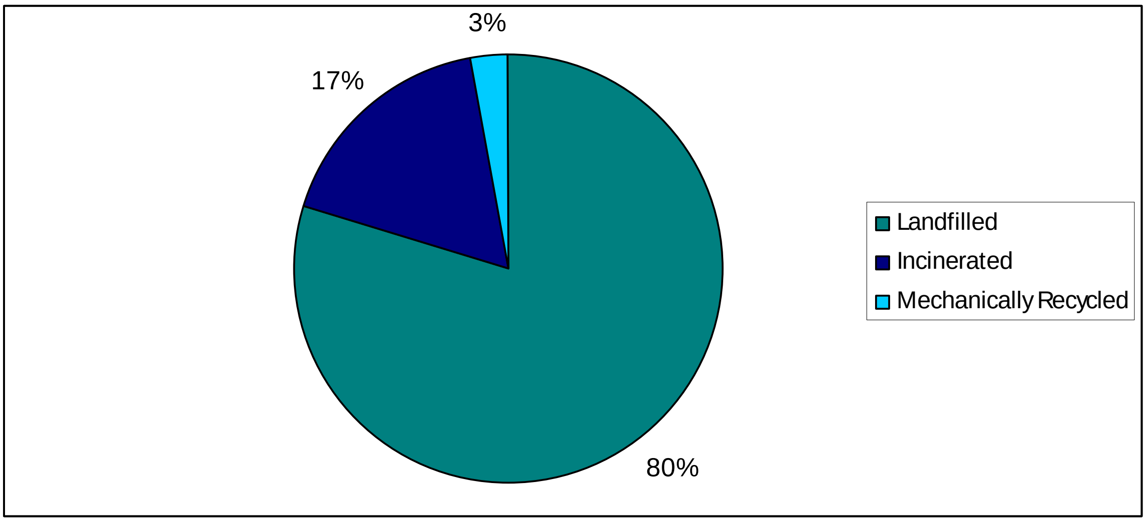
[119] P. D. Coates, A.L Kelly, R.M. Rose, S. Weston & R. Morton (2004) *Materials and Products from UK-Sourced PVC-rich Waste.* Final Report for WRAP, May 2004 www.wrap.org.uk/downloads/MatProdPVCRichWaste.7ab903f6.pdf

toys[120] and clothing, medical tubing, rubber gloves and sex toys[121]). Other European Countries are aiming to reduce the amount of phthalates used or are phasing out the use of flexible PVC for certain applications.

PVC has a tendency to become embrittled at low temperatures and to degrade at high temperatures. Like PET, the properties of PVC are determined by the degree of molecular branching. The main use for rigid PVC is for pipes, fittings and window or door frames. This material is often referred to as unplasticised PVC, or U-PVC. PVC has good insulation properties and, with the addition of plasticisers, it can be rendered flexible. As such, it is used for wire. Other applications include clothing, thermal insulation (PVC foam), automotive parts, flooring, adhesives and coatings.

Figure 2 shows the destination of post-consumer PVC waste in Europe at the time of the 2000 Green Paper:

Figure 2: Destination of Post-Consumer PVC Waste in the European Community



Adapted from Environmental Issues of PVC (Green Paper) 2000. Commission of the European Communities

PVC in incinerators can be problematic due to the release of harmful dioxins, heavy metals and the release of HCl into the raw gas, which requires more intense use of scrubbing and can create problems of corrosion.

A potential issue in terms of the disposal of rigid PVC is the release of additives, such as lead or cadmium. This is added as a stabilizer and is retained within the plastic during use, but emitted during incineration or in landfill. Up to 28% of lead and around 10%of cadmium emissions in landfill can be caused through PVC breakdown.[122] Flexible PVC has its own related issues related to the release of

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[120] C. N. Dorey (2003) *Chemical Legacy: Contamination of the Child*. Report for Greenpeace www.greenpeace.org/raw/content/international/press/reports/chemical-legacy-contaminatio.pdf

[121] TNO (2006) *Determination of phthalates in Sex Toys*. Report for Greenpeace, September 2006 www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/7938.pdf

[122] Commission of the European Communities (2000) *Environmental Issues of PVC* (Green Paper) http://ec.europa.eu/environment/waste/pvc/en.pdf

phthalates. Rigid PVC can be less damaging if it is reused and encapsulated using extruding technology within a 'cleaner' coating; it can then be contained for many years.[123]

In Europe (EU-27), the production of PVC products – including exports – totals about 8 million tonnes per year. European PVC resin consumption totals some 6.5 million tonnes per year, or 15% of all plastics use in Europe, with an average growth of 2-3% per year. The European PVC chain, from resin and additive manufacture to the final product, involves more than 23,000 companies and approximately 530,000 people (2008 Progress Report of Vinyl 2010).

In Europe the PVC industry is represented by the four associations ECVM (the European Council of Vinyl Manufacturers), ESPA (the European Stabilisers Producers Association), ECPI (the European Council for Plasticisers and Intermediates), and EuPC (the European Plastic Converters).

The figures in the table show the total volumes collected by Recovinyl (see Section 3.3.2) in 2005, 2006 and 2007.

Table 8: Recovinyl registered recycled volumes per country

	Year 2005*	Year 2006*	Year 2007*
Belgium	1,500	2,739	1,954
Denmark	-	-	2,896
France	2,000**	7,446	13,276
Germany	-	5,522	35,925
Ireland	-	251	-
Italy	-	828	4,252
Netherlands	4,500	10,972	8,959
Spain	-	2	-
Sweden	-	94	-
UK	8,000	16,836	42,162
Central Europe -		-	1,896
TOTAL	**16,000**	**44,690**	**111,322**

Table 9: Recovinyl Registered Recycled Volumes per Application (2007)

RIGID PVC APPLICATIONS	
Pipes	18,375
Profiles	39,517
Rigid Films	2,134
TOTAL RIGID PVC APPLICATIONS	**60,026**

[123] Pers. Comm. Axion Recycling

FLEXIBLE PVC APPLICATIONS	
Cables	37,469
Mixed	13,827
TOTAL FLEXIBLE PVC APPLICATIONS	**51,296**

The strong increase in recycling in just two years is rather striking. However, as these figures are limited to the PVC streams that are within the remit of Recovinyl, and, as they are not related to PVC waste generated in each year, they can not really be put in perspective.

Unfortunately, there are no specific reporting requirements on the issue of PVC waste generation.

INFU/Prognos (2007, p.64) estimate that 1,939,000 ton of PVC waste is generated per year (out of a total of 26,246,000 ton of waste plastics). Without going into detail, we should note that the authors of this study had to cope with important data gaps and with inconsistencies in data definitions. A specific issue was that several data was only available at the aggregated level. This was dealt with, amongst others, by sorting analyses of mixed municipal waste and mixed C&D waste.

The lack of systematically collected data was the main motivation for Vinyl 2010 to order a study with the following objectives[124]:

- Prepare a quantitative inventory of post-consumer PVC waste collected and recycled in the EU15 and Poland, and to identify the proportions originating from key applications
- Assess the amounts of post-industrial waste recycled
- Identify the main factors of evolution and carry out a quantitative forecast of PVC waste recycling in 2010.

This study was performed by AJI Europe (2006) and covered 2004.

According to AJI Europe (2006), about 113 Ktonnes of post consumer PVC waste generated in the EU15 were recycled either in the EU15 or in Asian countries (mainly China) in 2004.

While these amounts may seem very low compared to the INFU/Prognos estimates of waste generation, EuPR and EuPC point out that it is important to distinguish between collectable and available waste (see Section 3.3.1 for the wording in the Vinyl 2010 Voluntary Commitment). For instance, in relation to C&D waste, in a lot of countries, a building is just torn down without prior separation of waste streams. Whether or not PVC is first collected, depends on for instance the amounts of PVC and its ready availability (which is for instance not the case with PVC pipes in walls). As a second example, pipes in the ground are only dug out in the Netherlands, largely because of the limited availability of space[125].

According to the updated voluntary commitment of Vinyl 2010, "data from studies commissioned by Vinyl 2010 and practical experience show that the volumes of available collectable PVC post consumer waste are lower than previously estimated. The principal reasons are the longer in-service life of several applications than initially forecasted, the continuing ready availability of cheap landfill options for waste

[124] The motivation behind this study was explained by an anonymous stakeholder in a phone interview (29 May 2008).

[125] Information provided in interview by EuPC and EuPR.

disposal in most EU Member States and the direct re-use of some 'end-of-life' applications (e.g. window profiles)."[126]!

Geographical concentration of recycling was strong: Germany, the Netherlands and the UK represent altogether 67% of total post consumer PVC waste recycled in the EU15 by the recyclers interviewed by AJI-Europe.

When looking at statistics on the outlets for recycled products, it is useful to make a distinction between post consumer PVC waste and post industrial PVC waste:

- *Recycled products from post consumer PVC waste.* Recycled pipes, profiles and miscellaneous mixed plastics products (traffic signs, road bands, cones) represent 79% of total outlets for recycled PVC products.
- *Post industrial PVC waste recycling.* PVC converters in the EU15 have generated about 760 Ktonnes of post industrial PVC waste in 2004. In this amount, 51% is due to pipes / fittings, windows and other profiles. 54% of total post industrial PVC waste generated by converters in the EU15 is directly recycled in-situ. 39% is recycled outside the processing plant and 8% is landfilled or energy recovered. Vinyl 2010 claims that further improvements to these already very high levels of conversion efficiency will automatically result from market forces.

As explained by Ingham (2005, p. 79), the high rates of post-industrial (or process) waste can easily be explained. It is contaminant-free, consists of a single, identified polymer type and there is demand for the recycled product. Therefore, it makes financial sense to gather, recycle and rework as much scrap generated during the manufacturing process as possible. For some small operators, it is not economic to recycle in-plant, but even then reprocessors collect these wastes for recycling. Therefore, internal and external recycling from post-industrial waste is very developed. Post-consumer waste however is often mixed with paper, metals and food waste. As plastics waste for recycling needs to be contamination-free and relatively homogeneous, post-consumer waste needs to be sorted and cleaned before processing.

According to the Vinyl 2010 Progress Reports, in 2007, high raw material prices increased the demand for recyclates with a consequent increase in demand of post-consumer PVC waste and in investments for recycling it. Availability of post consumer PVC waste seems to be still affected by exports to Eastern Europe and the Far East. The reuse of postconsumer products is also perceived as a growing trend by waste management organisations in the market.

We will now provide a more in-depth overview of PVC recycling, differentiated according to the applications. Note that all data in AJI-Europe (2006) refer to the situation in 2004.

4.2.2. Packaging

According to APPRICOD (2006, p. 11), if "the total consumption is spread over the various industrial sectors, it can clearly be noted that the packaging sector is the major consumer of plastics with 37 per cent of all plastics consumed."

However, according to Wolf et al (2007, p.38), PVC has very low representation in packaging applications and it continues decreasing (3% of the packaging market in the WE countries in 2002). They claim that the "drop in PVC use in packaging has been strongly associated to the potential effects of chlorine in the end-of-life of the products and mainly to the presence of additives and their possible migration in food-contact applications".

[126] Actually, according to EuPC and EuPR, the life time of PVC is expanding further, certainly in the case of pipes where the life time is now moving to 100 years rather than 50 (information provided during face-to-face interview).

AJI-Europe (2006) confirm that mixed plastic packaging waste (containing PVC) is not developed. They have identified only one company (EKOL, Belgium) with a rather small tonnage[127]. Due to the substitution by PET, PVC bottles recycling has almost disappeared in the EU15. One PVC bottle filler subsisted in the west of France at the time of the study. In Germany, the PVC packaging contained in household waste is, with few exceptions, treated either by energy recovery (see Section 5.2.5) or by feedstock recycling (see Section 5.2.6).

4.2.3. Municipal solid waste

According to ACRR (2004), PVC represented 6.9% of plastic contents in municipal plastic waste in 2000. However, they point out that the definition of municipal waste varies considerably between individual European countries and may distort real data comparisons.

4.2.4. WEEE

According to Wolf et al (2007, p. 74) typical applications of PVC in electronic and electric waste are: cable coating, cable ducts, plugs, refrigerator door seals, casings. PVC corresponded to 4% of plastic consumption in E&E equipment in 2000.

AJI Europe (2006) provide more detailed information on this issue, which we summarize in the rest of this section. The reader should keep in mind that this study refers to the situation in 2004, and thus before the WEEE Directive was required to have been transposed into national law.

PVC in WEEE is present in significant proportion in the cords (electric connections between equipment and plugs), where it represents about 70% of total polymer weight, the other 30% being mainly polyethylene and rubber. About 95 Ktonnes of PVC is contained in the used cords.

Large quantities of WEEE are exported to Asian countries.

There is currently no post consumer PVC mechanical recycling[128] from WEEE, except the cords which are removed from the WEEE before their treatment. The reason is that the proportion of PVC parts inside the used EEE is very low and these parts are generally too small to be economically dismantled and recycled.

However, there is some PVC in the light fraction of the WEEE shredder residue. It comes mainly from the WEEE having kept their cords and from the small PVC parts contained in the WEEE. Several recycling companies try to optimise their process in order to obtain a rich-PVC fraction from this light fraction (Norplast and Galloo Plastics in France, Sims Group in the UK….). However, for the time being, as far as PVC is concerned, they can just get a mix of polymers with a PVC content of about 50%. This percentage is not sufficient to manufacture recycled PVC products or to use it as input for the Vinyloop ® process (see Section 5.2.3.1).

In consequence, almost all post user PVC waste from WEEE is currently sent to energy recovery or to landfill.

In addition to the above, small quantities of shredded WEEE were used by the SVZ feedstock recycling plant (Germany) until it ceased operations in 2007 (see Section 5.2.4).

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[127] As explained by ACRR (2004), NV Ekol uses recycled PVC with other plastics to make a range of products including noise reduction barriers, fencing and stakes, mobile traffic islands, flower tubs and garden furniture.

[128] For a definition of mechanical recycling, see Section 5.2.3.

Cords recycling in Western Europe

According to the EU Directive 2002/96/CE dated 27th January 2003, cords must be separated from WEEE prior to any treatment of the WEEE. This should result in a significant increase of volume for used cords separately collected and available for recycling. However, cords are a homogeneous waste, from which copper is easy to recycle. Therefore, cords were already more and more frequently separated from white, brown and grey products prior to the shredding of the WEEE before this Directive was in force.

The used cords have the following destinations:

- About 1% belongs to refurbished WEEE.
- When a used EEE is delivered at a shredding unit (mainly white products) the cord is sometimes removed.
- Some used EEE are exported outside the EU15 (mainly to Asia) together with their cord.
- Some used EEE are sent to landfill or to energy recovery together with their cord.

Used cords are collected and managed separately from building and construction (B&C) used electric cables because they need a finer shredding calibration.

For Europe as a whole, AJI Europe estimated that 8 to 13% of the WEEE (in number) is going to shredding units, 10 to 20% is exported to China and the remaining 70 to 80% is sent to landfill or treated in incineration plants.

The mechanical recycling at Vinyloop ® (see Section 5.2.3.1) represents 89% of the 3.15 Ktonnes of PVC recycled from used cables in Italy.

Cords recycling in Asian countries

The cords collected are sent to China, either after dismantling or together with the WEEE. Traders request that cords and B&C used electric cables are sent separately.

4.2.5. Vehicles

According to AJI Europe (2006), the PVC weight is approximately 5 kg per vehicle. It is mainly used for the under-body gravel protection layer. There is no suitable recycling technology for it. The second use of PVC in volume is for dashboards (threelayer parts). The attempts to recycle end-of-life dashboards after dismantling (Wipag, Chaise) have not been successful (see however Section 5.2.7).

Many small companies recycle dismantled plastic parts in low quality mixed-plastics products (particularly in Italy and Germany) but they represent very small tonnages.

There is some PVC in the light fraction of the ELV shredder residue. Several recyclers try to optimise their process in order to obtain a rich-PVC fraction from this light fraction (Norplast and Galloo Plastics in France, Sims Group in the UK, possibly CTR in Belgium….). As described above in the case of WEEE, they can just get a mix of polymers with a PVC content of 50% maximum. This percentage is not sufficient to manufacture recycled PVC products or to use it as input for the Vinyloop ® process (see Section 5.2.3.1).

In consequence, almost all post user PVC waste from ELVs is currently sent to energy recovery or to landfill (for example, the large collector Remondis (Germany) sends all its post user PVC waste from ELVs in the Hamburg energy recovery plant).

Small quantities of shredder residue were consumed by the feedstock recycling plant at SVZ, until it ceased operations in 2007 (see Section 5.2.4).

According to Wolf et al (2007, p. 88), the tendency goes to a decrease in the use of PVC in vehicles, the main reason being that "in order to achieve the targets of the ELV Directive, it is necessary to increase the plastic recycling rates. As a result, today there is a growing use of thermoplastic polyolefins as replacements of PVC and other thermoplastics elastomers" (p.90).

4.2.6. C&D waste

According to APPRICOD (2006, p 11), waste arising from construction and demolition (C&DW) alone amounts to around 180 million tonnes each year. This is over 480 kg per person per year, which makes C&D waste one of the most important waste streams (the commonly accepted European average is 30%). However, only about 28% across the EU-15 is re-used or recycled – the rest is landfilled.

A high proportion of conventional demolition waste, and particularly the fraction derived from concrete, bricks and tiles (the stony and sandy fraction, known as "debris" which can represent up to 90-95% of C&DW), is well suited to being crushed and recycled as a substitute for newly quarried (primary) aggregates in certain *lower grade* applications, most notably engineering fill and road sub-base. This practice has been common (though not necessarily widespread) in several Member States for many years. The use of such C&DW-derived aggregates in new concrete is much less common, and technically much more demanding.

According to APPRICOD (2006, p 11), B&C accounts for 20% or 8.7 million tonnes of plastics in 2004. The construction industry is the third largest user after household and domestic uses and the packaging sector. Moreover, over the past 25 years there has been a trend towards increased use of plastics in the building industry.

The dominant substance is PVC, which makes up 47 per cent by weight of total plastics used (2002 data)[129].

The most important applications of PVC in construction are (APPRICOD 2006, p 12-13):

- PVC pipes and ducts can be used above or below ground for the transport of many substances including drinking water, waste water and gas – they account for about 25 per cent of PVC resin demand in Europe.
- Some 40% of all European window profiles are made from PVC using about 600.000 tonnes, which is more than 10% of Western Europe PVC production.
- Other PVC applications consist of wiring and cable insulation (where PVC has 60% of the market share), cladding and roofing membranes and (vinyl) flooring. Plastic foams are used widely for thermal insulation of house walls, floors, roofing, pipes and many other applications.
- The third-largest application area for plastics is in window frames, which are made almost exclusively out of PVC. This is an application that has developed relatively recently (since only 1965) but, over 35 years, it has secured more than a 50% share of window systems in the major industrialised countries of Europe. The lifecycle calculation for window frames indicates an average life of 40 years.
- The fourth major application area is for wall covering and flooring. Plastic floorings, in particular those made of PVC, have been in use for 55 years. They have also made a very valuable contribution in public areas, such as hospitals, sickrooms, operating theatres, schools, municipal buildings, offices and sports centres.

[129] Since an increase in rigid construction projects is expected Wolf et al (2007, p. 110) forecast that this dominance will continue.

- Profiles for interior fittings (which have been in existence since 1955) have also secured an important role, accounting for 8% of the total plastics consumption in the construction industry. They are used in doors, flooring trim, skirting boards, pipes, and guide rails, covering and decoration.

The average working life of all plastics applications in construction is 35 years but, depending on the specific application, this has a wide variation between 5 years (such as wallpaper) and 100 years (such as pipes). This often means that for such products, the technical lifespan is longer than the effective lifespan and will be equal to the lifespan of the building.

Some plastic components such as pipes are buried below ground. In the normal course of events, they are unlikely to be removed for disposal, as the cost of this would far outweigh any perceived benefit.

According to a study by Waste Watch on plastics in the UK[130], the quantity of potentially recoverable plastics in building and construction sector is estimated at some 70% - this figure implies that within a reasonable time some 4,700,000 tonnes (70% of 6,700,000 tonnes used each year in buildings) of plastic waste is potentially recoverable.

According to Wolf et al (2007, p. 105), in C&D, waste generation is very different from one country to another. Despite huge demand for plastic, the ratio of plastic consumption versus waste generated is very low (8% in 2003). This is due to the long life spans mentioned above.

However, Wolf et al (2007, p.6) also point out that PVC has the biggest collection and recycling ratios in C&D stream (around 10%), resulting from campaigns targeted to specific building applications (flooring, window frames, pipes, roofing…). We will discuss these campaigns more in detail below.

4.2.6.1. Windows

According to the Vinyl 2010 Progress Reports, the commitment to recycle at least 50% of the collectable available quantity of window profile waste by 2005 was achieved.

PlasticsEurope (2008) point out that the quantities of recycled window, and window related, profiles being recycled increases each year: the total of 20 Ktonnes in 2005 grew to some 37ktonnes in 2006, an increase of 84%. As plastic windows can last for decades without problems, bigger quantities of waste are only expected in the future

On the other hand, AJI Europe (2006) points out that in many countries the low quantities available of used PVC windows and shutters prevent the development of recycling. One reason is that the PVC windows market has developed only recently on a large scale (end of the 80’s in countries as Spain or Poland), so only small quantities are arriving now at their end-of- life.

According to AJI Europe (2006), significant quantities of PVC from used windows and shutters are recycled outside the Vinyl 2010 schemes (see Section 3.3.1). Some used PVC windows were exported to Eastern Europe in the past, for re-use. However, these exports have stopped with the development of PVC windows production in Poland.

According to the Vinyl 2010 Progress Report 2008, EPPA (see Section 3.3.2) is increasingly integrating its activities with Recovinyl, to improve common schemes for collection and recycling. Window collection and recycling schemes are well established in Austria and Germany, and systems are in place in Belgium, Denmark, France, Ireland, Italy, the Netherlands, Spain and the UK with Recovinyl.

[130] Quoted by APPRICOD.

In Germany, landfill restrictions have a positive impact on the amount of available waste. Rewindo (Germany's largest clearing house for post-consumer PVC windows – www.rewindo.de), collected 14,324 tonnes in 2007. The output material from recycled windows was used completely in new applications (approx. 50% in window profiles, 10% in window-related applications and 40% in other building applications). On top of this, in Germany, an additional 1,474 tonnes of rigid PVC recyclate should be considered, originating from other rigid post-consumer window recycling activities and therefore not included in the Rewindo figures. In addition, the PVC in PVC windows being re-used represents approximately 4,000 tonnes per year.

4.2.6.2. Pipes[131]

TEPPFA (see Section 3.3.2) achieved its targets to recycle 25% of collectable available quantity of pipes and fittings waste by 2003 and 50% by 2005.

According to Recovinyl, 2007 saw good cooperation between TEPPFA and Recovinyl and EPPA. Almost all the national initiatives are now integrated into the Recovinyl system. However, Vinyl 2010 claims that in certain countries, like for example Spain, the achieved integration could not be exploited to its full potential yet and the level of activities remains low.

Vinyl 2010 concludes that TEPPFA's experience with promoting recycling schemes shows that availability of pipe waste is less than for window profiles, as pipes not only have longer life-cycles but are often left in the ground once decommissioned. Pipe waste collection volumes could nevertheless increase if pre-sorting of mixed building waste were carried out.

4.2.6.3. Electric cables

Unless stated otherwise, the information in this section has been obtained from AJI Europe (2006).

The PVC content in the used electric and communication cables collected from the C&D sector in the EU15 in 2004 represents about 150 Ktonnes.

Large telecom operators and electricity suppliers have contracts with waste collectors for the collection of their used electric and communication cables. Some of them have set-up collection schemes at country level (for example France Télécom in the case of PE-HD waste) but most of them have multiple contracts with local collectors.

As a consequence of the high prices paid by Asian countries (particularly China) and the low costs of the intercontinental shipping of the waste, the recycling of copper and aluminium from used electric cables has slowed down in Western Europe during the last five years. Only 20-30% of the used electric cables collected is recycled in Western Europe, the remaining fraction being exported to China after sorting, frequently without any preparation. In addition to the PVC contained in cables exported to Asia, part of the mixed plastics fraction resulting from cable shredding in Europe is also exported to Asia at high prices.

30 to 37 Ktonnes of PVC contained in used electric and communication cables were mechanically recycled in Western Europe in 2004. For Asia, the uncertainty on the tonnage of plastics recycled is very large and leads to an estimated tonnage in the range 7 to 44 Ktonnes[132].

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[131] All information in this Section has been obtained from the Vinyl 2010 Progress Reports.

[132] Again, we refer to AJI Europe (2006) for more details.

4.2.6.3.1. Cables collection and recycling in the EU15

The plastic fraction obtained after shredding of used cables is either recycled in mixed polymers granules (PE-HD + PVC + rubber) by specialised companies or energy recovered, or sent to landfill or exported to Asia. However, with current high prices of copper, the incentive to get money from the plastic fraction is relatively low. This induces a decrease in the plastic recycling activity.

This can be illustrated with the evolution of the situation in Italy. Large quantities of PVC from used electric cables were recycled at the end of the 90's by Italian recyclers. The largest one was Tecnometal, with 15 000 tonnes/year capacity (PVC).

However, these recyclers faced increasing constraints:

- higher and higher proportion of fillers in the PVC
- partial substitution of PVC by other materials, in particular reticulated polyethylene
- increasing proportion of fillers as calcium carbonate (up to 80% in some types of cables)
- start-up of the Vinyloop ® plant in Ferrara (see Section 5.2.3.1)
- competition from Asian recyclers which purchase used electric cables at high prices.

Finally most recyclers have stopped their PVC recycling activity from used cables.

4.2.6.3.2. Cables recycling in China

According to the Basel Convention and Regulation 1013/2006 on the shipments of waste, most used cables are on the B-list for non hazardous waste. Code B1115 describes: "Waste metal cables coated or insulated with plastics, not included in list A1190, excluding those destined for Annex IVA[133] operations or any other disposal operations involving, at any stage, uncontrolled thermal processes, such as open-burning". Code A1190 describes "Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB (3), lead, cadmium, other organohalogen compounds or other Annex I constituents, to the extent that they exhibit Annex III characteristics". Most ordinary cables are included in code B1115, while ground-cables usually are included in code A1190.

Used cable classified as B1115 can be exported freely, when accompanied by an identification form in accordance with article 18 of Regulation 1013/2006/EC, between OECD-member states. For export to non-OECD countries Regulation 1418/2007[134] has to be followed. China and Hong Kong request for the import of B1115 a specific Chinese control system in line with the European notification and a quality control before shipment. Taiwan, The Philippines and Thailand request a notification. Indonesia applies a specific procedure. Malaysia accepts the waste without procedure above, applying article 18 of the Regulation 1013/2006. For all other non-OECD countries in the Far East a notification is requested under article 37 point 2 sentence 2. If the competent authority of dispatch has reason to believe that the waste will not be managed in an environmentally sound manner in the country of destination concerned, export of the waste is forbidden[135].

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[133] Annex IV A of Directive 1013/2007 has remained empty until today.

[134] COMMISSION REGULATION (EC) No 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply

[135] Article 36 point 1 g of the Regulation 1013/2006/EC

Export of used cable classified as A1190 tot non-OECD countries like China is forbidden, under application of article 36 of Regulation 1013/2006.

Cable scraps require a notification[136] and financial guarantees in order to be exported from the EU, since it remains unlisted in the current Regulation. The competent national authorities frequently refuse to provide authorisations for cable scrap export.

Due to their low labour costs, Chinese cable recyclers are in a position to perform a manual separation of plastics from used cables. Officially, most plastics contained in the used cables exported to China are recycled. However, there is a great uncertainty about what really happens in this country. When the plastic coating is incinerated in an open fire or another uncontrolled thermal process is used, the application of the procedure of green listed waste is inappropriate and the shipment should be considered as illegal shipment.

AJI Europe (2006) has concluded that some plastic recyclers are operating according to the State-of-the-Art but cables imported by China are sometimes burnt prior to metal recovery. When mechanical recycling occurs, the stripping is frequently managed by very small companies or even by individual people[137].

Often, international traders are involved in this business. Once imported, the waste is handed over to locally active traders or to waste recyclers unknown to the country of dispatch, that offer the most profitable conditions. This way of trading is in violation with the provisions of the Regulation that requests clear contracts between producer and recycling plant, or that requests clear identification data on the notification forms[138].

Finally, during a face-to-face interview, EuPC and EuPR have emphasized that while it is difficult to keep cords and cables in Europe, this is not an issue at all for the other waste streams. Moreover, the Chinese are becoming more demanding.

4.2.6.4. Flooring

According to AJI Europe (2006), because of their geographical dispersion, only a small proportion of installation PVC waste is recycled, either by flooring manufacturers or by specialised recyclers.

The Vinyl 2010 Progress Reports confirms that this waste stream holds particular technical challenges in recycling the end-of-life product, which is often highly contaminated. The absence of appropriate recycling capacity will prevent EPFLOOR (see Section 3.3.2) from meeting the original interim commitment to recycle at least 25% of the collectable available quantity of PVC flooring waste by 2006. Vinyl 2010 has therefore decided to abandon the specific targets for flooring waste. However, the commitment remains to seek ways to increase recycling of this application in line with realistic conditions.

As explained in the Vinyl 2010 Progress Report 2007, in 2005, the Danish recycling plant of RGS 90 at Stigsnaes decided that it would not accept PVC waste. This resulted in a challenge for the PVC flooring sector to find an outlet for the lower quality post-consumer waste coming from flooring applications.

[136] Article 37 point 5 of Regulation 1013/2006/EC is applicable and requests a notification procedure if the cable scrap consists of a mixture of non hazardous wastes. Article 36 point 1 d is applicable and an export ban to non-OECD countries exists if it can be considered as a mixture of hazardous and non hazardous wastes.

[137] For a detailed analysis, we refer to AJI Europe (2006).

[138] Personal communication with OVAM (Flemish public waste agency).

However, EPFLOOR still managed to exceed its target by recycling 1,776 tonnes, a 2.78% increase on 2005 levels. These volumes have been used to make a range of products including flooring, street furniture, construction products and hoses.

To compensate for the situation at Stigsnaes, other recycling activities were increased, for example through the AgPR plant.

AgPR (Germany) is the only integrated collection system for post consumer floor-covering waste in Europe. The AgPR (Association for PVC floor covering recycling) was established at the end of 1993, by producers of PVC and PVC floor coverings[139]. The members finance the cost of the system, which can be described as follows:

- A network of collection centres takes back floor coverings meeting a list of acceptance criteria. The PVC floor coverings have to be separated from other floor coverings like linoleum, textile coverings, rubber flooring, bitumen covering, etc., but can be contaminated by cement or glue residues, which is frequent on building sites. The coatings are sorted beforehand on the building site.

- If the acceptance criteria are respected, collection is free of charge. However, the cost of disposing of delivered material that cannot be utilised in the recycling process is charged to the supplier of that material. If the amount of unusable material in one single delivery exceeds 5%, the AgPR refuses acceptance of the delivery or to charge the supplier for the sorting and return or disposal of non-recyclable material.

The recycling plant has a mechanical recycling capacity of approximately 6000 tonnes, but in real terms AgPR recycled 4000 or 5000 tonnes per year.

AgPR produces a finely ground black/grey powder (particle size smaller than 400) which is well suited for use in the production of new floor coverings.

Although the recycling plant is situated in Germany, collection also takes place in neighbouring countries.

According to the Vinyl 2010 Progress Report 2008, AgPR saw its collection figures in 2007 decrease in the first half year due to a fall in waste incineration prices in Germany. The situation improved in the last quarter though, after AgPR changed its gate fee conditions and multiplied its contacts and promotions towards waste collectors. Overall the collection in 2007 increased by 8%.

According to the Vinyl 2010 Progress Report 2008, despite the difficulties experienced in waste collection, EPFLOOR increased both collection (by 24%) and recycling (by 15.6%) volumes in 2007, with a final result of 2,054 tonnes recycled, close to the fixed target of 2,200 tonnes.

In the UK, tests were planned into the processing of safety flooring which has abrasive particles causing wear and tear to the machinery. Due to the takeover of the recycling partner by a new owner, the foreseen tests were not carried out. EPFLOOR believes that safety flooring recycling will remain at a low level until new and more effective recycling processes are found and will therefore continue to actively cooperate with Vinyl 2010 in the development of new recycling solutions.

[139] See http://www.agpr.de/ for more information.

4.2.6.5. Roofing membranes

Vinyloop® (see Section 5.2.3.1) was selected by ESWA in 2004 as the prime long term solution to deliver tailor made recyclates. In 2005 an agreement was made to recycle 100 tonnes of PVC roofing waste in 2005 and 250 tonnes in 2006. An initial difficulty was encountered with certain types of fibres but rapidly solved by diluting these with cable waste.

In 2006, Roofcollect ® recycled 10,504 tonnes, vastly exceeding its target of 2,000 tonnes. This is also meant a dramatic increase on 2005 levels (when 812 tonnes were recycled, significantly less than the target of 1,200 tonnes), when difficulties mainly due to the RGS 90 Stigsnaes plant were experienced (see Section 3.3.3).

According to the Vinyl 2010 Progress Report 2008, in 2007 ESWA (see Section 3.3.2) recycled 6,627 tonnes through its project Roofcollect®, well exceeding its target of 2,520 tonnes.

As Recovinyl extended its activities to flexible PVC in 2007, synergies with Roofcollect® were developed. In this framework, Roofcollect® transferred its Registration System to Recovinyl and for this reason the volumes accounted in the sectoral project in 2007 are apparently lower than those achieved in 2006.

Following the closure of AfDR18, the failure of the RGS 90 Stigsnaes plant to provide an outlet as expected, and the lack of available capacity from MVR Hamburg experienced, contractual relationships have been set up with Hoser (to recycle PVC roofing into drainage sheets for riding arenas and stables) and KVS for the shredding of rigid and soft plastics which are then sold to a number of customers to be reused in a range of PVC products. CIFRA is the other plant involved in recycling within the Roofcollect system.

Also, new recyclers were utilised in the Czech Republic (Ekotrend), France (Chaize) and Hungary (Mikrolin).

4.2.7. Extrusion coating

All the information in this section has been obtained from AJI Europe (2006).

22,5 t were collected in 2004 in Germany in the framework of the collection system IVK Sammel-und Verwertungssystem. The Wilhelm-Klauditz-Institüt (WKI, Braunschweig) has carried out tests a few years ago, in cooperation with a German manufacturer of PVC-coated wood furniture, in order to separate the wood from PVC, other plastics and rubber. Wood can be reused for wood based panels but PVC is going to energy recovery.

The French company Ferrari Group -Texyloop process- has collected and stored significant quantity of tarpaulins in 2003/2004. This waste has not been recycled yet. It is supposed to be treated by the Vinyloop ® plant (see Section 5.2.3.1).

4.2.8. Coated Fabrics

In respect of collection schemes a contract was signed in early 2004 between IVK (Industrieverband Kunststoffbahnen), the German Plastics Foils Association, and the German Waste Management company RWE Umwelt. Subsequent to the contract RWE was taken over and the new owner expressed no interest in continuing the contract in 2005/2006. Currently, Interseroh undertakes most of the collection and transport, with a smaller contribution by IVR and KMW. Transport costs remain an obstacle, even though the system of 'big bags' facilitates collection up to a maximum 1.1 tonnes of waste each.

On recycling, in 2004, German company Friedola received some of the collected waste from the IVK collection scheme. During 2005 Friedola invested, with financial support from Vinyl 2010, in technical improvements in the mixing silos, conveying and cooling material, exchange motors and control system. The firm has little use itself for the recyclates of coated fabrics and tests are ongoing to develop new markets for several end products (e.g. basic tarpaulins and reinforcement fabrics).

The company Hoser, in Kodersdorf, also successfully started recycling coated fabrics for its line of drainage sheets (see also section on flooring above)

EPCOAT has continued its relationship with the company Hoser, in Kodersdorf, which in 2005 started recycling coated fabrics for its line of drainage sheets and treated the bulk of the volume in 2005.

According to the Vinyl 2010 Progress Report 2008, in 2007 the coated fabrics sector had to face several challenges such as the quality of available waste with a lower percentage of PVC used in coated fabrics and increases in gate fees of some recycling plants. For these reasons the estimated volumes of recycling achieved (2,609 tonnes) were below the target of 3,500 tonnes.

A study completed in 2005 showed that synthetic or artificial leather is a significant market for PVC coated fabrics and so is a potentially major source of recyclable post-consumer waste. It is estimated that 65,000 tonnes per year of PVC artificial leather is consumed annually (excluding automotive applications). The French-based calendering and coated fabric trade association, SFEC, intends to explore the potential of different artificial leather markets as sources of collectable, clean PVC waste, but it is too early to report on its progress.

In 2006, an additional 245 tonnes were recycled by Arrow Plast, in Landau/Pfalz, Germany which makes granulates for plasticisers. Recycling at Friedola, an EPCOAT member, is still being explored. Tests are ongoing to determine if there is a market for the coated fabrics recyclates from their compacting system. In September 2006, a test was successfully carried out with 11 tonnes of truck tarpaulins.

4.2.9. Agriculture

According to Wolf et al (2007), PVC waste in agriculture was estimated to 157.371 tonnes (mainly in pipes and fittings) out of a total of 404.000 tonnes. Since the function of pipes and fittings is structural, their lifespan differs from other applications. PVC is also used in silage, but no data are provided on this specific issue. There is limited and sparse data in other applications of plastic in agriculture.

According to Wolf et al (2007), despite the availability of big volumes of waste plastic flows of steady composition in the agriculture sector (LDPE films and PVC pipes), the high degree of contamination and degradation, especially of LDPE films, restricts their recycling options at the moment.

4.2.10. Other non-regulated PVC waste

Other PVC waste include credit cards, hoses, as well as miscellaneous rigid and flexible (non-packaging) film as roofing, and including the tonnages for which the application was not specified by the recyclers interviewed.

According to AJI Europe (2006), one company (CIFRA, France) recycles used plastic parts from cooling towers located in nuclear power plants.

4.3. BATTERIES

4.3.1. Battery Types

There are many different types of battery on the market in Europe and these can be split into three distinct groups – portable, automotive and industrial. These are described in further detail in the sections that follow.

These three battery classifications do, however, create some problems in terms of identifying the waste generator. Whilst industrial batteries are exclusive to industry, portable batteries are used across consumer, commercial and industrial sectors (though the vast majority are used in consumer applications). Automotive batteries also straddle all three sectors.

For the purpose of this report the three distinct groups of batteries will be referred to, as the principal issues affecting the generation and management of waste batteries is the type of battery rather than end user. These are also the groupings laid out in the Batteries and Accumulators and Waste Batteries and Accumulators Directive (2006/66/EC) (hereafter "the Directive"), and so it does makes little sense to confuse this.

As noted in the Directive, "batteries" is used to mean single-life batteries, and "accumulators" to mean rechargeable batteries. In this report "batteries" is taken to mean both batteries and accumulators, unless otherwise specified.

4.3.2. Portable Batteries

Portable batteries are defined in the Directive as any battery, button cell, battery pack or accumulator that:

a) is sealed;

b) can be hand carried; and

c) is neither an industrial nor automotive battery.

These can be primary (single-life, non-rechargeable) or secondary (accumulators / rechargeable). Table 10 shows the various portable battery types, their class and typical uses.

Table 10: Portable Battery Types, Class and Typical Application

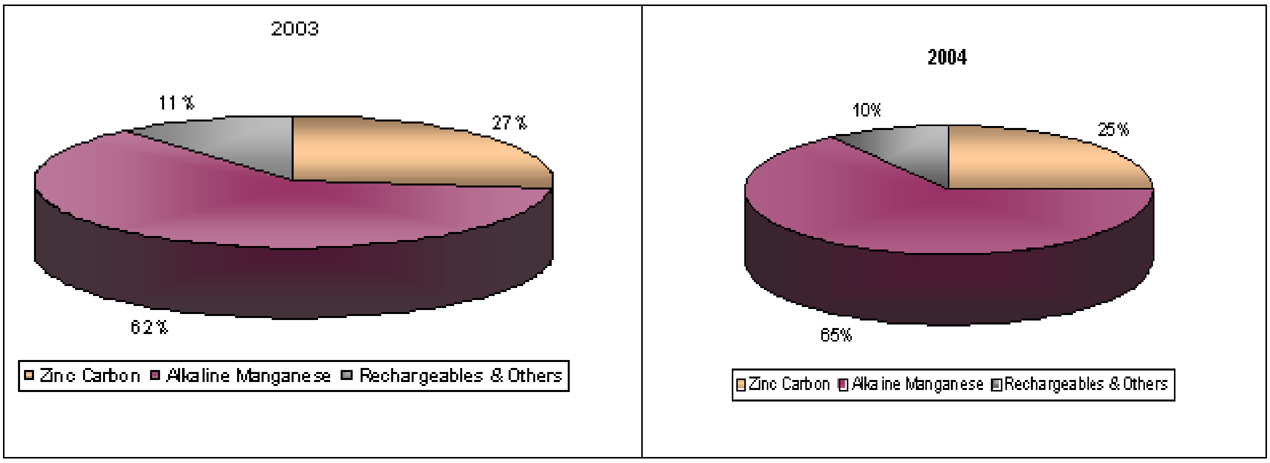
Battery Type	Class	Typical Application
Silver Oxide (AgO)	**Primary**	**Cameras, pocket calculators**
Zinc Air (ZnO)	Primary	**Hearing aids, pocket paging devices**
Lithium Manganese (LiMn)	Primary	**Pocket calculators**
Lithium (Li)	Primary	**Photographic equipment, remote controls**
Zinc Carbon (ZnC)	Primary	**Torches, toys, clocks**
Alkaline Manganese (AlMn)	Primary	**Radios, torches, cameras, toys**

Lithium Ion (Li-ion)	**Secondary**	**Mobile phones, laptops, palmtops**
Nickel Cadmium (NiCd)	Secondary	**Cordless phones, power tools, emergency lighting**
Nickel Metal Hydride (NiMH)	Secondary	**Mobile and cordless phones**
Lead Acid (PbA)	Secondary	**Hobby applications**

Source: ERM (2006). Battery Waste Management Life Cycle Assessment, Final Report for Defra, October 2006.

According to the European Portable Batteries Association (EPBA) sales for W&E Europe for portable batteries are split up as follows[140]:

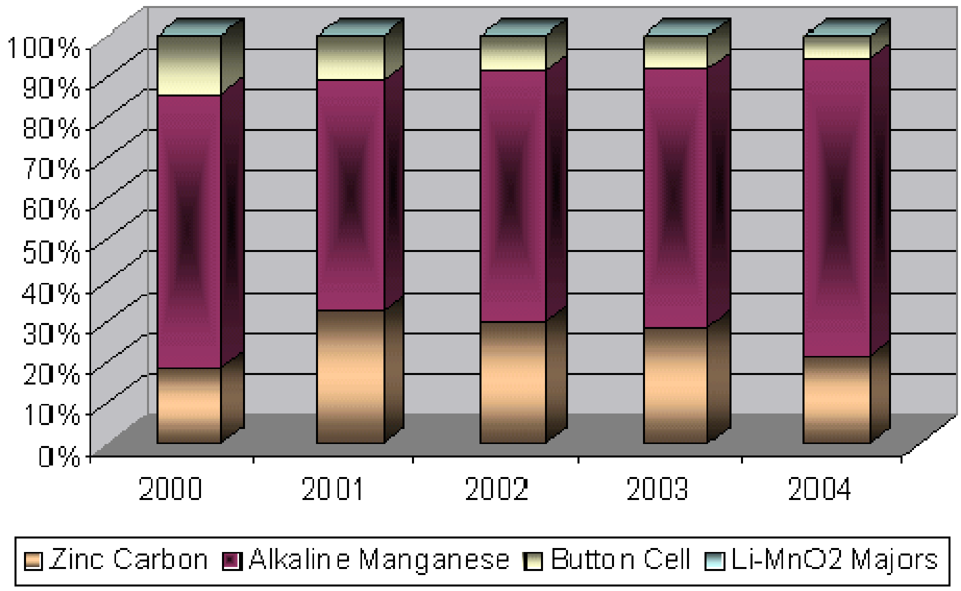
Figure 3: Shares in portable batteries sales



The portable market for primary batteries has evolved as follows in the period 2000-2004:

Figure 4: shares in primary batteries sales: time trends

140 http://www.epbaeurope.net/ . The 2004 data are the most recent data that are, at this stage, sufficiently reliable for publication. Phone interview of Mr Craen (EPBA) on 26 June 2008.



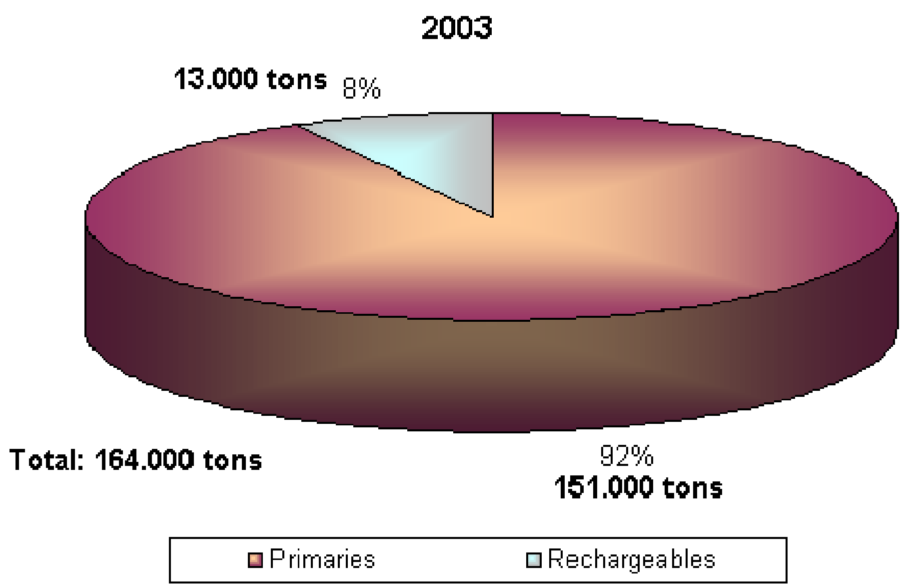
The weight on the market is distributed as follows amongst the different types of portable batteries:

Table 11: Portable batteries: shares in weight

Battery System	Weight 2003 (in tonnes)	%
Zinc Carbon	50,196.6	30.5
Alkaline	99,137.9	60.3
Button Cells	610.8	0.4
Li all others	981.7	0.6
NiCd	7,882.1	4.8
NiMH	4,133.4	2.5
Li-Ion	1,399.1	0.9

Finally, the market is split up as follows between primary and rechargeable batteries:

Figure 5: Primary versus rechargeable batteries



Primary batteries have a lifetime of approximately two and a half years and secondary batteries between three and ten years[141].

4.3.3. Automotive and Industrial Batteries

An automotive battery is one which is used for the starting or ignition of the engine of a vehicle, or for providing power for any lighting used by the vehicle.

This group is much more homogenous than the portable battery grouping as can be seen in Table 12.

Table 12: Automotive Battery Types, Class and Typical Application

Battery Type	Class	Typical Application
Lead Acid (PbA)	Secondary	Automotive / Motorcycle Starter, Lighting and Ignition (SLI)

Source: DTI (2002) Batteries Factsheet, August 2002.

An industrial battery or battery pack is one which is:

(a) designed exclusively for industrial or professional uses;

(b) used as a source of power for propulsion in an electric vehicle;

(c) unsealed, but is not an automotive battery; or

(d) sealed, but is not a portable battery.

[141] Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries

The types of industrial batteries are shown in Table 13.

Table 13: Industrial Battery Types, Class and Typical Application

Battery Type	Class	Typical Application
Lead Acid Standby	Secondary	Alarm systems, emergency back-up systems
Lead Acid Traction	Secondary	Motive power sources (forklift trucks, milk floats)
Nickel Cadmium	Secondary	Motive and standby (satellite and rail applications)

Source: DTI (2002) Batteries Factsheet, August 2002.

Eurobat classifies automotive and industrial batteries as follows[142].

4.3.3.1. *Automotive Batteries*

Starter batteries are supplied by the battery producers to the major motor vehicle manufacturers as original equipment and to the replacement market.

All automotive batteries are based on lead-acid batteries. Car and van batteries have a lifespan of approximately five years; motorcycle batteries have a life span of about two and a half year[143].

4.3.3.2. *Motive power (traction) Batteries*

Traction batteries are used principally for materials handling equipment including fork lift trucks, narrow aisle trucks, pallet trucks and for service vehicles such as floor cleaning equipment. They are supplied to original equipment manufacturers and to the replacement market.

4.3.3.3. *Stationary (standby) Batteries*

Stationary or standby batteries are used for ensuring secure power supplies for telecommunications, computer and data processing equipment, emergency lighting, utilities and many applications where power must be provided continuously when the utility is disconnected. Both lead/acid and nickel/cadmium batteries are used for these duty cycles.

4.3.3.4. *Electric Vehicle Applications*

Both lead/acid and nickel/cadmium batteries are used for electric vehicle applications, particularly for delivery vehicles and public transportation. Newer applications are growing and there is a trend towards hybrid electric vehicles.

4.3.3.5. *Advanced Systems*

Batteries are widely used for aerospace and military applications, on the one hand for submarine main batteries to small batteries for hand held devices.

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[142] http://www.eurobat.org/facts_and_figures_applications.html

[143] Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries

4.3.3.6. Nickel Cadmium Batteries

Nickel/cadmium batteries are used for standby as well as other applications. They are available with pocket-plate or sintered electrodes in steel or plastic containers.

Nickel Cadmium batteries are used in a variety of industries:

- Railways and public transportation
- Telecom networks
- Aircraft batteries

4.3.3.7. Lifespan of industrial batteries

The following table gives the average lifespan of industrial batteries[144]:

Table 14: average lifespan of industrial batteries

Traction batteries	Up to 30 years
Lead-acid lightweight standby batteries	Between 3 and 5 years
Lead-acid batteries in heavyweight applications	10 years
NiCd	7 years

4.3.4. Waste statistics

Article 10 of the Batteries Directive imposes that: "Member States shall calculate the collection rate for the first time in respect of the fifth full calendar year following the entry into force of this Directive." As the Directive entered in force on 26 September 2006 the first official reporting on the collection rates is to be expected from 26 September 2011 onwards.

The joint OECD/EUROSTAT questionnaire does not include an entry for reporting on waste batteries. The Waste Statistics Regulation however uses the EWCSTAT entry 08.41 for batteries and accumulators wastes, grouping seven EWC codes (160604, 160605, 200134, 160601*, 160602*, 160603*, 200133*). Annex I foresees a reporting on waste generation of hazardous and non hazardous batteries for the whole economy, including waste treatment industry and including household waste. It should be reported every second year after the first reference year 2004. The data for reference year 2004 are publicly available. No data on treatment are available at the requested level of detail.

Table 15: Generation of waste batteries and accumulators in 2004, reported through the Waste Statistics Regulation

	Hazardous (kton)	non hazardous (kton)	Total (kton)
Belgium	32,45	9,15	41,60
Bulgaria	2,36	0,04	2,40

[144] Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries

Czech Republic	12,71	0,10	12,81
Denmark	(0,21	0,00	0,21)
Germany	255,47	18,14	273,60
Estonia	4,52	0,10	4,62
Ireland	0,50	5,65	6,15
Greece	37,90	0,16	38,06
Spain	86,94	49,02	135,95
France	80,00	9,00	89,00
Italy	154,62	5,26	159,88
Cyprus	0,03	0,00	0,03
Latvia	0,36	0,00	0,36
Lithuania	1,78	0,32	2,10
Luxembourg	1,27	0,00	1,27
Hungary	34,30	5,99	40,29
Malta	0,00	0,00	0,00
Netherlands	36,31	0,07	36,38
Austria	20,45	0,00	20,45
Poland	16,62	0,29	16,91
Portugal	9,88	0,77	10,66
Romania	0,90	0,41	1,31
Slovenia	1,78	0,38	2,16
Slovakia	5,32	0,31	5,63
Finland	0,44	18,03	18,46
Sweden	16,71	1,41	18,12
United Kingdom	70,50	19,72	90,22
EU-27	884,32	144,31	1.028,62

The differences between the member States can be due to the actual generation, to the efficiency of collection or to the efficiency of data collection.

In preparation of the new Batteries Directive, the environmental impact of different scenarios has been assessed[145] [146]. Following data were collected for the reference year 2002: Approximately 800.000

[145] Bio Intelligence, Impact assessment on selected policy options for revision of the battery directive, final report July 2003

[146] EC Commission staff working paper, Directive of the European Parliament and of the Council on batteries and accumulators and spent batteries and accumulators, Extended Impact Assessment (COM(2003)723 final) 2003

tonnes of automotive batteries, 190.000 tonnes of industrial batteries and 160.000 tonnes of portable batteries are placed on the Community market. 45.5% of the portable batteries and accumulators sold in the EU-15 that year went to final disposal (incineration or landfill), instead of being collected and recycled.

Table 16: Spent batteries collection rates in EU-15 in 2002, EIA Bio-intelligence

Kton of spent batteries and collection rates as % of spent batteries	Starter batteries segment	Industrial batteries segment	Portable batteries segment
Starter Batteries	611 Kton (80-95%)		
NiCd Batteries		3,1 Kton (80-90%)	10,5 Kton (15-20%)
		14 Kton (30-35%)	
Other batteries		184 Kton (80-90%)	142 Kton (15-20%)
Total batteries	611 Kton (80-95%)	187 Kton (80-90%)	153 Kton (15-20%)
	950 Kton (70-85%)		

The following table gives the quantities recycled by members of the European Battery Recycling Association (EBRA), coming from the EU25, expressed in tonnes[147].

Table 17: Used batteries recycled by EBRA members

	Year 2005	Year 2006
Alkaline, Zinc-Carbon, Zinc-air	21797	26928
Lithium Primary	387	317
Nickel-cadmium Industrial	3194	3050
Nickel-cadmium portable (Sealed)	2304	2412
Nickel-Metal hydride	648	596
Lithium-ion	635	547
Button Cells	76	70
Total	29041	33920

Compared to 2005, the total amount of portable batteries recycled by EBRA members increased by 19%. The quantities of batteries recycled decreased in all categories except primary batteries and portable nickel-cadmium batteries.

[147] http://www.ebrarecycling.org/

EBRA gives the following figures per original countries of used batteries (expressed in tonnes and by types):

Table 18: Used batteries recycled by EBRA members

	Alkaline, ZN- Carbon, Zinc-air	Lithium Primary	NiCd Portable (Sealed)	Ni-Mh	Li- ion	Button Cells	**Total portable**	NiCd Industrial
Austria	1042,07	0	79,09	0	3,62	0	**1124,78**	96,46
Belgium & Lux	1525	0	127,89	23,46	4,79	0	**1681,14**	45,05
Cyprus	0	0	0	0	0,35	0	**0,35**	0
Czech Republic	21,86	0	0	0	4,52	0	**26,38**	400,16
Denmark	0	0	93,87	9,2	12,41	0	**115,48**	2
Estonia	0	0	0	0	0,58	0	**0,58**	0
Finland	0	0	58,6	0	2,31	0	**60,91**	45,5
France	8381,48	122,01	401,01	92,73	60,95	22,062	**9080,242**	966,91
Germany	7641,47	124	848,67	300,4	104,38	0	**9018,92**	415,54
Greece	184	0	4,2	0	4,72	0	**192,92**	30
Hungary	0	0	0	2	12,41	0	**14,41**	0
Ireland	102	0	8,77	1,03	1,94	0	**113,74**	0,1
Italy	0	0	47,54	9,94	25,66	0	**83,14**	125,73
Latvia	0	0	0	0	1	0	**1**	0
Lithuania	10	0	0	0	1,58	0	**11,58**	0
Malta	46	0	0	0	0,18	0	**46,18**	0
Poland	0	0	6,62	1,31	17,01	0	**24,94**	29,04
Portugal	179,2	0	0	0	4,68	0	**183,88**	0
Slovakia	0	0	0	0	2,4	0	**2,4**	0
Slovenia	0	0	2,31	0	0,89	0	**3,2**	0,87
Spain	604	0	46,26	14,04	17,93	6	**688,23**	87,87
Sweden	453	0	149	68,4	3,98	5	**679,38**	205,2
The Netherlands	1899	34	145,19	0	58,11	23	**2159,3**	5,92
United Kingdom	250,37	0	158,07	19,73	26,75	0	**454,92**	159,09
Switzerland	2200	1	155	33	24,32	14	**2427,32**	51,25
USA	0	0	2,78	0	131,72	0	**134,5**	0
Rest of the World	2388,17	35,73	77,08	20,52	18	0	**2539,5**	383,46
Total	26927,62	316,74	2411,95	595,76	547,19	70,062	**30869,322**	3050,15

4.3.5. Battery waste statistics: issues

It should be pointed out that an important controversy is surrounding the most appropriate way to calculate collection rate.

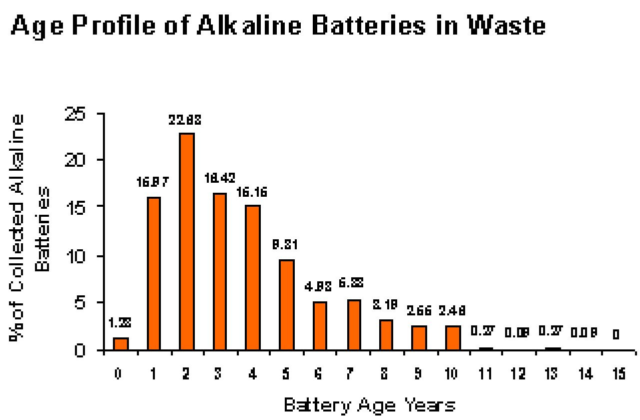
A European Commission study has found that 30% of primary used cells and up to 60% of rechargeable used batteries remain with the final users; thus the household storage reduces the amount available for collection; this phenomenon makes it very difficult to calculate the quantity of used batteries contained in the household waste stream; only periodic physical studies are able to evaluate it precisely…[148]

As explained on the EPBA website, over the years a number of methods have been adopted to measure the collection rate including:

- As a percentage of sales in the same year,
- As a percentage of sales over a number of years,
- As a percentage of spent batteries available for collection,
- As weight collected per inhabitant.

EPBA claims that methods (a) and (b) based on sales data are faulty in their conception because there is no relationship between batteries sold and batteries discarded. According to EPBA, primary batteries can take up to 15 years from the date of purchase to appear in the waste stream.

Figure 6: EPBA data on age profile of alkaline batteries in waste



EPBA argues that the weight of batteries sold in any country is very difficult to determine without a national register of producers.

Method (c) is the measure favoured by EPBA as the correct one. However, according to EPBA it was rejected by the Council of Member States in 2004 for NiCd batteries due to the costs associated with obtaining statistically significant samples representing the entire municipal wastes stream in a country.

In EPBA's opinion, method (d) overcomes the difficulties related to the variability of data which is inherent in the other three methods. It therefore provides a useful and comparable value to measure progress in battery collection over time. However it must be related to the consumption of batteries.

[148] Arnold, O. (2005), Efficiency of the battery channel, Ministère de l"Ecologie et du Dévelopement Durable, Working Paper 2005 -02

4.4. FOOD WASTE

The Waste Statistics Regulation requests reporting on a broad category of "animal and vegetal wastes" (EWCSTAT category 9), and on two more detailed subcategories: "animal waste of food preparation and products" and "animal faeces, urine and manure" (EWCSTAT categories 9.11 and 9.3). Other categories "Vegetal waste of food preparation and products" and "Mixed waste of food preparation and products" (EWCSTAT 9.12 and 9.13) are not reported as a separate category. In this way the data from the waste statistics regulation are hard to use in assessing the total quantities of food waste as described in paragraph 3.5.

Table 19: Grouping of EWC codes in EWCSTAT codes for animal and vegetal waste

EWCSTAT code	EWC codes
09 Animal and vegetal wastes	
09.1 Waste of food preparation and products	
09.11 Animal waste of food preparation and products	02 01 02 animal-tissue waste 02 02 01 sludges from washing and cleaning 02 02 02 animal-tissue waste
09.12 Vegetal waste of food preparation and products	02 01 01 sludges from washing and cleaning 02 01 03 plant-tissue waste 02 03 01 sludges from washing, cleaning, peeling, centrifuging and separation 02 03 03 wastes from solvent extraction 02 03 04 materials unsuitable for consumption or processing 02 03 99 wastes not otherwise specified 02 04 99 wastes not otherwise specified 02 07 01 wastes from washing, cleaning and mechanical reduction of raw materials 02 07 02 wastes from spirits distillation
09.13 Mixed waste of food preparation and products	02 01 99 wastes not otherwise specified 02 02 03 materials unsuitable for consumption or processing 02 02 99 wastes not otherwise specified 02 03 02 wastes from preserving agents 02 05 01 materials unsuitable for consumption or processing 02 05 99 wastes not otherwise specified 02 06 01 materials unsuitable for consumption or processing 02 06 02 wastes from preserving agents 02 07 04 materials unsuitable for consumption or processing 19 08 09 grease and oil mixture from oil/water separation containing only edible oil and fats

	20 01 08 biodegradable kitchen and canteen waste 20 01 25 edible oil and fat 20 03 02 waste from markets
09.2 Green wastes	
09.21 Green wastes	02 01 07 wastes from forestry 20 02 01 biodegradable waste
09.3 Slurry and manure	
09.31 Slurry and manure	02 01 06 animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site

Table 20 : generation and treatment of animal and vegetal waste in 2004, waste statistics regulation

	EWCSTAT 09 : animal and vegetal waste [149]					EWCSTAT 09.11 : animal waste for food preparation and products				
Kton 2002	Generation	Recycling and composting	Incineration energy recovery	Landfill	Bio-degradation [150]	Generation	Recycling and composting	Incineration energy recovery	Landfill	Bio-degradation
EU 27	70.566.902	-	-	-	-	8.529.348	4.216.185	-	169.729	-
Belgium	6.434.247	-	-	4.468	0.000	439.325	-	-	0.000	0.000
Bulgaria	367.112	0.000	-	52.795	72.101	57.746	0.000	-	27.029	0.008
Czech Republic	734.923	279.582	-	56.010	-	95.538	9.823	-	0.228	-
Denmark	-	-	-	-	-	165.326	165.326	-	0.000	-
Germany	6.734.774	6.086.249	-	85.956	4.288	362.148	261.335	-	0.042	-
Estonia	397.105	36.741	-	6.490	0.000	81.972	3.821	-	3.077	3.719
Ireland	1.239.861	350.025	-	0.056	-	289.855	294.530	-	0.000	-
Greece	783.543	26.444	-	274.891	8.636	250.000	1.081	-	0.137	0.000
Spain	8.080.970	732.840	-	350.021	9.861	812.187	493.513	-	13.370	0.377
France	3.713.000	2.773.000	-	608.000	52.000	9.000	32.000	-	5.000	0.000
Italy	8.077.627	3.218.060	-	32.189	12.102	172.838	7.054	-	1.174	0.000
Cyprus	145.564	93.825	-	37.109	-	23.561	3.140	-	15.991	2.500

[149] Without manure and without EWC 09.11

[150] D2: Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.)

Latvia	237.510	67.391	-	0.347	-	4.219	-	-	0.189	-
Lithuania	314.955	291.691	-	7.303	6.929	10.738	7.220	-	0.028	0.103
Luxembourg	92.862	62.195	-	-	0.000	2.608	0.000	-	0.000	0.000
Hungary	1.214.549	90.312	-	59.045	-	160.963	0.000	-	0.000	-
Malta	54.296	1.535	-	8.792	0.000	1.628	0.000	-	1.628	0.000
Netherlands	10.130.725	9.965.300	-	21.489	0.000	724.034	276.819	-	2.040	0.220
Austria	3.325.778	3.036.939	-	3.228	-	375.300	19.052	-	-	-
Poland	5.312.211	824.070	-	33.393	7.452	1.779.200	584.538	-	43.043	5.334
Portugal	2.368.162	348.800	-	245.469	1.146	417.480	270.166	-	28.410	3.056
Romania	1.129.872	23.052	-	6.291	0.897	4.107	0.048	-	0.002	0.000
Slovenia	66.040	5.270	-	5.101	0.000	29.633	-	-	0.225	0.000
Slovakia	345.650	450.810	-	22.150	5.290	27.620	16.220	-	0.290	0.010
Finland	332.602	107.307	-	62.565	0.329	255.632	205.435	-	6.262	0.005
Sweden	826.896	333.501	-	20.927	4.434	79.516	185.711	-	1.495	0.000
UK	8.106.068	6.317.449	-	277.985	159.402	1.897.174	853.020	-	20.069	0.000

An important fraction of food waste is mixed with common household or municipal waste, of which it forms an important constituent of the biodegradable fraction. Through the OECD/EUROSTAT joint questionnaire Member States reported on the composition of the household waste and the quantities or fractions of organic biodegradable waste and food and garden waste collected in the mixed fraction and collected separately. However, in a recent study, Barth et al have emphasized that there is a lack of common definitions on this issue. At the European level, they have been unable to achieve consistent data on biowaste (source separated organic waste from households and similar installations) and green waste (garden and park waste) and its treatment.

Table 21: Organic waste and food and garden waste in municipal waste, OECD/EUROSTAT joint questionnaire

	mixed				separate collection		year
	organic		food and garden		organic	food and garden	
	Kton	%	Kton	%	Kton	Kton	
Belgium			1894	40			2002
Czech Republic					4		2003
Denmark					573	570	2003
Germany					3465		2002
Estonia					28		2003
Greece			1850	51			1996
Spain	11743	49					2002
France			10509			3101	2002
Ireland			575	23		34	2002
Italy						1815	2002
Cyprus	194	38					2003
Latvia				26			2003
Lithuania			534	50			2000
Luxembourg						33	1999
Hungary			1317	31			2002
Malta	130	60					2002
Netherlands	3199	40	3065	38	1947	1813	2001
Austria	712	23			478		1999
Poland							-
Portugal		36				37	2000
Slovenia			331	32			1995
Slovakia			648	38			2000
Finland		33					2000

Sweden							-
United Kingdom		21					1997
Bulgaria			1270	40			2003
Romania	3474	51	2779	41			2002

Based upon an extrapolation of German data, Barth et al (2008, p 144) provide the following estimation of organic residues that do not belong to residual household waste and that could be composted:

Table 22: Estimation of organic residues not belonging to household waste

	DE 1993 (61 mio inh.)	**DE 1993**	**EU 27 projection**
Waste type and origin	**Quantity t/fresh matter**	**(t/ fresh matter per inh)**	**Quantity t/ fresh matter x 485 mio inh.**
1. Food residues			**Total 41 mio. t**
Food preparation	3,921,000	0.064	12,000,000
From markets	2,164,000	0.035	17,200,000
Catering waste	731,000	0.012	5,800,000
Spoilt food residues	679,000	0.011	5,400,000
Food product residues	103,000	0.002	800,000
2. Forestry residues			**Total 90 mio, t**
Bark	1,300,000	0.021	10,400,000
Wood residues	10,000,000	0.136	79,400,000
3. Agro industries			**Total 2,182 mio t**
Animal husbandry excrements	220,000,000	3.606	1,749,200,000
Husbandry excrements which are a real surplus	1,500,000	0.025	(12,100,000)
Straw in total	25,000,000	0.409	198,400,000
Straw residues (real surplus production)	10,000,000	0.163	(79,400,000)
Sugar beet and potato haulm	28,000,000	0.459	222,600,000
Residues of growing o f beans, peas, flax and vegetables	1,500,000	0.025	12,100,000
4. Food & beverage industry			**,Total 122 mio t**
Breweries and malt houses	2,035,000	0.034	16,300,000
Wineries	310,000	0.005	2,500,000
Fruit and vegetable production industry	252,000	0.004	1,900,000
Potato industry incl. starch	60,000	0.001	485,000
Sugar beet residues and soils	3,120,000	0.051	24,800,000
Slaughterhouse residues	1,375,000	0.023	10,900,000
Meat production	226,000	0.003	1,800,000
Whey	8,000,000	0.131	63,600,000

Total for the EU27	**2,345 mio t**

4.5. CARDBOARD

'Cardboard' is a colloquial term used by the general public to describe a variety of materials. These can be divided into two main groups:

1. Corrugated board and;
2. Carton board and similar products such as solid board, grey board, flat board and fibre board.

Corrugated board is a structured material made from a combination of liners and fluting. Carton board, and similar products, are essentially very thick paper made up of several layers which are very often coated in a surface suitable for printing and varnishing.

Exact figures are unknown, but for both material streams it can be assumed that almost 100% is produced for packaging purposes.

In the trade, board is regarded as a sub-category of paper. This review of current literature has found some information specific to board but the majority discusses paper and board as one. Therefore, most of our discussion will cover the more general issue of paper and only discuss cardboard when more specific data is available.

4.5.1. Packaging waste

In its report to the Council and the European Parliament of 6 December 2006 on the implementation of the packaging Directive and its report of 19 July 2006 on the implementation of Community waste legislation, the Commission notes considerable improvements in terms of recycling, recovery and incineration of packaging and packaging waste between 1997 and 2002. It notes that in 2002, the 75 targets applicable to EU-15 were achieved.

Packaging is a relatively small but not insignificant product and waste stream. In 2002, around 66 million tonnes of packaging waste were generated in EU15. This is around 5% of total waste generation. Packaging waste accounts for around 17% of municipal waste by weight and between 20% and 30% by volume. In 2002 the EU-15 average rate of packaging recovery and incineration with energy recovery at waste incineration plants was 62%, and the average recycling rate was 54%. The average recycling rate for paper and board packaging waste was 68%. All Member States have set up return, collection and recovery systems for packaging waste. Most have adopted measures aiming to encourage the use of recycled material.

Recovery and recycling have had positive environmental effects, including a reduction in greenhouse gas emissions and resource savings if compared with the mere disposal of packaging in landfills to be incinerated without energy recovery. The Commission also notes that recycling packaging does not cost much more than disposal, while packaging prevention is both complex and difficult to implement effectively. Furthermore, certain national measures and an incorrect application of the Directive have led to partitioning of the internal market, in particular in the beverage sector, and the Commission hopes to evaluate in more detail the ways in which such market restrictions may be avoided. The Commission also hopes to remain flexible with respect to incentives aimed at encouraging prevention and reuse of packaging.

4.5.2. Definitions and data availability

The recovery rate is defined as:

$$RR = \frac{WP_{cons} + WP_{EX} - WP_{IM}}{PB_{CONs}}$$

Where WP_{CONS} is waste paper consumption, WP_{EX} is waste paper export, WP_{IM} is waste paper import en PB_{CONS} is paper and board consumption. It thus expresses the ration between waste paper recovery and total consumption. The recovery rate measures the success with which one is able to recover used paper and board from the waste stream; it provides an indication of to what extent litter and improper disposal has been reduced[151].

The utilisation rate reveals the extent to which the recovered paper is actually used to process new useful paper and board production:

$$UR = \frac{WP_{CONS}}{PB_{PROD}}$$

Where WP_{CONS} is waste paper consumption in domestic paper and board production and PB_{PROD} is paper and board production. UR is an important indicator for issues such as forest protection and energy conservation (Berglund, C. and Söderholm P (2003)).

The collection rate is defined as the ratio between paper and paper products collection and paper consumption. However, there are usually no actual collection statistics on recovered paper. Usually, the volume of recovered paper collection is calculated using consumption and trade figures: the exports of recovered paper are added to the consumption of recovered paper and imports are subtracted in order to estimate the collection volume. It is important to keep in mind that the reliability of trade statistics can vary substantially[152].

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[151] Berglund, C. and Söderholm P (2003), An Econometric Analysis of Global Waste Paper Recovery and Utilization, Environmental and Resource Economics, 26:429-456.

[152] Ervasti, I (2007), Recovered paper – Calculating collection rate for individual recovered paper grades, presentation given at IPE, Bilbao

4.5.3. Official figures on paper and cardboard packaging

As argued above in paragraph 3.6, cardboard will be mainly found in packaging, and scarcely in other applications. The figures are just an approximation because paper packaging is included and mixed packaging is sometimes included but sometimes excluded from the reported figures.

Table 23 : Paper and cardboard and paper and cardboard packaging, generation and collection for recycling from OECD/EUROSTAT joint questionnaire

	Paper, paperboard and paper products						Packaging material of which: paper and paperboard					
	Generated (kton)			Waste collected for recycling (kton)			Generated (kton)			Waste collected for recycling (kton)		
	2001	2002	2003	2001	2002	2003	2001	2002	2003	2001	2002	2003
Belgium	:	:	:	:	:	:	457	569	:	:	:	:
Czech Republic	120	176	171	:	:	:	38	68	93	:	:	:
Denmark	:	:	:	721	752	:	488	502	:	317	308	:
Germany	18545	18212	18517	13825	13696	13643	6275	6525	:	5706	5807	:
Estonia	8	4	3	11	30	39	:	:	:	:	:	:
Greece	:	:	:	:	:	:	374	365	370	:	:	:
Spain	:	:	:	3496	3617	:	2649	3049	:	:	:	:
France	:	:	:	5355	5588	:	4327	4234	:	:	:	:
Ireland	:	:	:	:	:	:	380	387	:	89	132	:
Italy	:	:	:	4680	4938	:	:	:	:	2109	2369	:
Cyprus	133	135	140	7	7	7	:	:	:	:	4	7
Latvia	13	:	:	:	15	33	:	6	30	:	:	:
Lithuania	:	:	:	53	53	58	:	:	:	:	:	:
Luxembourg	:	:	:	74	67	:	30	:	:	18	:	:
Hungary	:	:	:	:	:	:	:	:	:	:	:	:
Malta	:	:	2238	:	:	:	:	:	:	:	:	:
Netherlands	3017	2947	2897	1829	1836	1798	1377	1382	:	898	1001	:

Austria	:	:	:	:	:	:	:	:	:	:	:	:
Poland	:	:	:	42	43	45	:	:	:	:	:	:
Portugal	:	:	:	:	:	:	487	507	515	:	:	:
Slovakia	:	:	:	154	:	:	:	:	:	:	:	:
Finland	:	:	:	739	:	:	267	255	:	198	191	:
Sweden	:	:	:	441	645	:	:	:	:	420	440	:
United Kingdom	12907	12411	:	5553	:	:	:	:	:	2031	2208	:
Bulgaria	:	:	:	:	:	:	:	:	:	:	:	:
Romania	30	59	:	30	59	:	18	45	:	18	45	:

Data are rather fragmentarily reported in the joint OECD/EUROSTAT questionnaire, and data on this level of aggregation in the reporting from the waste statistics regulation have not yet been made publicly available. However, for some countries a ratio of generated and recycled paper and cardboard packaging can be calculated.

Table 24: Collection for recycling of paper and cardboard packaging, based on OECD/EUROSTAT joint questionnaire

	% of paper and cardboard packaging collected for recycling in 2003
Denmark	61,35 %
Germany	89,00 %
Ireland	34,11 %
The Netherlands	72,43 %
Finland	74,90 %

Data on packaging waste generation, recovery and incineration at waste incineration plants with energy recovery and recycling have to be provided annually by Member States 18 months after the end of the reference period (e.g. by 30 June 2007 for the year 2005). The data have been provided in the format of Commission Decision 2005/270/EC. The received data can be found below. This dataset differs from the general data source mentioned above. It is used as a proof of compliance with the recycling and recovery thresholds. Although these data are more complete, they are not derived from the general statistical systems (usually based on reporting through generators or collectors) but often retrieved from the notified bodies involved in take-back obligations. The data mentioned in Table 25 illustrate the recycling and recovery rates for packaging waste generated in 2005.

Table 25: Recycling and recovery rates for paper and cardboard packaging waste

	Packaging waste generated (ton)	Total recycling (ton)	Other forms of recovery (ton)	Recycling rate (%)	recovery rate (%)
Austria	495000	427500	42000	86,4	94,8
Belgium	636671	530075	54264	83,3	91,8
Bulgaria	149319	121772	2	81,6	81,6
Cyprus	39155	5062	0	12,9	12,9
Czech republic	306346	257361	20695	84,0	90,8
Denmark	516341	309682	204592	60,0	99,6
Estonia	59111	26642	433	45	45,8
Finland	247700	195900	21800	79,1	87,9
France	4295497	3473549	485342	80,9	92,2
Germany	6896300	5661600	902890	82,1	95,2
Greece	400000	290000	0	72,5	72,5
Hungary	296017	254025	21147	85,8	93,0

Ireland	325888	233219	0	71,6	71,6
Italy	4315000	2875000	444000	66,6	76,9
Latvia	66775	39476	2494	59,1	62,9
Lithuania	72587	43080	20	59,3	59,4
Luxembourg	31881	22090	6923	69,3	91,0
Malta	0	0	0	0,0	0,0
Netherlands	1465000	1051000	372600	71,7	97,2
Poland	1253300	513300	24400	41,0	42,9
Portugal	525108	314118	43185	59,8	68,0
Romania	270260	138000	1210	51,1	51,5
Slovakia	0	0	0	0,0	0,0
Slovenia	56030	43316	23	77,3	77,3
Spain	3133368	2169167	203342	69,2	75,7
Sweden	645000	465860	396	72,2	72,3
UK	3725652	2762612	386288	74,2	84,5
Total	30223306	22223406	3238046	73.3	84.2%

The most noteworthy point about these figures are the outliers with low recycling and recovery rates (Cyprus, Estonia, Poland, and Romania) on the one hand and the extremely high *recovery* rates obtained in some other countries (Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Luxemburg, The Netherlands) on the other hand.

4.5.4. Figures provided by IPTS Study

A recent study undertaken by INFU/Prognos for the Institute for Prospective Technological Studies provides a description of the total flow of waste paper and cardboard (INFU/Prognos 2007, p.48).

The table below gives the sources of paper and cardboard generation in 2004.

Table 26: Sources of paper and cardboard generation in EU27

Waste source	Amount estimated (1,000 tonnes)	Amount estimated (%)
Municipal solid waste (MSW), bulky waste	19,460	24.48
Paper packaging and other paper waste	37,412	47.07
Demolition and construction waste	4,443	5.59
Production area (industrial sources)	18,137	22.82

End-of-life vehicles	26	0.03
Total	79,478	

This is composed of:

Table 27: Composition of the Paper and Cardboard Waste Stream

Composition	**Amount estimated (1,000 tonnes)**	**Amount estimated (%)**
Paper (de-inking)	31,931	40
Paper/cardboard from packaging	30,116	38
Other papers	17,432	22

This results in:

Table 28: Uses of waste paper

Uses	Amount estimated (1,000 tonnes)	Amount estimated (%)
Paper/cardboard recycled	33,019	41.5
Landfilled waste from recycling process	6,772	8.5
Otherwise disposed waste from recycling process	4,426	5.6
Landfilled waste (from non-recycled fraction and from sorting process)	24,534	30.9
Incinerated waste (from non-recycled fraction and from sorting process)	9,825	12.5
Other disposal (from non-recycled fraction and from sorting process)	903	1
Total	79,479	100

In total, 51.9 million tonnes (56%) were collected with the objective of recycling but due to losses during the sorting and recycling processes, actual recycled amounts are substantially lower.

Thus, the high amounts of recycling and recovery obtained in packaging waste are not matched by a similar performance in the other waste streams that are not subject to targets by European legislation.

Although these figures are based partially on information provided by CEPI, the notes on the methodology used for data collection do not allow understanding the exact reasons for the differences with the figures provided in Section 4.5.5.

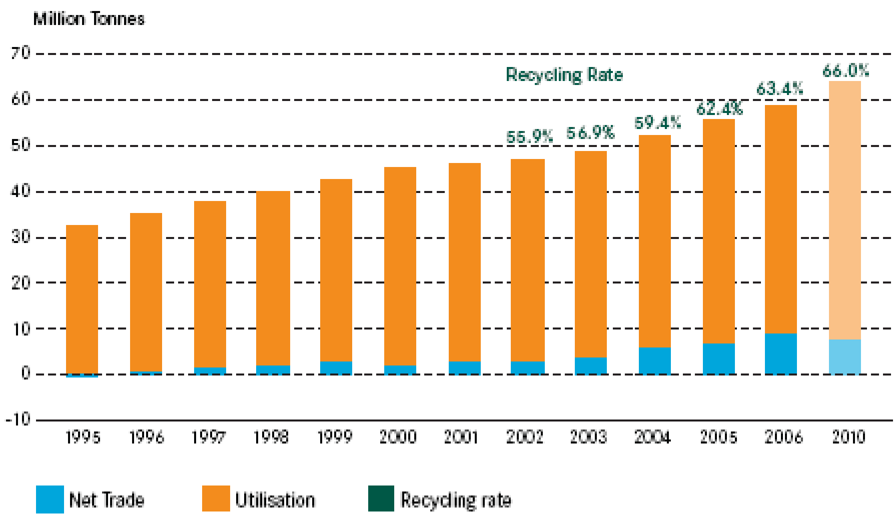
4.5.5. Statistics provided by industry

Data are also provided in the Monitoring Report on the European Declaration on Paper Recycling[153].

The recycling rate in Europe came to 63.4% in 2006, which is close to the industry's voluntary target of 66% by 2010.

The total amount of paper collected and sent to be recycled in paper mills came to 58.2 million tonnes, an increase of 5.7 million tonnes (or +9.8%) since 2004, the base year for the target. Some 7.7 million tonnes (or 13%) of the total of 58.2 million tonnes was exported for recycling in third countries.

Figure 7: European Paper Recycling



The European Recovered Paper council provides detailed figures on the uses of recovered paper in CEPI countries in 2006[154].

Table 29: Recovered paper utilisation by sector in CEPI countries in 2006

Paper Sector '000 Tonnes	Recovered Paper Grades A Mixed Grades	B Corrugated and Kraft	C News-papers & Magazines	D High grades	E Total Use of R.P.	F % Usage by Sector*	G Total Paper Production	E:G % Utilisation Rate**
Newsprint	220	0	9 152	113	9485	19.4	11 244	84.4
Other	225	97	2 729	750	3801	7.8	39 073	9.7

153 http://www.feica.com/pdf/EDPR_Annual_report-WEB.pdf

154 Key Statistics 2006, European Pulp and PAPER Industry, available from www.cepi.org .

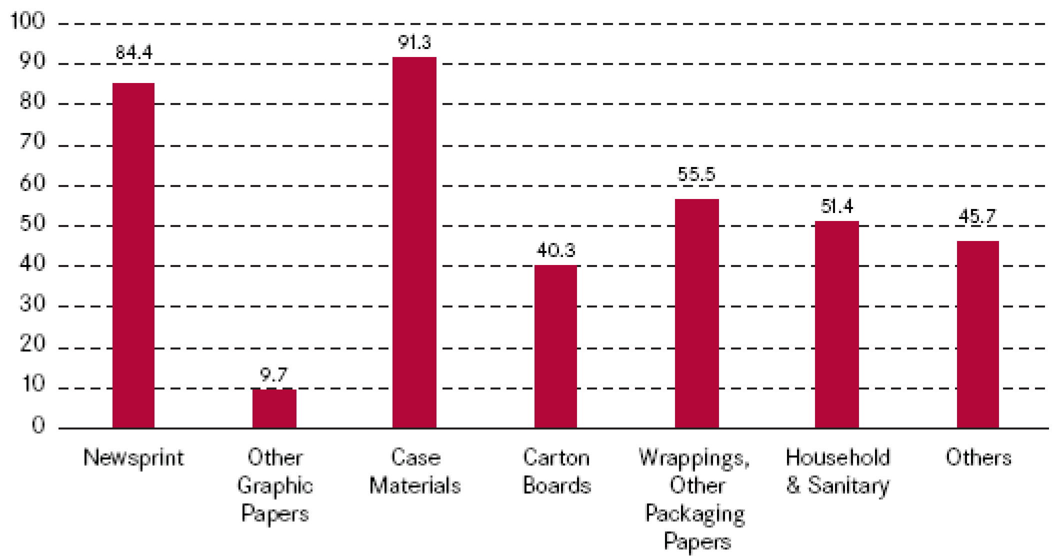
Graphic Papers								
Total Newsprint + O.G.P.	445	97	11 881	863	13286	27.2	50 317	26.4
Case Materials	4873	16 539	225	791	22428	45.9	24 570	91.3
Carton Boards	1718	449	431	791	3389	6.9	8 412	40.3
Wrappings, Other Pack. Papers	1 989	1 557	462	476	4484	9.2	8 074	55.5
Total Packaging Papers	8 580	18 545	1 118	2 058	30 301	61.9	41 056	73.8
Household & Sanitary	327	42	930	1 988	3 287	6.7	6 389	51.4
Others	423	1 325	128	166	2 042	4.2	4 469	45.7
Total	9 775	20 009	14 057	5 075	48 916	100.0	102 231	47.8

*: Usage by sector: total use of recovered paper in a sector as % of the total recovered paper used by the industry

**: Utilisation rate: use of recovered paper in a sector as % of the total production in that sector.

The last column of the table is also presented graphically:

Figure 8: Recovered paper utilisation rate in CEPI countries in 2006



This shows clearly the huge variation according to the application.

The highest potential clearly lies in graphic papers (with the exception of the newsprint industry). However, this requires higher quality and higher collection rates[155]. The CEPI Special Recycling Statistics give the origin of recovered paper in Europe:

CEPI also provides some figures on the evolution of international trade in recovered paper.

Table 30: CEPI Exports of Recovered Paper to Other Regions 2002-2006

'000 Tonnes	2002	2003	2004	2005	2006	% Change
						2006/2005
Other Europe	636	418	410	390	340	-12.8
North America	19	25	6	22	24	9.1
Latin America	13	5	15	5	1	-80.0
Asia	3 605	3 765	5 089	7 086	7 655	8.0
Rest of the World	85	62	70	140	180	28.6
Total	4 358	4 275	5 590	7 643	8 200	7.3

Table 31: CEPI Exports of Recovered Paper to Other Regions 2002-2006

'000 Tonnes	2002	2003	2004	2005	2006	% Change
						2006/2005
Other Europe	422	526	563	680	762	12.1
North America	319	285	237	197	230	16.8
Latin America	3	1	1	4	8	100.0
Asia	4	1	4	0	0	0.0
Rest of the World	6	6	9	9	6	-33.3
Total	754	819	814	890	1 006	13.0

Most striking in the long run is of course the increase of exports to Asia.

Besides these general figures, it also possible to obtain some data that are specific to the type of carton one is considering.

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[155] Miranda, R (2006), Collection of recovered paper: Driving Forces and Trends, presentation given to the Task Force "Collection Systems", for "The Limits of Paper Recycling", COST Action E48.

4.5.5.1. Cartonboard[156]

The markets into which cartonboard is sold is mainly the carton market with a smaller quantity going into the graphical field for such items as point of sale displays, book covers, calendars etc (where carton refers to printed folding boxes used for such items as cereals, pharmaceuticals, tobacco, cosmetics, tissues and food). In other words, cartonboard is used for the type of boxes or cartons seen in retailers containing products.

In Europe the production of this type of cartonboard is around 8 million tonnes. Of this about 85% is sold in Europe and Turkey with the balance being sold in other parts of the world. In addition cartonboard is imported into Europe from the Far East, USA, South America and other areas.

Of the 8 million tonnes of production in Europe about 55% is manufactured from recovered fibre with the balance being made from virgin pulp. The usage of each type varies country to country depending on the wishes and needs of the customers (brand owners and retailers). For example, in Italy in 2007 about 70% of all cartonboard used was made from recovered fibre. In the UK the proportion of cartonboard made from recovered fibre was under 40%. This will depend on the requirements and wishes of the specifier of packaging such as the brand owner or retailer and the carton printer who converts the board supplied by the cartonboard manufacturer, as they will use the type of material their customer needs.

4.5.5.2. Corrugated cardboard[157]

Corrugated board is made from a combination of two sheets of paper called «liners» glued to a corrugated inner medium called fluting. These three layers of paper are assembled in a way which gives the overall structure a better strength than that of each distinct layer.

This construction forms a series of connected arches that are able to support strong weights. This structure gives corrugated board considerable rigidity and resistance. The air circulating in the flutes also serves as an insulator which provides excellent protection against temperature variations.

The following table allows to see how quantities shipped have evolved.

[156] The information in this Section was provided per e-mail correspondence by Richard Dalgleish of CEPI Cartonboard.

[157] Information in this Section was obtained from the website of the European Federation of Corrugated Board Manufacturers, http://www.fefco.org/ .

Table 32: Total shipments in Thousands of tons

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	314	332	346	362	368	398	408	421	430	448
Belgium	536	559	594	602	604	612	587	602	568	593
Czech Republic	262	284	300	312	328	267	314	385	356	409
Croatia	NA	NA	NA	NA	NA	NA	NA	NA	124	NA
Denmark	280	270	266	276	271	271	267	271	265	263
Finland	165	157	142	143	137	150	155	159	151	159
France	2.731	2.830	2.931	3.046	3.000	2.930	2.950	2.937	2.996	3.022
Germany	3.310	3.400	3.492	3.661	3.649	3.748	3.778	3.889	4.004	4.340
Great Britain	2.156	2.120	2.160	2.147	2.096	2.114	2.096	2.128	2.208	2.000
Hungary	130	137	144	162	171	209	213	214	222	223
Ireland	168	168	168	168	164	162	158	159	158	NA
Italy	3.045	3.127	3.297	3.541	3.552	3.660	3.667	3.710	3.710	3.791
Netherlands	567	580	583	593	588	590	613	610	628	659
Norway	112	110	110	103	103	101	103	103	109	110
Poland	425	485	521	526	588	653	720	932	1.020	1.162
Portugal	215	203	213	221	217	215	221	225	234	NA
Romania	73	64	82	92	122	134	150	163	176	185
Slovak Republic	NA	NA	NA	NA	NA	81	80	83	83	89
Spain	1.996	2.139	2.235	2.330	2.335	2.427	2.461	2.475	2.441	2.544
Sweden	335	332	347	335	345	353	338	345	341	354
Switzerland	219	231	244	246	233	228	223	226	230	258
Turkey	641	629	682	718	667	734	827	951	1.139	1.318
EUROPE total	17.680	18.159	18.857	19.585	19.538	20.037	20.331	20.987	21.593	21.928

4.5.5.3. Drink cartons

Beverage cartons represent about 5% of all paper packaging in Europe.

In 2003, 11 billion used beverage cartons were collected for recycling from households in Europe. In that year, the beverage carton industry achieved 30% recycling and 58% total recovery[158] of all carton packaging in the previous European Union of 15 member states. During the same period, the enlarged European Union of 25 member states achieved 28% recycling and 53% total recovery.

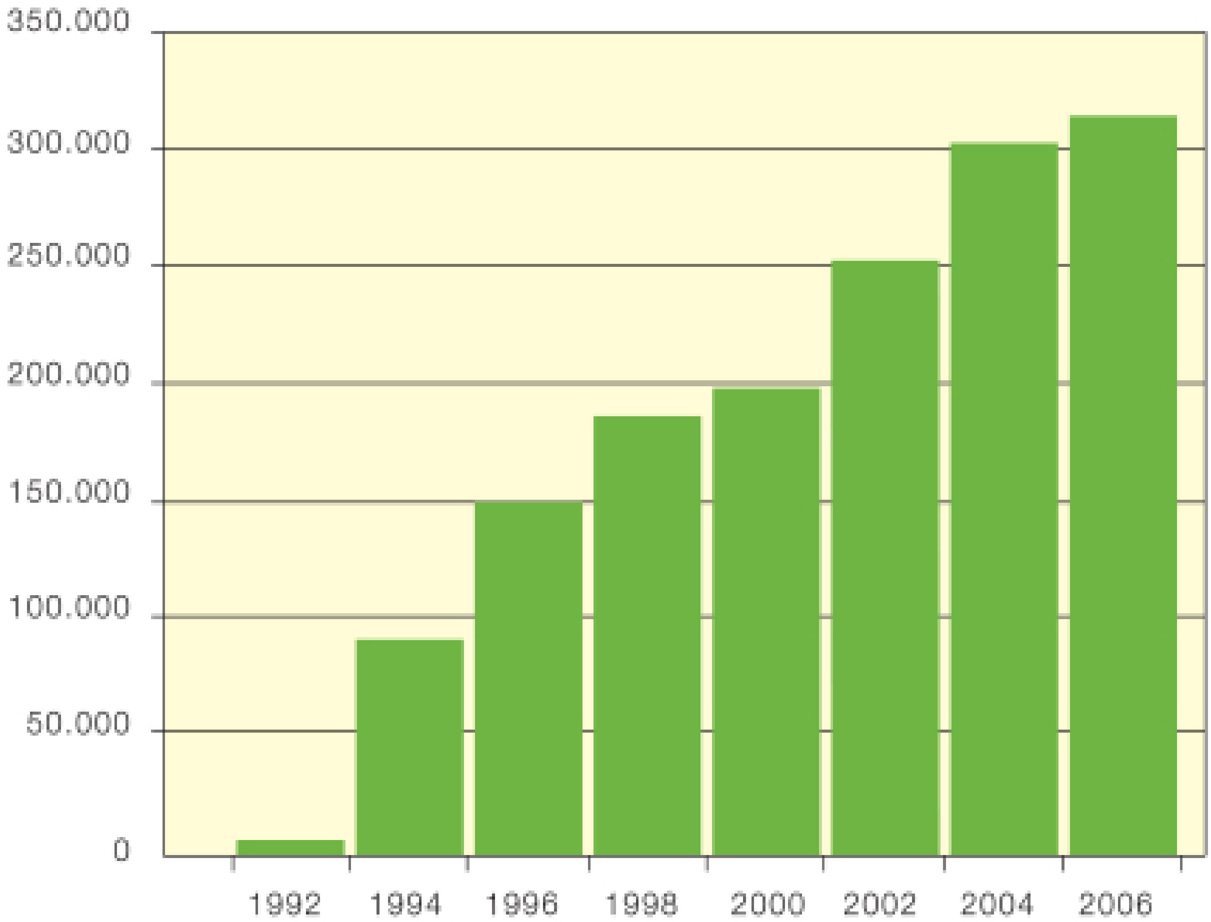
In 2006, 313,000 tonnes of beverage cartons were recycled in 2006 or some 12 billion cartons in all. This represents a recycling rate of 30% in Europe (EU-27, Norway and Switzerland). Combined recycling and recovery rates reached 639,000 tonnes (a 61% recovery rate) within the EU, Switzerland and Norway[159].

The increase through time since 1992 is shown on Figure 9.

[158] Total recovery includes both recycling and energy recovery.

[159] Press release by ACE of 12 September 2007. During the meeting with ACE of May 30 2008, it was clarified that these data come mainly from the national recovery organisations.

Figure 9: Beverage carton recycling in Europe (EU & Norway) 1992 - 2006 (tonnes)



5. RECYCLING TECHNOLOGIES

5.1. TECHNOLOGY FOR WASTE COLLECTION: STATE OF THE ART

5.1.1. Collection – definition

The waste Framework Directive 2006/12/EC defines 'collection' as 'the gathering, sorting and/or mixing of waste for the purpose of transport'. The new Waste Framework Directive specifies that it includes the preliminary sorting and storage of waste, and that all collection activities are for the purposes of transport to a waste treatment facility. "Separate collection" is defined as the collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.

A grey area remains on transhipment of waste after collection from the primary producer and before delivery to the first waste treatment or pre-treatment plant, especially when the nature and composition of waste could change. For instance, in the Belgian region of Flanders, the question has been raised whether municipal container parks belong to the collection system or can be considered as the first step in the pre-treatment because waste is split up at the container park in different sections.

5.1.1.1. Kerbside collection

The oldest organised way of public waste collection consists of the collection of waste bins or other waste recipients directly at the place of origin with a given, usually weekly, frequency. Kerbside collection belongs traditionally throughout Europe to the competences of the local authorities. It evolved from street cleaning activities when Eugène Poubelle, préfet de la Seine in Paris between 1883 and 1896, introduced the waste bin in a decree of 7 March 1884. Even from this early stage selective collection has been introduced for biodegradable waste, paper and textiles, and glass faience and oyster shells. More modern systems for kerbside collection introduce individual recipients or recipients for a grouping of buildings.

Figure 10: Kerbside collection of waste using shared recipients

To implement polluter-pays or pay-as-you-throw principles, systems have been introduced based on volume or on weight. Volume based systems are the most easy to implement and use waste bags that are for sale from the waste collector. The price of the waste bag includes the retribution for the waste collection and treatment and is thus related to the volume of waste that is handed over. Other systems impose the use of prepaid stickers. Weight based systems use multiple–use waste containers that contain an identification chip or barcode. The waste is weighed when it is entered in the garbage truck.

In France, progress is also being made in equipping collection trucks with GPS as attempts are made to optimise separate collection services by modifying service frequency and routes. The development of underground collection systems is of minor interest and will remain restricted to a small number of urban renewal and neighbourhood regeneration schemes[160].

Different recipients can be in use to make a distinction between different waste streams, or to make a distinction between household waste and commercial or industrial waste. Kerbside collection is optimised for household waste but it is used to some degree by small enterprises. When they do not (have to) pay a market based retribution for the waste collected, this could distort the market of the private waste collectors. The costs will be shifted to the community and the polluter pays principle will not be applied correctly. In some Member States, like Denmark, Germany, Austria, Luxemburg, municipalities are obliged to perform waste collection for certain waste fractions for all companies present on their territory, while in other regions and states, like the Brussels Region or Switzerland and like many decision of individual municipalities, collection of certain fractions of non-household waste through the municipal system is forbidden.

5.1.1.2. Collection on demand

The opposite of kerbside collection is collection on demand, usually by private companies. This method of waste collection is applied generally by companies that contact a professional waste collector. Containers or recipients for waste can be owned by the collector or by the waste producer. A large spectrum of different containers, each adapted to the nature and the quantity of the produced waste, is available on the market. Open or closed containers, for solid or liquid waste or for sludge, with press mechanisms to reduce size, with protection against calamities or contamination…

Collection on demand usually takes place after a period of collecting and storing the waste at the premises of the company, until enough quantity is reached to make external collection affordable and necessary. It can be paid on volume or on weight. Subscription systems are possible as well. In this case, waste is collected on a periodical basis and the price depends more on the chosen formula and the frequency of collection than on the quantity. When a private collector serves on a frequent basis and during one collection round a group of companies that are located in the same geographical area (e.g. an industry park), the distinction with kerbside collection becomes less obvious.

Collection on demand is not frequently used by private households, except when a container is hired at the occasion of private construction and demolition works or on comparable occasions. Collection on demand is introduced in some Member States for reuse schemes or repairable second hand goods, often organised by charities or by municipal reuse initiatives.

5.1.1.3. Bring systems – decentralised

Decentralised collection schemes are usually set up at the level of a neighbourhood. They are fit for use by households, but sometimes they accept waste from SME as well. In Great London and in other cities civic amenity sites exist that accept only mixed household waste, and replace the kerbside collection of this waste where the latter is not feasible for practical reasons. But these are exceptions. Usually decentralised bring systems are part of a system for separate collection of specific waste streams. They

[160] ADEME, MARKETS IN WASTE RELATED ACTIVITIES, Situation in 2005-2006 – Outlook for 2007, March 2007, Study realised for ADEME by In Numeri.

are set up for glass, packaging waste and plastics, paper and sometimes some other waste streams. As they collect post consumer waste which has a larger risk of contamination, the collected waste usually has to be submitted to a pre-treatment operation of a further sorting operation before it can be applied for recycling. The standard solution for decentralised bring systems are small containers with provisions to accept as much as possible only the requested waste type, e.g. round openings to prevent flat glass and other waste to be entered in a globe for packaging glass. The containers are included in Directive 2000/14/EC of 8 May 2000 relating to the noise emission in the environment by equipment for use outdoors, as they can produce noise nuisance to a neighbourhood. The positioning and the visibility of the containers and the frequent maintenance are also important to avoid fly tipping and to strengthen the social control. The collection of the waste from decentralised bring containers usually requires adapted collection equipment.

Figure 11: Truck for offloading containers, Van Gansewinkel

In France, progress can be observed in the construction of underground or semi-underground containers and silos. In some experimental cases this aims to reduce noise and odour pollution, optimise the frequency and efficiency of separate collections, and reduce work's accidents. What is more, it seeks to cut costs, even though investment remains a heavy burden (around 1 to 6 or 8 when compared to traditional containers). This type of collection is particularly suited to urban and densely populated areas.

For hazardous waste alternative mobile decentralised bring systems are possible, including a chemocar that collects hazardous household waste at a certain place at a certain time. These systems do not always prove to be the most efficient solution, and are in several Member States replaced by a more centralised bring system.

A special case of a decentralised bring system consists of neighbourhood composting sites, where local residents can dispose of their gardening and kitchen waste. These systems are usually driven by a social project or by voluntary action.

Figure 12: Panoramic view of a ward composting initiative in Lokeren - Belgium

5.1.1.4. Bring systems – centralised

Civic amenity sites (CAS) are becoming a more and more important actor in the waste collection market. They are designed for household waste, but they usually accept against payment of a retribution waste from SME. Often limits to the quantities of waste that can be discarded are imposed, and sometimes a special day is reserved for commercial and industrial waste from SME. In Brussels Region, two Regional CAS are accepting exclusively waste from SME, while the municipal CAS are not open for SME.

CAS usually serve 2.500 to 25.000 households and have a markedly larger scale than the sites for decentralised bring systems.

Different systems to apply the pay-as-you-throw principle are applied. In Spain, a proposed system for user-based fees would consist in shared containers that weigh waste when it is added, but where the introduction of waste requires a magnetic card that allows the identification of the household[161]. More common are systems for entry of the CAS, where this is limited to holders of an ID-card or an entrance badge that is distributed to the inhabitants of a municipality or a group of municipalities.

CAS play an important role within the take-back obligations for several waste streams. They offer a logistic structure to perform the actual reverse logistics, and their costs are reimbursed by the group of producers that are involved in an EPR scheme.

Well equipped CAS are provided with infrastructure to accept small hazardous waste in a safe way. The CAS are operated and guarded during opening hours by a trained staff and they are fenced and physically closed during closing hours.

Waste is sorted into different fractions by the people bringing the waste. Larger quantities of more or less good quality and homogeneous waste arises from the activity of the CAS, quantities that become economically interesting for recycling companies that collect the waste from the CAS. Some fractions have a positive economical value and represent a revenue for the CAS and the municipality or intercommunal cooperation that exploits the CAS, while collection of other fractions has to be paid.

[161] Barlaz M, Loughlin D and Willians J, (2002) Spain in “Strengthening Markets for Recyclables, A Worldwide Perspective”, North Carolina State University.

Waste Category	Equipment		
	No. Units	Max. Capacity, m^3	Type of container
Waste for landfilling	**1**	10-12	Open
Bricks, roof tiles, aerated concrete	1	10-12	Open
Concrete, garden tiles, natural stones	1	10-12	Open
Mortar, porcelain,ceramics, mirrors	1	10-12	Open
Soils	1	12	Open
Car tires	1	12	Open
Asbestos, asbestos cement	1	20	Closed
PVC	1	12	Open
Bulby Waste	1	30	Open
Mineral wool, impregnated wood, asphalt paper, asphalt	1	30	Open
Refrigerators	1	30	Open
Iron and metals	1	30	Open
Gypsum	1	30	Closed
Electronic (WEE)	1	20'	Closed - back doors
Glass	1	12	Open
Garden waste - (composting)	2	20-30	Open
Hazardous Waste	1		Special closed - double bottom
Oily wastes	2	0.75	Pallet tanks
Mercury lamps	2		Pallet boxes
Automobile batteries	2		Pallet boxes

Table 33: Typical set of containers in a civic amenity site[162]

5.1.1.5. Bring systems – treatment plant

A more traditional way of waste collection consists of households and smaller companies that bring their waste with own means to a landfill or to a waste treatment or recycling plant. Some municipally operated treatment plants do not accept waste from individuals, while others do accept waste if a certain quantity is exceeded. Because the cost of a professional waste collector is avoided, bringing its own waste to a treatment plant can be beneficial. It is used by charity organisations or youth movements that collect

[162] Preparation of Solid Waste Management Measures in Pazardjik, Pleven and Vidin Regions, (EuropeAid 117409/D/SV/BG) Investment Plan for Waste Management Development – Vidin Bulgaria

household paper or other waste with a positive economical value to a recycling plant. It is also used by some larger companies whose waste production is large enough to allow them to negotiate favourable conditions, or because they have a specific type of waste for which the professional waste collectors are not organised. Although direct acceptance of waste does persist, especially on high value waste like scrap, the importance of this way of waste collection is diminishing.

5.1.2. Collection schemes

5.1.2.1. Municipal collection scheme

Municipalities have in most Member States the traditional duty to collect waste from their inhabitants, but they often extend their activities to small and medium sized companies that generate comparable waste. As described above, this activity could create conflicts with the private sector, but only for these waste streams where collection is lucrative. Municipalities perform the collection activities themselves, or they hire a private contractor, or they organise themselves in intermunicipal cooperation schemes with or without the support of a private partner.

The used techniques are kerbside collection, decentralised and centralised bring systems. Municipalities often control waste disposal installations like landfills and incineration plants. Waste recycling plants under control of the municipalities are often limited to reuse centres and composting plants, and sometimes breaking of inert waste.

5.1.2.2. Private market collection schemes

Private market collection is focussing on collection on demand for industrial wastes, sometimes extended to collection rounds for geographically concentrated companies. They perform tasks in the collection of municipal waste, as a contractor for the municipalities. Collection is focussing on lucrative waste streams, with a high recycling value or for which they can charge enough to the producer. They usually are less active in the market of small quantities of less lucrative waste streams.

Most types of waste disposal or recovery and recycling installations can be found in the private market, or in public private partnerships.

5.1.2.3. EPR collection schemes

Collection schemes for EPR schemes use the above mentioned techniques for collection of waste, and add some specific techniques. Some EPR schemes are limited to a system of financial reimbursement and good book-keeping to prove the competent authorities that the imposed recycling targets are reached. Other EPR schemes use and reimburse existing infrastructure such as the civic amenity sites of the municipal kerbside collection. A third category of EPR schemes actively intervenes in the market and develops its own system of reverse logistics. The distribution sector is often involved when a one-for-one take back system is installed. The retailer takes back the waste product when he sells a new product, on delivery at a client’s premises or in the shop. He stores the waste and a private waste collector, paid by the EPR notified body, collects the waste and transports it to its treatment place. This system is often used for WEEE, voluntary take back systems of paints etc… A variation on this one-for-one system is established for end-of-life vehicles where not every retailer takes back the ELV when selling a new car, but where a network of geographically decentralised take-back and decontamination centres is set up. One-for-zero take back systems (for instance for batteries, toner cassettes and other small hazardous waste) is set up in cooperation with retailers, schools and organisations. The EPR notified body provides recipients and awards an incentive both to the public handing over their waste and to the network. For expired medicines, collection networks have been developed through the pharmacies.

5.1.3. Pre-treatment

Sorting at source delivers often better quality of recyclable waste that sorting after collection. Although the expertise for good sorting is not always present with the involved citizens or companies, the sorting burden is spread over much more actors that each for themselves can spend more time on it. Because the burden is spread, the perceived costs for sorting is spread or diminished. Sorting at source often is driven by a sense of duty and environmental concern, while sorting after collection is more dependent on an economical logic to minimise costs and to sort until the minimum requirement is reached.

Different techniques and legal provisions are applied to stimulate sorting at source. In the Belgian region of Flanders, garbage chutes in blocks of flats are forbidden and a sorting space has to be foreseen. Sorting obligations for households and for companies vary between the Member States. In Flanders 12 waste categories plus a set of hazardous waste categories have to be sorted at source by the households, and 15 categories have to be sorted by the companies. In The Netherlands about 9 categories have to be sorted. In other Member States this is limited to the usual categories of paper, glass, plastics, metals and biodegradable waste (e.g. Germany), and to the categories from the recycling directives (batteries, ELV, packaging, WEEE).

Legal provisions sometimes allow waste to be collected together, usually dry fractions, if it is assured of being sorted out after collection. In Greater London packaging waste is collected in another type of waste bag, but using the same waste truck. The bags are separated with an optical system before they enter the drying and fermenting installation.

In any case, municipal and industrial post-consumer waste usually needs pre-treatment in one way or another to augment quality and to guarantee high quality recycling.

5.2. TECHNOLOGIES FOR PVC RECYCLING

5.2.1. General issues

There are two methods for recycling plastics waste:

- Mechanical recycling
- Feedstock recycling

Energy recovery is another option.

According to APPRICOD (2006, p 16), the infrastructure for recycling plastics *post-producer* consists of four major components:

- Collection: different scenarios can be used to collect post-producer plastics in order to favour recycling instead of landfilling.
- Sorting: the collected plastics need to be sorted to increase their quality and reduce the costs of evacuation.
- Reclamation: the sorted plastics are cleaned and processed directly into end products or into pellets of a quality acceptable to manufacturers.
- End-use: the pellets or end products are marketed to manufacturers.

The recycling of plastics *post-consumer* is more complex because of unknown residual contaminants. The steps for recycling these plastics post-consumer may vary from operation to operation:

- Inspection: incoming plastics are inspected for contaminants.
- Pre-sorting.

- Granulating: post-consumer plastics are ground and washed.
- Flotation tank: if the different kinds of plastics are not sorted, they are separated in a flotation tank (density of the different plastics).
- Drying: clean plastic pellets must be dry because dampness decreases the quality of the end product.
- Melting: heat and pressure melt the plastic in an extruder (each type of plastic has a different melting point).
- Filtering: the molten plastic is forced through a fine screen to remove any contaminants that may have eluded the washing cycle.
- Pelletizing: the strands are cooled and chopped into pellets to be sold.

We shall now discuss each option separately.

5.2.2. Sorting technology

This section is based directly on the information provided in ACRR (2004). We should however add to the information provided below that, although automated sorting technologies are fairly well developed, many actors still use manual sorting. According to Vinyl2010, the two main reasons for this are[163]:

- Investment costs are often too high for SMEs
- It takes users some time to learn of a new technology, try it, adapt it to their circumstances and become convinced of its superiority.

Waste plastics sorting activities can be separated into two main categories; the sorting of small pieces like bottles and other household packaging, and the sorting of the bulky items, like pipes and films.

5.2.2.1. Small waste plastics

Small waste plastics fractions are usually packaging products collected with other materials (multi-material collections). A typical sorting chain for the mixed packaging waste has the following lay-out:

> Unloading of the collection trucks on a provisional stocking area => alimentation of conveyor with a loader => separation of the different fraction: metallic fraction (magnetic and Foucault current separators), light fraction (air classification), size separation (trommel and vibrating table), hand sorting on belt conveyors => baling => stocking

The sequence of the material separation varies from one sorting plant to another; some plants have equipment additional to those described above, whilst others do not.

In multi-material waste stream, ACCR recommends early separation of plastic films as their presence can clog equipment and interfere with the efficiency of the ferrous magnet separation system by wrapping around ferrous cans.

Automated sorting plants have a higher material throughput (in the region of 1-2 tonnes per hour) than hand-sorting plants (80 kg per employee per hour). Therefore, automated techniques may be more cost-effective for large volumes of materials.

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[163] Information provided by Vinyl2010 in e-mail of 08 July 2008.

One of the following two feed systems are typically used:

- Single feed systems are able to identify and eject objects one-by-one with sensors able to identify multiple polymers.
- Binary (mass) systems however, are able to handle a higher throughput, but require at least one sensor for each type of polymer sorted.

According to ACRR, a whole host of technologies are available for separating high volumes of waste plastics at relatively low cost. The most commercially available of these technologies employ the use of a Near Infrared Detector (NIR) which is particularly suited for use in dirty applications.

SORTechnology, developed by the DSD[164] in Germany is an example of fully automated sorting plant. Mixed waste plastics are separated from the rest of the waste using air separators. The waste is then passed through a spectroscopic identifier, which can identify up to ten different classes of plastic and additional optical devices can be incorporated which sort plastics by colour. Spectroscopic identifiers can also serve to separate plastics from non-plastics. Based on the information recorded, computerised air jets are activated which isolate the object to be separated. This kind of sorting plant can be coupled with a plastic preparation plant, which includes wet-mechanical preparation (washing) and processing technologies that reduce the sorted plastics into granulates.

ACCR reckons that SORTechnology has the potential to reduce the sorting cost of the lightweight packaging by up to 30 per cent and the cost of sorting and processing by up to 50 per cent.

ACCR points to some precautions that must be taken into account when employing automated plastic sorting equipment:

- if they permit high mass flow, a degree of sorting error still exists (contamination level of between 5 to 10 per cent maybe expected) and a visual checking system seems helpful. The future development of those technologies will probably increase their performance
- in general, the flow of material that reaches the automatic sorter must be free of contaminants such as paper, glass and metals
- as they represent an high capital investment, they must be used intensively to be economically viable
- the maintenance of this equipment requires computer and electrical systems knowledge and maintenance skills

There are other technologies that have been developed for the separation of the plastics from a multimaterial feed stream. The most commercially available of these include:

- hydro-pulping: A pulper - a large, agitated water tank - is used to separate paper. In the water, a rotor - similar to a blender - turns constantly. The rotor tears the composite materials apart and separates them into paper fibres, plastics, and aluminiumplastic composites.
- centrifugal separation: In a gravitational field, shredded plastics are sorted based on density. Polystyrene and PVC can largely be removed.

Among the other separation methods used for the plastic separation, flotation technologies are quite common. This is based on the differences in density between plastic polymers, but it can be difficult to separate plastics with similar density. A disadvantage is that these methods generate wastewater.

The sorting of plastic granulates has also improved in recent years as spectroscopic methods have developed.

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[164] DSD, the Duales System Deutschland, is the German producer responsibility organisation for packaging waste.

5.2.2.2. Bulky waste plastics

Large items of waste plastics will arrive at the sorting plant through the container parks or other waste collection services for bulky waste. These items are usually large enough to be effectively and efficiently hand sorted at point of collection/ deposit. As such, little capital investment is required to sort these wastes.

The cleanliness of the sorting platform is important in order to avoid the contamination of the waste plastics by foreign material. For the films, the absence of dust and moisture is essential because their large surfaces can retain contaminants such as these more easily than the other wastes.

ACRR therefore points to the importance of further developing public communication, awareness and education systems.

5.2.2.3. Quality control

ACRR recommends the establishment of routine quality control. Samples of sorted materials should be analyzed in detail and the results compared with the requested quality. A more detailed analysis will identify the cause of a bad sorting: misunderstanding of the sorting instruction, equipment failing etc. The installation of video network can be helpful to identify the failures in the sorting chain.

5.2.2.4. Reduction of volume and storing sorted waste plastics

Sorted waste plastics can be bulky to transport and store. To make these activities more economical, some type of volume reduction process is necessary.

According to ACRR, baling is a suitable option for both films and bottles, providing a reduction in volume that aids storage and management of the waste plastics. Over-compaction may weld the waste together making it difficult to separate whilst under-compacted bales will be unstable and difficult to stack.

For the big pieces of waste plastics, such as pipes or window frames, ACRR reckons that pre-shredding can be an interesting option. However, shredded material, particularly mixed shredded plastics are not accepted by some markets because quality standards beyond common sorting processes are required and therefore assured applications for the shredded material should be investigated.

5.2.3. Mechanical recycling

Mechanical recycling is the material reprocessing of waste plastics by physical means into new plastics products. This kind of recycling is used for post-production waste as well as consumer waste[165].

It is feasible when sufficient quantities are available and the quality is sufficient.

According to the website of ECVM, mechanical recycling of *source-separated* PVC is technically relatively simple and common practice. Suitable post-use products are those which are easy to identify and separate from the waste stream or which can be kept relatively clean, ending up as a high-quality recyclate for use within the existing range of PVC applications.

According to APPRICOD (2006, p 17), if the plastics are hard (window frames and pipes) and quite clean, then traditional mechanical recycling techniques are used: shredding, sorting (glass and metal particles

[165] See www.vinyloop.com.

are removed), regranulation, extrusion and production of recycled products (as much as possible for window frames).

For softer (roofing and cables) and less clean PVC, the VINYLOOP® process (see further) can be used in addition to conventional mechanical recycling.

According to ECVM, recyclate from PVC applications which contain another material to fulfil their function, but cannot be separated into pure PVC (so called `composites') is only suitable for such applications where the mixed composition can be tolerated. PVC recycling operations, covering such products, have also been initiated.

According to ECVM, when homogenous plastics streams are not available, recycling schemes suitable for mixed plastics, including PVC, may be used. Mixed plastic waste containing up to 15 per cent PVC is not considered to pose technical problems, although the quality of the recyclate is suitable for a limited number of applications.[166]

For the mechanical recycling of end-of-life PVC products, Vinyl 2010 clarifies that the PVC industry examines the various applications for recycling potential against the following criteria:

Products should be easy to sort and easy to identify for separation into clean fractions, suitable for further treatment.

Sufficient quantities should be collected to fill industrial plant capacities, with waste transported within reasonable distances.

Quality of recyclate should match marketable applications at competitive economic conditions.

According to ACRR (2004), applications for the recycled resin include outdoor furniture, pipes, flooring, window profiles, hose core, mud flaps, clothing and matting.

5.2.3.1. The Vinyloop ® process[167]

Vinyloop® has been developed by the Belgian firm Solvay. The first commercial plant was inaugurated in February 2002 in Ferrara (Italy).

The Vinyloop process allows the extraction of a regenerated PVC compound at a high degree of cleanliness from the mixed wastes. Before one had to leave such wastes for low quality applications or landfill.

Vinyloop can separate PVC compound from non-PVC materials which are intimately linked to it or mixed with it, such as polyester fibres, glass fibres, natural textiles, polyurethane foam, metals, rubber etc.

At Vinyloop Ferrara, the line currently regenerates PVC compound from cable waste (PVC mixed with rubber, fibres, other plastics).

Besides, real industrial campaigns were run successfully with end of life flooring material (PVC and glass fibre), roofing membranes (PVC with polyester web), blister packaging (PVC laminated with PE), wastes from post consumer window recycling and agricultural sheets (PVC and soil), either at a rate of 100% or

[166] PlasticsEurope has studied this subject in depth, but the latest technical report on this issue is from 1994!

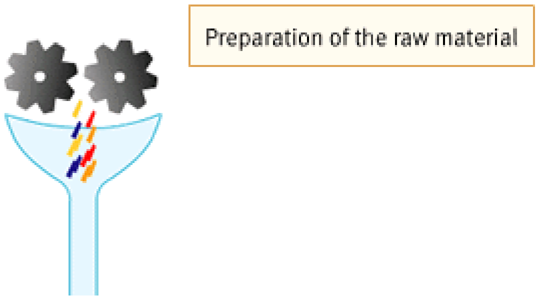
[167] Unless stated otherwise, the information in this Section comes from http://www.vinyloop.com/ .

in a mixture with cable wastes. Some wastes will require extra investment to be treated such as tarpaulins (both PVC with polyester web) and wall covering (PVC and non-woven PP), flooring material (PVC and glass fibres), roofing membranes (PVC with polyester web). These investments are in progress.

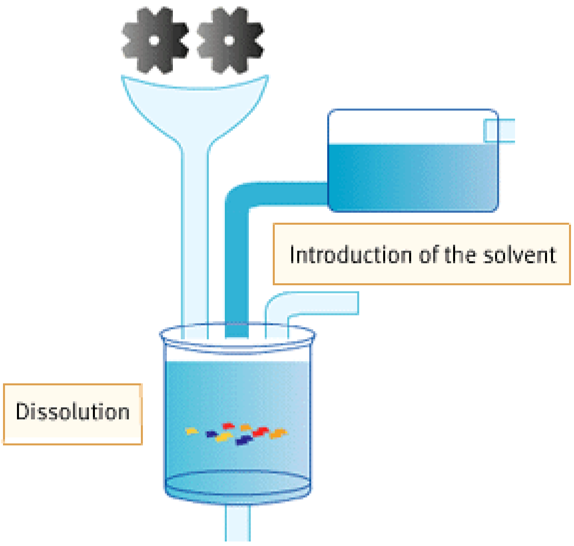
The ambition for 2007[168] was to treat 10,000 t of waste and sell the extracted PVC compound.

The recycling phase can be described as follows:

- In pre-treatment, the waste is turned into raw material suitable to be fed into the Vinyloop®.

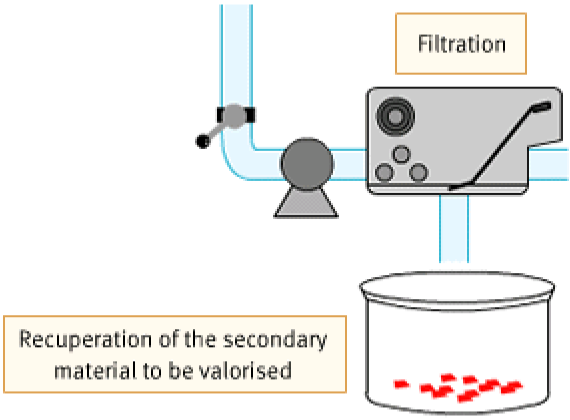


- Dissolution: in a closed reactor, the waste is combined with a selective solvent that releases the PVC compound matrix. All the additives and foreign materials are either dissolved or are in suspension in the liquid.

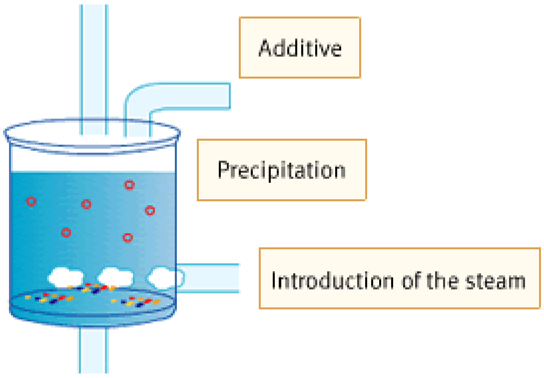


- Separation: the solution is filtered. The non-dissolved fraction is separated.

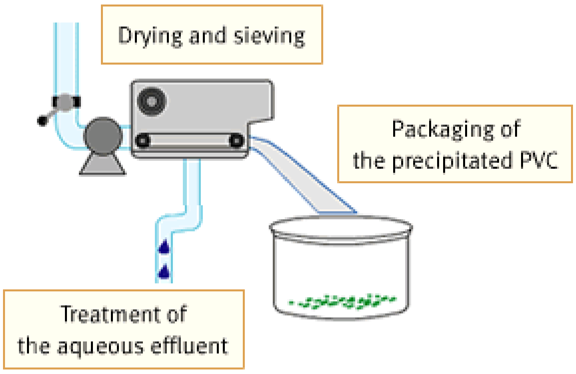
[168] Latest information available from the Vinyloop® website.



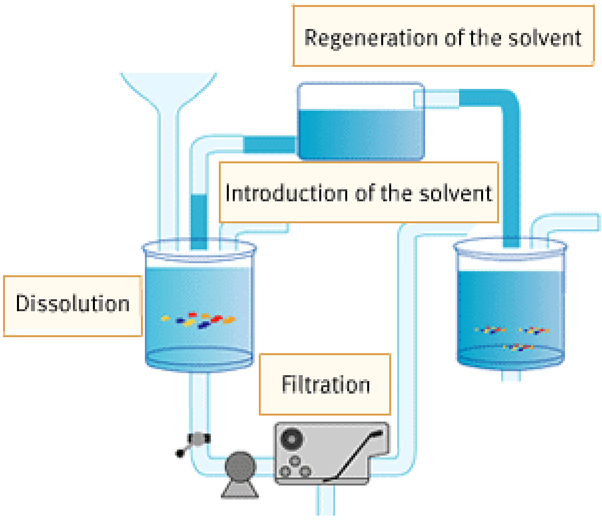
- Precipitation: the addition of steam converts the organic phase into an aqueous one. The PVC resin precipitates and captures the constituents of the compound in PVC compound microgranules.



- Drying: the water is extracted from the slurry.



- Solvent recovery: the solvent is re-used in a closed loop.



Considering its qualities, the regenerated PVC compound could be sold at a price several percent lower than that of the equivalent virgin PVC compound. The precipitated PVC compound has comparable properties to the initial compounds, except for the colour, which depends on the raw material.

The Vinyloop ® website points to the two following challenges:

- The collection of post consumer waste collection, where it refers to the importance of the collection schemes such as Roofcollect (see Section 3.3.3), Rewindo (see Section 4.2.6.1), and Recovinyl (see Section 3.3.2).
- Processing post industrial waste is well known to industry. Such recycled materials are of known origin and composition and their processing is under control. But this is not the case for the post consumer waste that Vinyloop regenerates. Their exact composition can be guessed at, but not precisely known. Moreover they are made in obsolete compound formulations because the material was processed 10, 20, 30 years ago. The recycling industry is working on product norms or specifications, in building up product quality control systems.

According to the Vinyl 2010 Progress report 2007, in 2006, technological improvements were made at the Ferrara plant in order to further reduce costs and energy consumption, and to improve R-PVC quality. A significant investment was planned for solving the problems caused by the quality of cable waste, which is often inhomogeneous and contaminated by copper and fibres.

Together with a closer cooperation with cable recyclers and the installation of a new type of secondary filter plate, a technical breakthrough was expected with the installation of a new decanter centrifuge (planned to be operational in the second half of 2007). This new decanter should have allowed a significant reduction in the contamination and filler contents of cable waste. However, according to the Vinyl 2010 Progress Report 2008, the secondary filter plate did not give the expected performance. Moreover, there was a delay in the installation of the new decanter centrifuge.

In terms of R-PVC sales, Vinyloop® Ferrara saw a dramatic increase in 2006, with approximately twice the 2005 sales volume, with requests exceeding the current production capacity.

According to the Vinyl 2010 Progress Report 2008, increased performance was due to new measures taken in 2007:

- a new density separation table downstream (which improves the separation of copper from cables);
- closer cooperation with cable recyclers;

- sourcing higher quality waste.

The Texyloop® technology could present a solution for the treatment of tarpaulins, and depending upon the availability of waste also for other fibres containing PVC waste.

The start-up of the pilot module, with a capacity of 2,000 tonnes, foreseen in the second half of 2007, was postponed to 2008, due to the delay in obtaining the new decanter centrifuge, which is an essential pre-requisite for Texyloop®.

Wolf et al (2006) refer to the Vinyloop® process as an example of a high-end specific process. They also point out that Vinyloop® fixes restrictive specifications for the input material acceptance.

According to AJI Europe (2006), current R&D developments aim at increasing the purity of the PVC-rich fraction obtained from the light fraction of the shredder residue from WEEE and ELV. Some recyclers can already produce (by post-sorting after flotation process) a fraction containing 40% PVC. However, the Vinyloop process requires a minimum proportion of 80%. An additional postsorting is necessary. It is difficult to forecast further process improvements.

ARN (Netherlands) plans to separate a PVC-rich fraction from the shredder residue in 2007. A new plant is supposed to use the SiCon (VW) process. Outlets are intended for use by the Vinyloop process. However, for the time being, the PVC rich fraction obtained by the SiCon process does not meet the Vinyloop specification.

5.2.3.2. Light Concrete

As explained in the Vinyl 2010, Progress Report 2007, the Light Concrete project aimed to determine whether PVC can be used as a filler for light concrete – lightweight concrete products, normally made by adding lower density materials e.g. clay or polystyrene to the concrete. Non-structural applications make use of these fillers for example for providing thermal and acoustic insulation or for lightweight roofing. If PVC could be used for light concrete, it would provide a sizeable outlet for construction or demolition material which may be contaminated with other materials such as cement and difficult to recycle conventionally. For some applications, PVC-based light concrete would have a cost advantage over using virgin materials while offering comparable properties and a sustainable solution.

The Light Concrete project has been put on hold currently due to limited waste availability, but Vinyl 2010 hopes that it can be revitalised in the future as the feasibility study showed good results. Other opportunities are being sought for the Light Concrete project as, from a technical point of view, it is promising[169].

5.2.4. Feedstock recycling

According to APPRICOD (2006, p. 17), feedstock recycling or chemical recycling is material reprocessing which breaks down the plastics into their chemical constituents usually by heat and pressure (depolymerisation). This recycling method is suited for large amounts of mixed plastics like household packaging. The recovery process is unique to plastics. Post-user plastics waste treated by feedstock recycling produces basic chemical substances of defined specifications and high quality. Feedstock recycling reduces the consumption of oil resources used for production but this option needs a high-performing and expensive installation.

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[169] This is the most recent information available on the subject. E-mail from Antonino Furfari of EuPR on 28 May 2008.

According to ECVM, feedstock recycling must be seen as complementary to mechanical recycling for two reasons: first to have technologies in place which are less sensitive to unsorted or contaminated waste products; and, second, to enlarge the overall recycling capacities for the larger waste quantities of the future.

According to Vinyl 2010, very few feedstock recycling technologies are actually used on an industrial scale[170].

According to ECVM[171], there are a number of compositions or multiple material products which, when returned for recycling, cannot be economically sorted into generic (single) polymer streams. Examples of these are laminated films, 'leather cloth', footwear or car dashboards, where the construction includes a number of different plastic and non-plastic materials. These materials are intimately connected to each other for performance reasons but economic separation is not yet feasible.

The feedstock recycling processes operating today treat mixed plastics waste from packaging sources with a PVC-content up to 10 per cent.

The 'thermal cracking' of this plastic waste stream can be done via hydrogenation, pyrolysis or gasification. Since the recovered hydrocarbon products are mostly used in petrochemical processes, the specifications limit the amounts of halogens in the waste below limits varying usually between 0.1 and 1%. One way to achieve this is to pre-treat the waste.

Such pre-treatment consists of a sortation or separation step of the used input - that means by dilution of a possibly excessive chlorine content with less chlorine-containing or chlorine-free polymer mixture. A second possibility is thermal dehalogenation before the pre-treated product is further processed. This thermal dehalogenation takes place either in a liquid or in a fluidised bed pyrolysis. The hydrochloric acid produced is neutralised or separated for industrial use.

The chlorine content of the resulting hydrocarbon feed can vary depending on the final processing step which is the determining factor. It is also common to dilute the chlorine-containing hydrocarbon feed with chlorine-free petroleum fractions coming from refineries.

Thus, in the case of feedstock recycling, ECVM thinks relatively low PVC/chlorine content, as found in mixed plastics waste (coming mainly from short life applications such as packaging etc) is acceptable as long as an appropriate pre-treatment of the plastics waste is guaranteed.

The feedstock recycling of a waste stream in which PVC is the dominant material (>30 per cent) - for example the multiple-material products as described earlier - has to be designed primarily for the recovery of hydrochloric acid, but also to recover the hydrocarbon content and/or energy.

Some commercial installations capable of handling large amounts of chlorinated waste are operating in Europe. A number of other processes have been proposed to specifically deal with this matter, such as, gasification in a metal or slag bath, and pyrolysis in a circulating fluidised bed. Most are at the concept or early development stage, but some have reached pilit plant stage, notably the process developed by Sumitomo Metals in Japan. According to ECVM, major operating step is to purify the hydrogen chloride so

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[170] Information provided per e-mail of 08 July 2008.

[171] Unless stated otherwise, all remaining information in this section comes from:

http://www.ecvm.org/code/page.cfm?id_page=151 that it can be fed as a gas to the oxychlorination unit in vinyl chloride monomer plant, the feed product for making new PVC, or to other chemical processes.

Vinyl 2010 explores existing technologies of feedstock recycling, in order to handle and recover waste with a high content of PVC which is not suited to mechanical recycling. Vinyl 2010 has invested heavily in research, development and pilot and commercial scale plants. However, certain processes using this technology have proven more challenging than expected technically and in terms of current economic feasibility. The PVC industry intends to continue investigating feedstock recycling processes and to support those that appear promising.

For instance, the Redop project (REDuction of iron Ore in blast furnace plants by Plastics from municipal solid waste) is a feedstock recycling treatment for mixed plastics/cellulose fractions from municipal solid waste (MSW). As explained in the Vinyl 2010 Progress Report 2007, the project was re-examined in 2006, after pilot trials, and the steering group concluded that the economic and market conditions do not justify proceeding with the next step of this project for the time being[172].

In the Vinyl 2010 Progress Report 2008, the following examples are mentioned:

- The technology proposed by the German company Sustec Schwarze Pumpe GmbH (SVZ), which operated a gasification plant for fluid and solid kinds of waste, was investigated in 2006 by Vinyl 2010. Although SVZ could accept waste with a chlorine content of up to 10%, this solution did not convince the market because of the existence of cheaper solutions, and in 2007 SVZ ceased operations[173].
- The possible use in Europe of a feedstock recycling process based on Sumitomo Metal gasification technology is currently under evaluation. Vinyl 2010 is trying to identify a suitable location for a 30kt plant in Europe.

5.2.5. Energy recovery

If recycling is not feasible, energy recovery is another option. Mixed plastics can be used to generate heat and/or power, as with the use of plastics waste in cement kilns because of its high calorie content. Energy recovery can also allow the recovery of a substantial proportion of the energy used for the production of plastics products.

According to Wolf et al (2007, p. 222), the usage of plastic waste as fuel substitute in cement kilns produces lower environmental effects than its incineration with other wastes since the solid residues are incorporated to the clinker instead of being discarded as ashes. The required investment at the cement plant, for handling and feeding those alternative fuels, is the only handicap of this option since it always means an extra expense that is relatively low and entails modifications of the standard designs in order to accept the secondary fuels. The differences between the alternatives in other aspects, like capacity for scale economy, running requirements or application (accepting that the waste plastic derived fuels have adequate heating value and do not incorporate compounds or elements that could change either clinker or cement qualities, affect the process stability or negatively modify emissions) are not detected as significant.

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[172] There is no more specific information available on the subject. E-mail from Antonino Furfari of EuPR on 28 May 2008.

[173] EuPC and EuPR explained in a face-to-face interview that, in the case of SVZ, the failure was mainly due to economic issues such as a high gate fee, whilst the failure of the Stigsnaes plant was more related to technical issues.

The chlorine content of PVC places a high demand on alkaline reagents in air pollution control systems at incinerators, so much so that each unit of PVC requires the same amount of reagents as up to 70 units of MSW (see IEEP (2003)).

Salt residues are by-products of some municipal solid waste incineration (MSWI) technologies. According to Vinyl 2010, only part of these residues are due to PVC waste.

According to Vinyl 2010, the PVC industry commits:

- To support technology developments in order to minimise the quantities of salt residues produced.
- To develop purification technologies, with the objective to recover the salt to be reused in chemical processes, and minimise the final residues to be disposed.

However, it is not specified how these commitments will be monitored.

5.2.5.1. Halosep®

The Halosep® process was designed with assistance from Vinyl 2010 (see Section 3.3.1) to make use of flue gas residues generated during the incineration of waste containing chlorine.

The trial phase was completed during 2006 in Denmark[174]. The Halosep® treatment of residues from wet and semi-dry flue gas treatment processes contributes to environmental protection by separating chlorides and heavy metals from the waste residue. Not only does this reduce the quantity and hazardousness of waste, it also transforms a large part of the waste into a marketable product, and, according the owner RGS 90, at a competitive cost.

According to the Vinyl 2010 Progress Report 2008, RGS 90 is now looking for partners to build a demonstration plant of commercial size.

5.2.6. Main issues related to PVC recycling technology

According to EuPC and EuPR, there are limits to what mechanical recycling can do and future waste volumes cannot be accommodated with mechanical recycling alone. Moreover, mechanical recycling is more limited by the level of contamination than chemical recycling. Several technologies exist, but no one is keen on investing because a steady supply is needed. Some technologies used in feedstock recycling have not found a market application yet. The biggest issue is not demand for the recycled product, it is assuring a steady supply of the raw material[175].

Actually, EuPR thinks that Vinyl 2010 should help a secure supply for high capacity plants – this supply was not yet available at the time of the Stigsnaes plant failure.

[174] See however Section 3.3.3 for the problems this caused for the ESWA targets in 2005.

[175] Information provided by EuPC and EuPR in face-to-face interview.

5.2.7. Specific issues related to PVC waste from ELV[176]

5.2.7.1. PVC coming from dismantling of ELV

PVC waste coming from dismantling of ELV is generally rather clean or may be somewhat contaminated by other materials. These materials can be recycled by using a densification process (CHAIZE process). This PVC material can be used in applications such as shoe soles or carpet undercoating. Some new applications, such as rolls for handling trolleys or reels, are developing for recycled PVC coming from dismantling of ELV.

5.2.7.2. PVC coming from shredding of ELV

PVC waste coming from Automotive Shredder Residues (ASR) is mixed with other polymers and miscellaneous materials. Today, there are two ways to dispose of ASR: land filling or energy recovery in municipal waste incinerators. A new recycling technology, in which ASR is extruded in shape of bars and ground in fine powder, is under development.

For the powder, new applications are investigated, as fillers in concretes used in bricks, tubes, walls or pavement edges. Extruded bars have a high calorific value, and thus are attractive for energy recovery.

Using the VINYLOOP ® process enables to dissolve the waste from ASR, which has a high content in PVC. This technology produces PVC compounds possibly recycled in garden hoses, floor coverings and road surfaces.

ENSAM[177] studies the best way to treat instrument panels, which contains different polymers. ENSAM has set up a pilot facility for sorting these materials.

5.2.7.3. French pilot project

According to AUTOVINYLE (see Section 9.7.3), it became clear that the all-shredding solution would not allow to reach the objectives of ELV Directive. Therefore AUTOVINYLE requested a study with the aim to estimate:

- The costs of dismantling a vehicle (time - quality- selectivity etc.)
- The feasibility of achieving a total dismantling up to the body-in-white, which would be supplied to the shredder.

This study was undertaken by INDRA (chain of dismantlers) and ENSAM, which has a technical expertise in splitting, sorting and recovery technologies.

This preliminary work enabled to start in September 2003 a project focused on flexible PVC parts. The project was limited to parts that were easily accessible and identifiable by trained personnel without specific specialisation in plastics.

This project was carried out at MAS, a dismantler part of the INDRA network, on a sample of 25 vehicles, which were representative of the French park of ELV.

[176] Information in this Section has been obtained from http://www.autovinyle.com/ .

[177] Ecole Nationale Supérieure d’Arts et Métiers, see http://www.ensam.fr/fr/centres_et_instituts/institut_chambery

PVC products coming from this dismantling were identified, and weighed. The teardown times were very precisely measured as in a current industrial process.

Per car, 1.52 kg of flexible PVC (coming from all automotive components except for electrical cable harnesses and instrument panels) was collected. The average time required for selective dismantling was 18 minutes/vehicle (all included)

5.3. TECHNOLOGIES FOR BATTERY RECYCLING

5.3.1. Sorting

Sorting can be carried out manually, automatically or semi-automatically into the following chemical systems[178]:

- General purpose alkaline manganese and zinc carbon batteries,
- Nickel cadmium and nickel metal hydride rechargeable batteries,
- Lithium ion rechargeable batteries,
- Lead acid rechargeable batteries,
- Button cells

Unless stated otherwise, all remaining information in this Section has been obtained from Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries.

The degree of accuracy required of sorting operations will be dictated by the purity requirements of the recycling facility. Most recycling facilities available in Europe today require pre-sorting to some degree, although many will offer sorting at additional cost.

One tonne of mixed consumer batteries can contain up to 40,000 individual battery units with up to 10 different battery chemistries. They can vary in size from button cells to block batteries weighing a kilogram or more. Therefore hand sorting of batteries, even on a small scale, is likely to be inaccurate and very time consuming.

Three criteria are put forward in the study of the Scottish Environment Protection Agency (SEPA):

- **Accuracy** relies on the identification of a number of different properties of a battery including the physical size and shape, the weight, the electromagnet properties, internal cell structure determined by x-ray, and any surface identifiers such as colour or unique markings.
- **Speed**.
- **Low cost** means large-scale facilities, in the order of 50 to 80 tonnes per shift, which have the added benefit of economies of scale, are preferred to smaller, more costly operations. Such facilities can be operated at a cost not exceeding £110 per tonne.

A first large-scale battery sorting facility was operated by AVR Holding (Rotterdam, the Netherlands). The plant was capable of processing 3,000 tonnes per year, of post-consumer batteries, at an accuracy exceeding 99% for critical battery streams.

This facility has subsequently proved to be too large and complex for the Dutch market and consequently the equipment has been sold to the Belgian battery PRO BEBAT (see Section 7.8).

Other successful battery sorting plants operate in Europe today based on similar principles to the EPBA (European Portable Battery Association) model.

At the time of the writing of the SEPA report, other sorting principles were under development including a vision-based system, and an X-ray system.

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[178] Information obtained from EPBA website

The X-ray system was then in the late stages of development and should prove to be a very accurate and reliable sorting method. At that time, the designer's aim was to own and operate the system in-house and not to make the equipment commercially available. The problems with commercialising such a system could have included the capital investment required in the X-ray sensor and the safety aspects of operating such equipment within a waste-handling environment.

The principle of using vision for sorting has already been used in other fields. Cameras take images of the product as it passes and these are compared to a database of images stored within a central processing unit. When applying this technology to batteries, it is important to appreciate that many thousands of unique battery labels are marketed today. Early attempts to use this technology as a stand-alone battery sorting method have proved unsuccessful due to the vast processor power and memory required to operate at speed. With advances in computer processing power and memory this could become a valuable technology for future sorting operations.

SCS Automation and Control, Poole, Dorset, have recently developed a vision system to complement the selection of mercury-free cells for low-cost recycling, and this has been installed for trials on the RWE process in Germany. Due to the restrictions discussed above, this system will not be capable of replacing existing sensors or detectors, but will concentrate on selecting certain label types.

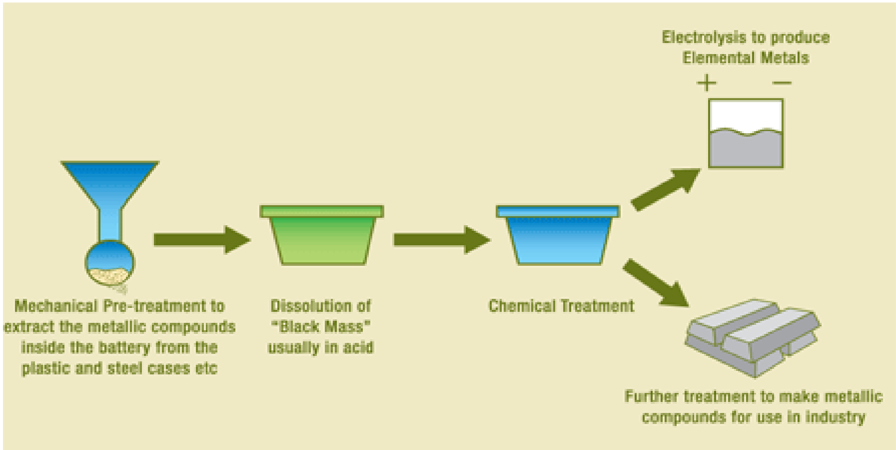
5.3.2. Recycling: general issues

Once sorted the batteries may be recycled according to one of the following recycling processes.

The dry mechanical process separates out the metallic compounds (namely zinc, manganese and carbon), or 'black mass', from the steel casings and the paper and plastic elements. The steel goes to the metal industry. The plastic and paper element cannot be recycled due to contamination by the black mass.

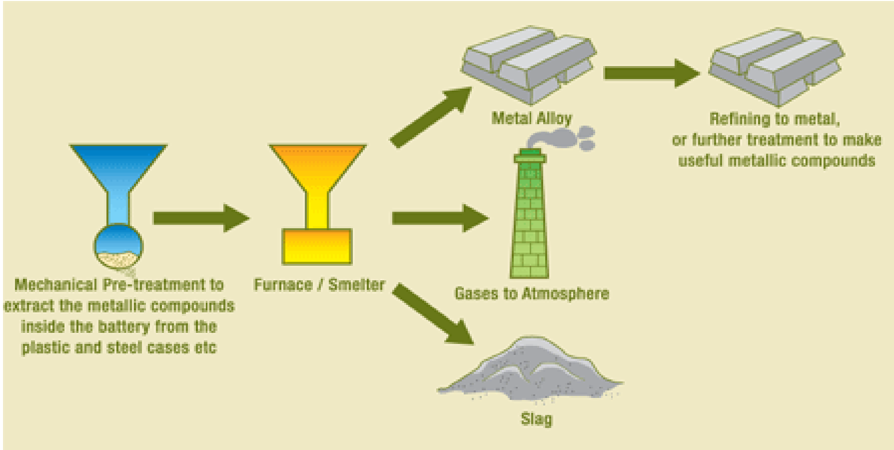
The hydrometallurgical process dissolves the black mass and after further chemical treatment and electrolysis is able to produce elemental metals. This process, shown in Figure 13, allows a high level of recycling efficiency, though the degree to which this efficiency is achieved is compromised by cost.

Figure 13: Hydrometallurgical Process



An alternative treatment method is via a pyrometallurgical process. This involves heat treating the material through a furnace or a smelter resulting metal alloy as a product, but also slag which is less marketable. This process is shown in Figure 14.

Figure 14: Pyrometallurgical Process



The actual recycling process used depends on the battery type[179]:

Table 34: Recycling process per battery type

Battery Type	Recycling Process
Alkaline manganese and zinc carbon	Both hydro and pyrometallurgical processes are available to recover zinc, steel and ferro manganese or slag usable in road construction.
Nickel cadmium	Pyrometallurgical processes are used to recover 99.9% purity cadmium that is reused in new NiCd batteries, as well as ferronickel.
Nickel Metal Hydride	Processed to recover nickel, iron and other metals.
Lithium Ion	Processed to recover cobalt, iron and other metals.
Lead Acid	Lead is recovered for reuse in new batteries.
Button Cells	Silver oxide types used in watches are collected by jewellers and recycled to recover silver metal. Other types can be recycled to recover mercury, zinc and steel.

National and (future) European end-of-waste criteria and procedures, mainly depending on leachate properties, have to be applied before slag can be used as a road construction material.

Other possible applications are[180]:

- Zinc can be recovered as zinc sulphate and used in the production of fertilizers, in galvanisation industries and by zinc producers.

[179] Information obtained from EPBA website.

[180] Information provided per e-mail by an anonymous stakeholder.

- Manganese is recovered as manganese sulphate and is mainly used for fertilizers.
- Iron is sold to recyclers industries or to international scrap dealers.
- Mercury is used for electrolysis plants and some mercury-containing devices.

In the case of lead acid storage accumulators used as automotive and industrial batteries, all main compounds (plastics, metal content) are reused to manufacture new products and substitute primary material. While the vast majority of lead is reused to manufacture lead batteries, there is a variety of applications for the plastic material recovered. According to an anonymous industry stakeholder, there are no recycling technologies in this segment that are not used to their full potential.

In the case of rechargeable batteries, the situation is the following[181]:

Table 35: Uses of material recovered from rechargeable batteries

Battery types	Quantities	Uses
Lead-acid	approximately 800’000 Tonnes/year = Automotive and Industrial	Lead (65% by weight) is recovered as a paste of mixed lead oxide and lead metal. The mixed paste is treated in a pyro-metallurgical process to recover lead metal which is re-used in batteries.
Nickel-cadmium	approximately 15’000 Tonnes/ year – Portable + Industrial	After thermal distillation of the cadmium (7-15 % by weight) which is recovered, an iron nickel residue is obtained. Nickel represents 20 % by weight and iron 25 % by weight of the Ni-Cd battery. Cadmium metal is recovered and recycled in the cadmium metallurgy for the production of cadmium oxide used to produce nickel cadmium batteries. The iron-nickel residue is further processed in the steel industry for the production of nickel-iron alloys that will be used in steel production.
Nickel-metal hydride batteries	Approximately 10’000 Tonnes / year	Spent Ni-MH batteries are processed in dedicated units

[181] Information provided by RECHARGE aisbl per e-mail.

		where the iron-nickel-mixed metal oxides residue is obtained after thermal treatment. It is sold to the steel alloys industry. The batteries can also be processed as such in metallurgical processes for the recovery of iron –nickel alloys that will be used in steel production. Nickel may represent 30 % by weight of the battery and Iron 20 %.
Lithium-Ion batteries	Approximately 10'000 Tonnes/year	In a similar process as for the Nickel-Metal hydride batteries those batteries containing either cobalt- or nickel- or manganese oxides can be processed as such in metallurgical processes for the recovery of iron –nickel-cobalt-manganese alloys that will be used in steel production. There are also dedicated processes which will recover selectively the batteries components such as aluminium and copper as well as the mixed oxides that will be sold to the appropriate metallurgical industries. In those batteries, Cobalt may represent 20 % by weight of the battery.
Zinc-based Primary batteries	Approximately 140'000 Tonnes/year	Those batteries have a zinc content (20% by weight) that can be recovered either by hydrometallurgical processes or by thermal processes. The recovered zinc is sold to secondary zinc smelters. The iron jacket (20 % by weight) of alkaline batteries is sent back to steel production as iron scrap. The manganese oxide (20 % by weight) content is usually left in slags of metallurgical processes. There is one hydrometallurgical process allowing the production of a mixed iron-zinc-manganese oxide (ferrite).

Due to the nature of substances used in batteries there are “dedicated processes” for the treatment of the various types of spent batteries. Indeed, steel metallurgical plants do not accept lead, mercury nor cadmium –based materials. Dedicated processes exists for lead-acid, nickel-cadmium, nickel-metal hydride, zinc-based and lithium-ion batteries. In parallel to dedicated processes, spent batteries can also be processed in metallurgical processes operating for primary and/or secondary metals production. This is the case for nickel-metal hydride and lithium-ion batteries[182].

A study undertaken by BIO IS for the European Commission **in 2003** has brought together data on the cost of recycling in the battery sector for the various countries in Europe[183]. It shows that there are considerable disparities between the various types of used batteries:

Table 36: Recycling costs for batteries in 2003

Type of used batteries	Recycling cost
Alkaline and Zinc-Carbon batteries	1.000 EUR/ton
Button cells	2.600 EUR/ton
Lithium Batteries	2.000 EUR/ton
Lead-acid Batteries	1000 EUR/ton
NiMH Rechargeables	0 EUR/ton
NiCd Rechargeables	300 EUR/ton
Li-ion rechargeable	1000 EUR/ton

According to the author of this study, these disparities are due to differences in resale prices of the recovered materials, their hazardous (or not) character and the nature of the recovery process involved.

5.3.3. The REVABAT process

The REVABAT process used by REVATECH produces the following fractions[184]: washed black mass, a ferrous fraction, a non ferrous fraction, a plastic fraction and two waste fractions. The ferrous and the non ferrous fraction are bought by a local scrap trader. The plastic fraction is used as refuse derived fuel (RDF) in cement kilns. The plastic is bought by Recyfuel.

The washed black mass of Belgian waste batteries is treated by Hydrometal. Hydrometal requires a fixed treatment cost, but pays for the zinc content of the residue. Depending on the zinc contents of the residue and the zinc price, a negative treatment cost is possible. The washed black mass contains a lot of manganese and relatively little zinc. It can thus be mixed with similar residues. Hydrometal has an

[182] Information provided per e-mail by RECHARGE aisbl.

[183] Quoted in Arnold, O. (2005), Efficiency of the battery channel, Ministère de l’’Ecologie et du Dévelopement Durable, Working Paper 2005 -02

[184] Information provided in “Integrale evaluatie van verwerkingstechnieken voor Belgische afvalbatterijen (zinkkool- en alkaline fractie)”, Study undertaken the Flemish Institute for technological Research (VITO) on behalf of OVAM, November 2006.

excellent knowledge of the zinc market. According to Hydrometal, they process only a part of the black mass.

The new REVATECH process, which is still under development, has a zinc sulphate solution and manganese dioxide as final products. REVATECH assumes that the zinc sulphate serves the same market as the Hydrometal zinc sulphate solution. REVATECH has mentioned one potential buyer for the manganese dioxide – a Dutch based Belgian company. This company would further process the MnO2 for use in the brick industry – it does not fulfil the requirement for re-use batteries.

REVATECH is assured of the treatment of Belgian waste batteries. On top of that, REVATECH also recycles a significant number of foreign waste batteries. For foreign batteries, VALDI is considered the most important competitor.

The new European Directive on batteries and battery waste is the main source of uncertainty for the further development of REVATECH. The Directive imposes a minimum recycling percentage for zinc carbon and alkaline batteries. The REVATECH process, where manganese is recycled as manganese dioxide, fits within the development of the European Directive.

5.3.4. Lead battery recycling

For the sake of example, let us take the STCM. The STCM (Société de Traitement Chimique des Métaux) is the most important lead recycler in France (80,000 tonnes per year). 70% of this lead originates from batteries. The most important constraint is linked to the global environmental impact of this waste stream, as the slags and the gaseous emissions are not recovered.

Several solutions exist that could limit these impacts:

- Treatment of the slags in a reverberating-kiln.
- The elimination of SO_2 through a scrub tower
- The filtering of volatile organic components

However, these techniques are expensive and the current scale of lead recycling, even in a relative large market as France, is too small for required investment.

5.3.5. Closed loop recycling for rechargeable batteries

The information in this section has been obtained from http://www.batteryrecycling.umicore.com/valeasProcess/ .

Lithium-ion is the main technology being used to power portable electronic equipment such as mobile phones and laptop computers. Currently around 9,000 tonnes of cobalt is sold each year to make some 1.4 billion cells. According to Umicore, all rechargeable battery market forecasts are positioning Lithium ion batteries as the major source of energy for portable electronic devices for the next 10 years, and that these numbers are set to grow in the future as are the volumes of used equipment and batteries that need recycling.

Umicore battery recycling has developed a process called Val'Eas®. It claims that this process enables an environmentally sound battery recycling[185] of used Li-ion, Li-polymer and NiMH batteries, without any potentially hazardous pre-treatment, and returns the main Nickel and Cobalt metals into the form of new

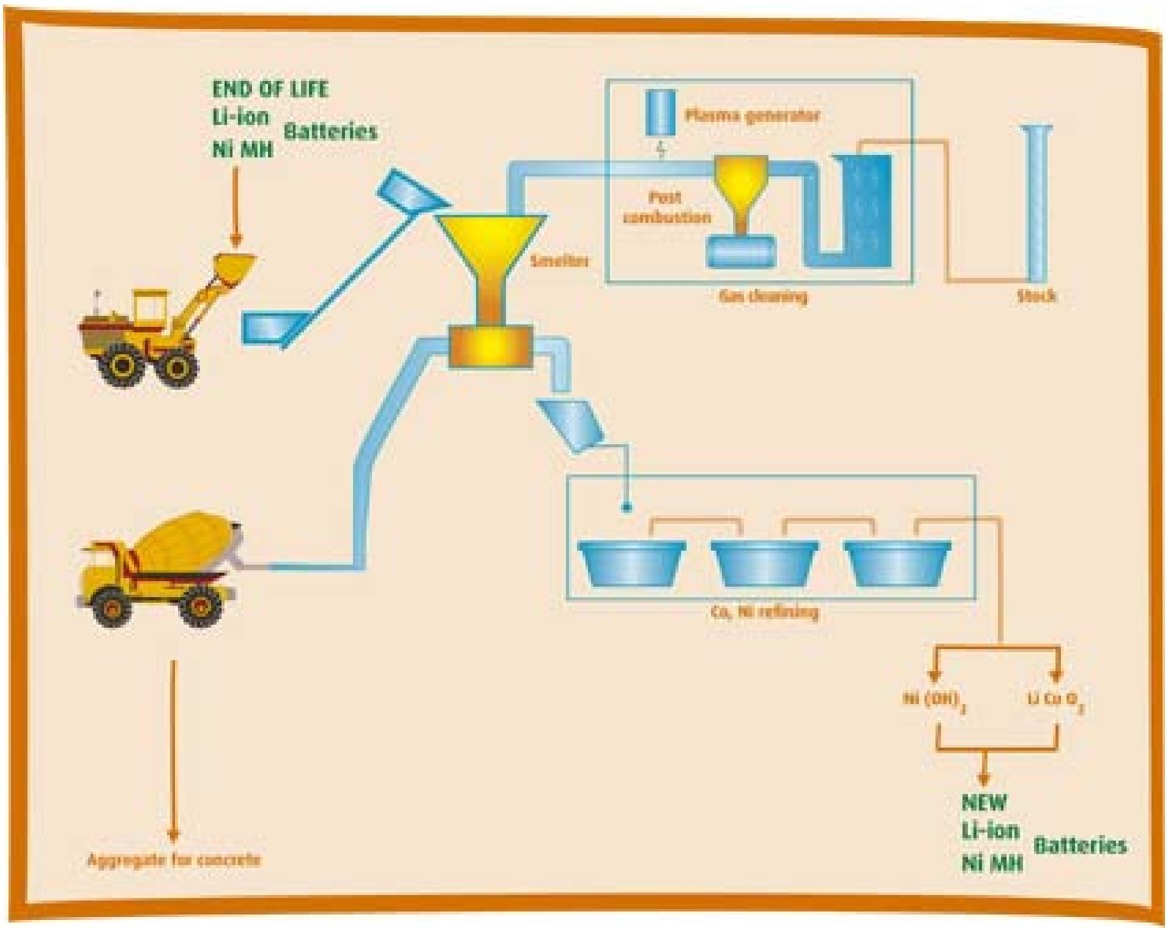
[185] Umicore battery recycling has won the European Environmental Press (EEP) Association's Gold Award 2004 – see http://www.eep.org/eep-award-2004-winners.htm .

advanced materials for new battery applications. The Val'Eas® process is operated at industrial scale in Europe in Sweden and Belgium.

The battery recycling process includes:

- a melting operation: rechargeable batteries, battery packs and other input materials are injected into a furnace without any pre-processing, in order to minimise all hazardous risks
- a preferment gas cleaning of installation equipped with the new plasma technology to make the formation of dioxin and furan impossible
- well controlled melting conditions so that a clean slag can be produced and further re-used in construction and/or as aggregate for concrete.
- a cobalt & nickel refining installation where the cobalt & nickel containing alloys can be further treated so that pure cobalt and nickel are prepared.
- followed by a process for transformation of cobalt products into the final lithium cobalt dioxide LiCoO2 which is then used in the production of new lithium ion batteries.

Figure 15: the Val'Eas® process for closed loop recycling



Umicore Recycling Solutions claims to be the only company that offers a one-stop-shop recycling solution and real closed loop solution for all portable electronic devices, including mobile phones and laptops, recycling not only the handset or electronic part containing precious metals, but also the rechargeable batteries and their accessories.

5.3.6. Emerging practises and technology[186]

Product design can extend the life of a battery and thus prolong the period, before it enters the waste stream. Several examples are provided in the SEPA study and we refer to that document for more details.

According to the SEPA study, adequate battery recycling facilities exist in Europe today for lead-acid, NiCd and NiMH batteries. However, the study contains an inventory of emerging recycling technologies in the fields of primary consumer batteries and lithium technologies.

One point should be mentioned here, though.

The recycling of batteries within electric arc furnaces has been thought to be a promising route. At the time of the writing of the SEPA study, trials had been conducted in the UK, Spain and The Netherlands, but only a Dutch plant has operated commercially. It had however to cease battery-recycling operations due to increased emissions.

According to the SEPA study, due to financial constraints, the European steel industry had not been able to commit financially to modernisation and to take advantage of batteries as a feedstock. Moreover, the lack of available batteries had prevented the industry to make the investments necessary for a day-to-day recycling of batteries – note that is quite similar to the problems identified in the case of PVC recycling.

5.4. TECHNOLOGY FOR FOOD RECYCLING

A considerable part of this chapter is derived from the 6th Framework Programme Project no: 006509 (SSPI-Holiwast, Holistic Assessment of Waste Management Technologies), report D2-1 on waste treatment options, of October 2006, Scuola Agraria del Parco di Monza.

5.4.1. Definition and scope

Food waste is a specific form of biodegradable waste, which is by definition a mixture of materials that decompose in aerobic or anaerobic conditions. Biodegradable waste mainly consists of three fractions: paper & cardboard, food waste and garden waste.

Food waste differs from the two other fractions by its biochemistry, its seasonal fluctuations and its bulk density. Food waste with up to 80% water content should be collected by bulk lorries. Food waste has higher putrescence and moisture compared to garden waste.

Sorting at source is necessary for a high quality recycling of food waste. In this chapter no attention will be paid to techniques where food waste is processed as a part of the mixed municipal waste by techniques of mechanical biological treatment (MBT) where the food waste is composted or digested as a part of the production of RDF or other fractions from mixed municipal waste. End-products from MBT show 5 to 10 times more heavy metals contents compared to compost resulting from source separated organic waste[187]. The end-product remains in the scope of the Landfill Directive. Applications of such stabilised organic waste should thus be restricted to limited applications (non food), if they are to be

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[186] Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries

[187] European composting network www.comportnetwork.info/biowaste/biowaste.htm

used at all. This is not considered as recycling of food waste, because separation at source of municipal bio-waste remains essential to produce a high quality compost.

5.4.2. Collection

Collection schemes for municipal food waste include kerbside collection and centralised bring systems. Specific containers are used for the kerbside collection of this highly putrescible waste fraction. Separate collection of food waste has a large impact on the collection of the remaining mixed residual waste. The quantity of this residual fraction will go down considerably, as bio-waste forms 30-40% of the household waste. Furthermore the putrescibility and the moisture content of the remaining mixed household waste goes down and allows for other, e.g. less frequent, collection regimes. The introduction of separate collection of food waste should therefore not be seen merely as an extra collection scheme and an extra cost above the collection scheme for mixed household waste. Bring systems are more obvious for garden waste than for kitchen waste. Collection of biodegradable waste however can be avoided when backyard composting is promoted.

A distinction is made between garden waste and all pre-cooking kitchen waste, and food waste that is cooked and can contain meat and fish. In the Netherlands, Belgium (Flanders) and in some sites in Germany and Austria, the definition of VGF (vegetable, garden, fruit) is used, meaning a mixture of yard waste and the food waste portion produced before cooking: hence these schemes do generally not include, for instance, meat and fish scraps and the troublesome, highly fermentable nature of cooked scraps (see Section 7.9 for the example of Flanders). In Italy, Spain (Catalonia) and parts of the UK (South Somerset, London District. etc.) the collection schemes for food- and garden waste are kept separate: intensive collection of "food-waste" as a whole (including cooked stuffs as meat and fish) is performed by means of small volume bins and buckets (usually 10 - 20 lt), whereas a different scheme tackles yard waste only – see Section 8.2 for the example of the UK and Section 12.9 for Spain.

Collection schemes, usually collection on demand or subscription systems, for commercial and industrial food waste are mainly driven by the market of private waste collectors, because larger quantities can be collected as once. Some composting installations accept direct supply from producers.

For frying fats and oils a specific waste collection market exists. In Belgium a take-back obligation for this kind of waste creates large incentives to ameliorate the coverage and the efficiency of the collection schemes (see Section 7.9.3).

For offal and corpses of dead animals, specific collection services do occur, managed by the treatment plants (see for instance Section 7.9.5).

5.4.3. Treatment

5.4.4. Anaerobic digestion

Anaerobic digestion (AD) involves the biological degradation of organic material in the absence of air, often with the addition of water to give the feedstock the appropriate consistency. The main products are biogas (comprising principally carbon dioxide and methane), as well as a digestate, a reduced mass of bacterial biomass. The biogas can be captured for energy generation (either using gas engines, or through cleaning the gas for use as vehicle fuel or for injection into the gas supply network, of using fuel cells).

Digestion systems are especially interesting in the context of the twin objectives of recovering organic matter and in seeking to develop supplies of renewable energy. AD is applied on separately collected food waste and other bio-waste, and mixed household waste.

There are a number of different techniques falling under the definition of anaerobic digestion (AD). They are usually distinguished on the basis of:

- Operating temperature (thermophilic plants operate at around 55° C and mesophilic at around 35° C)
- The dry matter content of the substrate (dry systems with more than 20-40% dry matter, wet systems usually have less than 15% dry matter)
- Whether the digester is continuously fed or whether a batch feeding system is used.
- Two phase (acidification + methanisation) or single phase (combined).

After the digestion process has finished, a residue remains which can either be:

- Spread directly on land, although there may be good reasons (related to the activity in the remaining material, and its potential to be phytotoxic) not to do so;
- Pressed to separate the liquid and solid, with the liquid being used as fertiliser and the solid being further 'matured' (composted) to stabilise the product for use as compost; and
- Pressed to separate the liquid and solid, with the liquid being treated (as waste water) and the solid being further 'matured' (composted) to stabilise the product for use as compost.

Spreading on land requires licensing as digestate is often considered as a 'sludge". Sometimes (for instance in Denmark) it is considered as a product and can thus be applied onto farmlands with no licensing procedure.

The main material flow for anaerobic digestion is presented by the Scuola Agraria del Parco di Monza as follows:

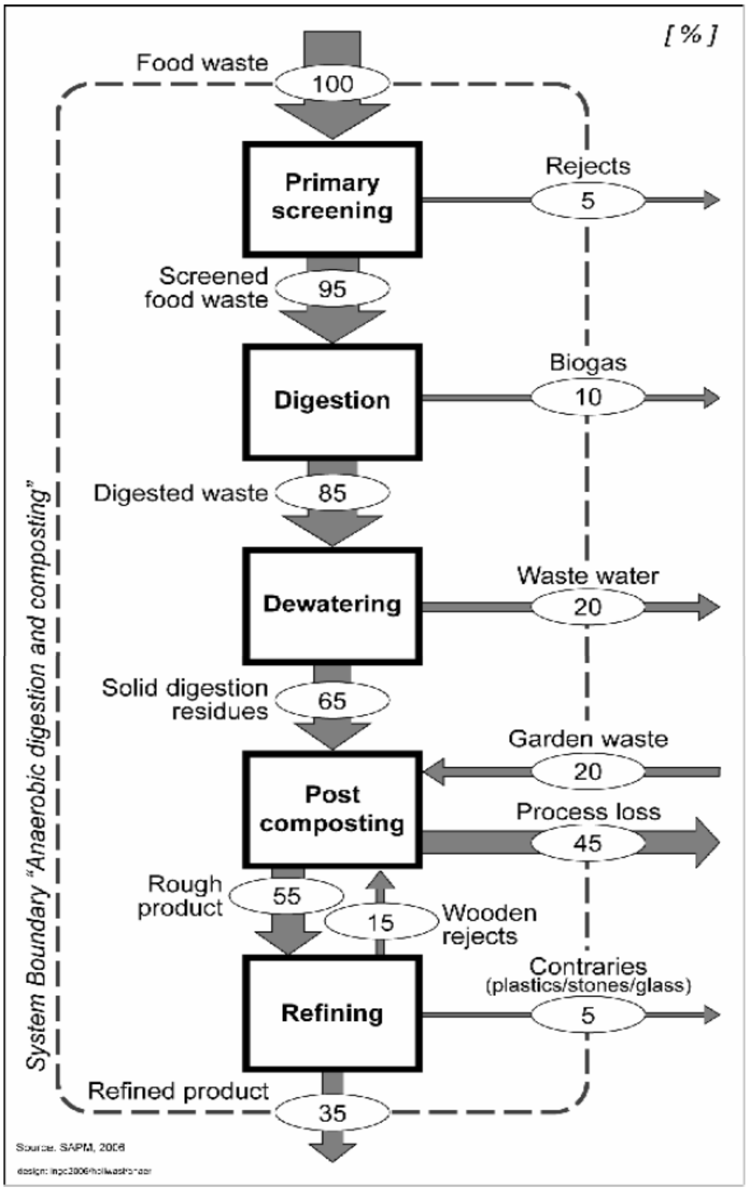

Figure 16: Material flow for anaerobic digestion of food waste

Because of the limited use of the digestate, it could be questioned if anaerobic digestion is a recycling process of food waste or an energy recovery process where the residue is recycled through aerobic (post) composting. The main reason to apply anaerobic digestion is not to be found in the value of the processed digestate but in the energy recovered.

5.4.5. Composting

A variety of aerobic composting systems are available in the market. At the EU level, the market for aerobic systems is much more mature than for the anaerobic systems. Generally industrial scale facilities for treating bio-wastes containing kitchen wastes now have to be "covered systems". This means that systems cannot be open air systems, and will have to be either:

- Fully enclosed systems, where the material is effectively sealed off from outside interference (other than aeration)
- Covered systems, in which the mass of material is not so much enclosed as housed. Typically, such systems will be covered windrows.

Systems can be divided into:

- Batch systems, in which a mass of material is treated in one container or as one load
- Continuous flow systems, in which materials can be added continuously over time.

Systems can be further sub-divided into:

- Dynamic systems, in which the material is agitated by paddles or augers
- Plug flow systems, which move the material through a process without agitation

In enclosed or covered systems, it is frequently the case that aeration is applied to the system by mechanical means. Systems can act with a 'blowing' (positive pressure) or 'sucking' (negative pressure) action. In systems which are not fully enclosed, the latter is believed to have certain advantages in terms of management of bio-aerosols and odours since air can be sucked directly into a bio-filter and the material is not so agitated by the aeration process (so operatives are less exposed to dust or bio-aerosols).

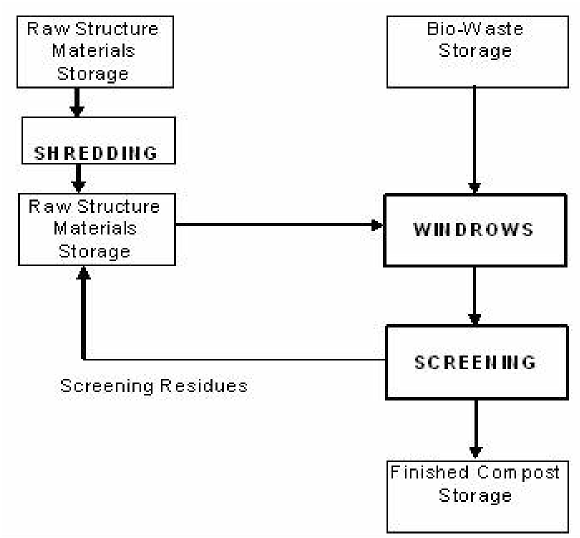

Figure 17: Windrow composting technology scheme[188]

The main material flow for anaerobic digestion is presented by the Scuola Agraria del Parco di Monza as follows:

[188] Preparation of Solid Waste Management Measures in Pazardjik, Pleven and Vidin Regions, (EuropeAid 117409/D/SV/BG) Investment Plan for Waste Management Development – Vidin Bulgaria

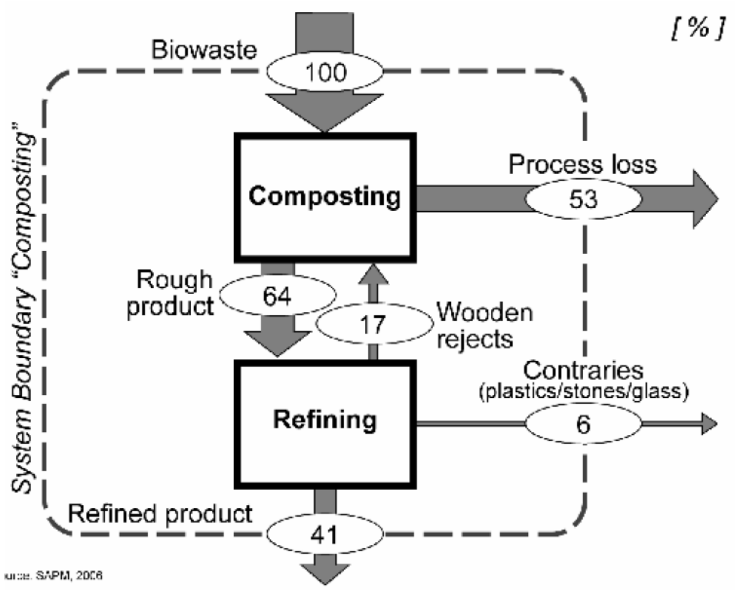

Figure 18: Material flow for aerobic digestion / composting of food waste

5.4.6. Treatment of animal waste

Depending on the type of animal waste, different treatment types are allowed. Since the outbreak of BSE, which was spread through prions present in animal by-products and waste, food safety considerations became predominant in the recycling and disposal options for waste with different risk aspects – see Section 3.5.3 for the regulatory context. The basic approach for hazardous waste remains incineration or conversion into animal flour and fat.

The scheme below represents the standard process flow within RENDAC[189], a major company in the treatment of animal corpses and animal waste category 1 and 2 in the Benelux:

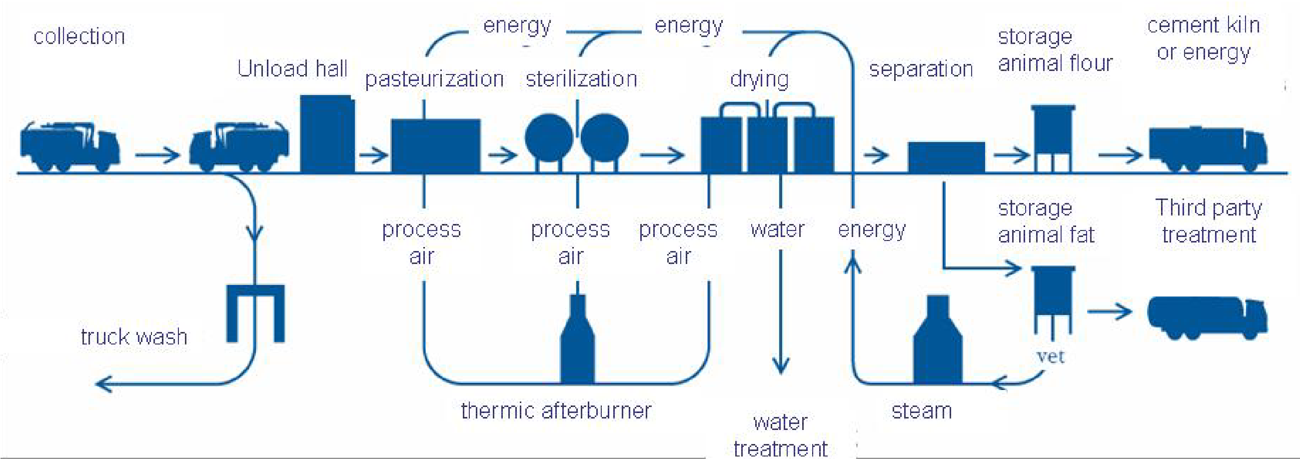

Figure 19: Treatment of animal corpses and cat I and II waste in installations of Rendac.

[189] RENDAC, Jaarverslag 2007, http://www.rendac.com/nl/pdf/rendac2007.pdf

5.4.7. Treatment of frying oils

Valorfrit, the notified body for the EPR of frying oils in Belgium, reports on its website[190] that in 2007 63% of the collected frying oils and fats are used for the production of biodiesel, 14% is used in technical applications like presswood, plastics, industrial soaps, lubricants,… 23% is incinerated with energy recovery. Recycling in animal feed is forbidden for reasons of food safety.

BDI, Biodiesel International[191] in Austria, uses a mixture of fresh plant oils, waste cooking oils, animal fats and fatty acids as a raw material for their transesterification process. Alcohol and a catalyst, as well as acids to treat the by-products are necessary resources. The process ends up with biodiesel and two by-products. Glycerine, which can be used as a raw material in the chemical and pharmaceutical industries, and a solid material that can be used as potassium fertiliser in agriculture and the fertilizer industry.

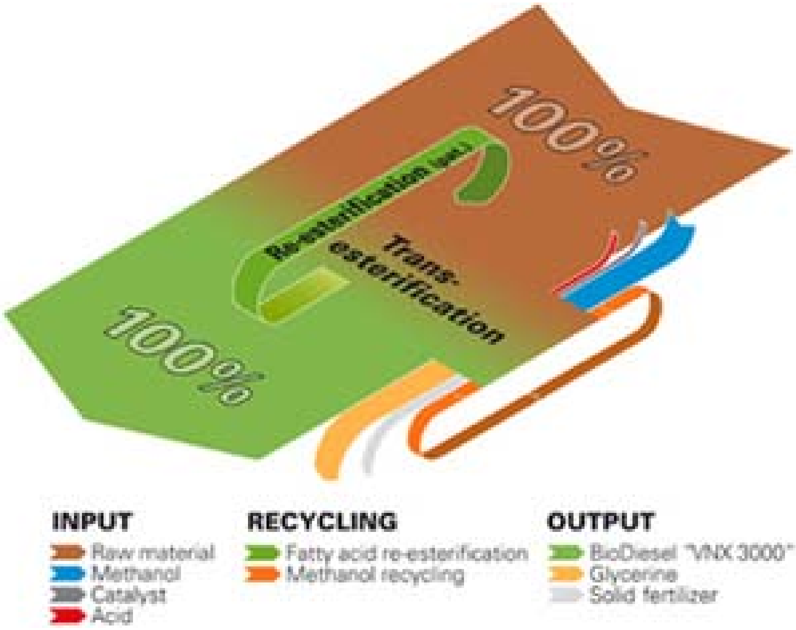

Figure 20: Inputs and outputs of the transesterification process of BDI

5.4.8. Link between collection system and technological options[192]

Household organic waste is composed of three fractions:

- Kitchen waste: food waste, fruit, vegetable
- Garden or green waste
- Paper and cardbaord

[190] www.valorfrit.be

[191] http://www.biodiesel-intl.com/

[192] The information in this Section is based upon Gabarda Oliva (2004), L'application de la méthanisation aux déchets alimentaires des restaurants collectifs et commerciaux, ADEME.

As organic waste have traditionally been composted, most selective collection systems in Europe aim at recovering compostable waste, even if they are destined for biogas production: green waste, and to a lesser extent, kitchen waste. Collected biodegradable waste can thus contain up to 80-90% of green waste, while the mixed fraction can contain up to 50% of kitchen waste. However, the biogas potential for green waste is limited.

5.5. TECHNOLOGY FOR CARDBOARD RECYCLING

5.5.1. Paper and board recycling: overview

Cardboard can be reprocessed up to six times before the fibres become too short and begin to disintegrate. The cardboard recycling process involves soaking the cardboard in water to release the fibres and form a pulp. At this stage metal and ink contaminants are removed, finishing chemicals are added and the pulp is pressed into sheets and dried[193].

There are broadly speaking 2 channels for waste paper and cardboard (ALCIMED 2005, p.68):

- A first channel groups the paper and the cardboard that is not de-inked. In this channel, the mechanical properties are more important than the visual properties.
- A second channel groups the paper and the cardboard that is de-inked. In this channel, the visual properties are more important than the mechanical properties.

The different grades of recovered paper and cardboard are determined by:

- The visual properties
- The mechanical properties (partly linked to the length of the fibre)
- The quantity of contaminants: glue, ink, plastics, metals

According to Miranda and Blanco (2008), depending on the origin of the collected recovered paper, a clear distinction exists between pre- and post-consumer recovered paper. Pre-consumer recovered paper is paper and paperboard material from manufacturing, converting and finished paper from obsolete inventories. Post-consumer paper comprises paper and board recovered from retail stores, offices and homes after these products have been used as consumer items and papers separated from municipal solid waste. It is also very important to distinguish between the municipal and the industrial collection channels, because the collection circuits are very different. The main characteristics of the recovered paper of each source are summarized in Table 37.

Table 37: Main characteristics of the recovered paper depending on its source

Source			**Quality**	**Homogeneity**
Pre-consumer	Industrial channel	Printing, converting and finishing	Medium-High	High
Post-consumer		Trade & industry	Medium-High	Medium
	Municipal channel	Offices & Administration	Medium	Medium
		Others (household, small shops, etc.)	Low-Medium	Low to medium

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193 WasteBook (2008) *Recycled paper products*, http://www.wastebook.org/recpap.htm

5.5.2. Paper and board recycling: problems[194]

In a recent study, ALCIMED has identified the following possible obstacles for paper and board recycling:

- In the past, paper bales were bound by metal cords, and techniques existed to recover them during the pulping. These metal cords can now be replaced by polypropylene ones, for which no equivalent technique exists.

- Radio Frequency Identification (RFID) markers are being introduced in order to trace products. If these are used to mark paper and cardboard packaging, this will result in new contaminants for which the paper mills do not have yet a sorting technique.

The amounts of sticky materials are increasing as well. Indeed, as a side-effect of the efforts to reduce the weight of packaging, the use of glue has increased. Moreover, labels are used more and more as a marketing tool. The main difficulties linked to the elimination of these "stickies" are:

- Micro-stickies (< 100 µm) can clutter following a thermal or chemical shock, and can cause an interruption of machine operations.
- The elimination of macro-stickies (> 100 µm) leads to a loss in long fibres (which are of approximately the same size).

Efficient R&D in this domain would require coordinated efforts by the paper industry and the glue manufacturers.

Another issue is the use of flexographic ink[195]. Traditional flotation techniques separate the hydrophobic particles of which traditional offset inks are composed[196]. This result cannot be obtained for the hydrophilic particles of flexographic ink. It has however been demonstrated that it is possible to limit these hydrophilic properties, in order to avoid these particles to dissipate in the waste water of the mill (which is reused in a closed loop system). The mixing of paper waste using flexographic ink and paper waste using offset ink causes difficulties for the tuning of de-inking techniques. Using recyclable flexographic ink in all applications could only become economically viable if this type of ink could be used for 60 to 80% of the volume of printed matter.

R&D is currently undertaken to tackle these issues.

Most of the problems identified above are due to the fact that paper mills function without knowing the exact composition of the products they process. The ALCIMED study has estimated that the use of sensors could increase the productivity of recycled paper production by 50 to 85% for the fraction that is de-inked and by 95% for the fraction that is not de-inked.

Currently, no commercially viable technique exists to separate short fibres from metal, plastic and wood contained in the paper pulp. The main difficulty here is that both have approximately the same length. The elimination of metal, plastic and wood is important for the production of sanitary and household paper. A centrifugal technique has been tested, but has turned out to be hugely energy consuming.

[194] Unless stated otherwise, all information in this section has been obtained from ALCIMED (2005).

[195] See http://en.wikipedia.org/wiki/Flexography for a description of flexography.

[196] See http://en.wikipedia.org/wiki/Offset_printing for a description of offset printing.

Finally, the composition of sludges resulting from the de-inking is highly variable. Therefore, they are used less and less in agricultural land spreading. Cement kilns or energy recovery are alternative possible uses, but no alternative recycling application has yet been found.

Section 9.10 contains more details on how these issues are dealt with in France.

5.5.3. Beverage cartons

Unless stated otherwise, all information in this Section (including graphics) comes from the following sources:

- Tetra Pak brochure "Recycling of used beverage cartons in Europe".
- Tetra Pak and ACE website
- Information provided per e-mail by Hanneke de Leeuw of ACE
- Meeting with ACE of 30 May 2008 (including PPT presentation "Beverage carton recycling in Europe")

Beverage cartons designed to distribute food products at ambient temperature contain on average 75 % paperboard, 4 % aluminium and 21 % polymers. On the inside of the package the paperboard is coated with a thin (6 µm) aluminium foil as a barrier against oxygen, flavours and light and also a thin polyethylene film that seals in the liquid food. The outside of the beverage carton is coated with polyethylene to protect food against moisture and bacteria. Beverage cartons designed to distribute food products under refrigerated conditions may not contain aluminium. The composition of individual beverage cartons differs according to packaging sizes, functionalities and among manufacturers.

Beverage cartons designed for fresh products like milk and juice contain on average 88% paperboard and 12% polymers.

Beverage cartons can be recycled into new paper products such as office stationery (not common), tissue paper, cardboard, corrugated board and paper bags. Beverage cartons are not recycled into beverage cartons again, since the fibre composition of beverage cartons is entirely made from food-contact approved virgin pulp fibre.

The collection system will affect the options open for sorting and recycling:

- Beverage cartons collected from households in an appropriate paper container are either sent to a paper sorting centre or are baled and sent directly to a paper mill. This waste paper is typically separated into newsprint, corrugated board and mixed paper. Generally beverage cartons remain with the mixed paper grade for recycling if they represent less than 5% of the total. In Sweden however, where used beverage cartons represent up to 35% of the paper packaging collected, they are recycled together with the other paper packaging without any sorting.
- In countries where beverage cartons are collected in the same container as plastic bottles and cans, the different materials must be separated either manually or automatically before being sent to recycling plants.

ACE claims that the technology for recycling beverage cartons is simple and widely available.

5.5.3.1. Fibre recovery

The most common way to recycle used beverage cartons is through recovery of the fibre at paper recycling mills. Recycling mills take paper and cartons and put them into a large vat of water, where they are swirled around. The swirling action rubs the fibres apart, helping the paper "dissolve" faster. The fibres absorb water and become part of a great slurry of watery fibre. Any non-paper elements (such as polyethylene and aluminium) will either float or sink and can be picked, scraped or sieved off. This process usually requires about 15-30 minutes and will recover most of the fibre.

The virgin fibres can be used as raw material for new paper and board products.

The fibre content corresponds to 75% of the weight of the drink carton before it was filled. But since there is always some unavoidable drink residual in post consumer drink cartons, the fibre contents corresponds to 60% of the weight of the collected cartons[197].

This is not the case for the experience from Hurum paper mill, recycling beverage cartons from the Norwegian market for 14 years. These cartons are emptied and dry so that there is no residual product left in the cartons prior to collection and recycling.

5.5.3.2. Recovery of non-fibre components

Recovery and recycling of the polylaminate (aluminium-polyethylene) extracted during the repulping process varies from country to country.

Aluminium and polyethylene recovered from the repulping process can also be recycled in a variety of ways:

- In one major German paper mill, polyethylene and aluminium are used as catalysts for cement kilns. The mixture of polymers and aluminium is fed into the kilns as an alternate form of fuel, usually displacing coal. The process of generating energy leaves the aluminium oxidized. Aluminium trioxide is an ingredient in cement.
- The Finnish company Corenso recovers each part of the beverage carton: the repulper recovers the paper fraction, while a gasification plant recovers the aluminium foil and produces energy. Corenso is specialized in producing paper cores, extensively used both in the paper and in the textile industry. While producing virgin aluminium from bauxite is very energy intensive, recycling aluminium takes a fraction of the energy. Consequently new aluminium products can be made more economically. Plastic is used to generate energy, that produces steam for the paper mill (for pulp drying) and energy to the city of Varkaus.
- At the StoraEnso mill in Spain, the polylaminate is currently landfilled but an investment is under way to use pyrolysis to separate the aluminium from the polyethylene. The aluminium will then be recycled, while the polyethylene will break down into a combination of methane and ethane. These gasses will then be burnt in a boiler or will replace natural gas used in the paper machine.
- In Sweden, Fiskeby AB recycles paper packaging from households, including up to 35% beverage cartons. They have recently decided to build a solid fuel incinerator that will give Fiskeby enough steam for their entire operation plus generation of 50% of the electricity they need. The capacity

[197] Information provided by Juan Vila of StoraEnso in telephone interview on 26 May. ACE has commented that this figure seems too high to them. According to their knowledge, there is an average rest of about 2ml per 1-Liter carton which is partly pressed out in the pressing and baling process. They have also pointed out that adherences and residuals are also the case for every other kind of beverage packaging material.

of the incinerator is 95,000 tons/year and the residuals from recycling the paper packaging will be one part of the fuel.

To date, we have no specific information on the recovery technology in other paper mills. However, it should be noted that the European mills described above represent more than half of the global recycling activity.

5.5.3.3. Suitability for energy recovery

Beverage cartons have a calorific value in the range of 20-25 MJ/kg, and are therefore suitable for energy recovery. The calorific value of the non-fibre polyethylene and aluminium components available after the fibre recycling process is typically around 30 MJ/kg.

6. PRELIMINARY ASSESSMENT OF THE MARKET SITUATION AT THE EUROPEAN LEVEL

6.1. THE WASTE MANAGEMENT SECTOR

Hopstaken (2007) distinguishes between the following business concepts in household waste companies:

- Multi Utility (Veolia, SITA): these firms are also involved in activities such as waste, energy, transport and water. Hopstaken claims that the multi-utility approach does not create much synergy.
- Vertically integrated waste services (Remondis, AVR/VG): these firms cover services ranging from collection to treatment and recycling. Hopstaken claims that this "one stop shop" approach is a profitable concept: it focuses on the customer, leads to low risks in capacity planning, encourages the development of new products and allows to optimize the product chain.
- Niche player (Biffa, ALBA, Interseroh, Shanks): these firms focus on a technology, a concept, a region, a sector… They are limited by scale, and Hopstaken is not aware of multinational examples.

In a recent report, Hall (2007) has given an overview of the waste management sector in Europe.

According to Hall, between the start of 2006 and June 2007, a significant concentration has taken place in the sector: there have been 16 major mergers and acquisitions in waste management, for a total value of 12.5 billion EUR. In half of the deals, private equity firms were involved as buyer and seller, and they were involved in all the largest deals.

Table 38 Largest municipal waste management companies in Europe 2007 (Hall (2007))

(P=private; PE=private equity; M=multinational, stock exchange listed; Mun=municipal)

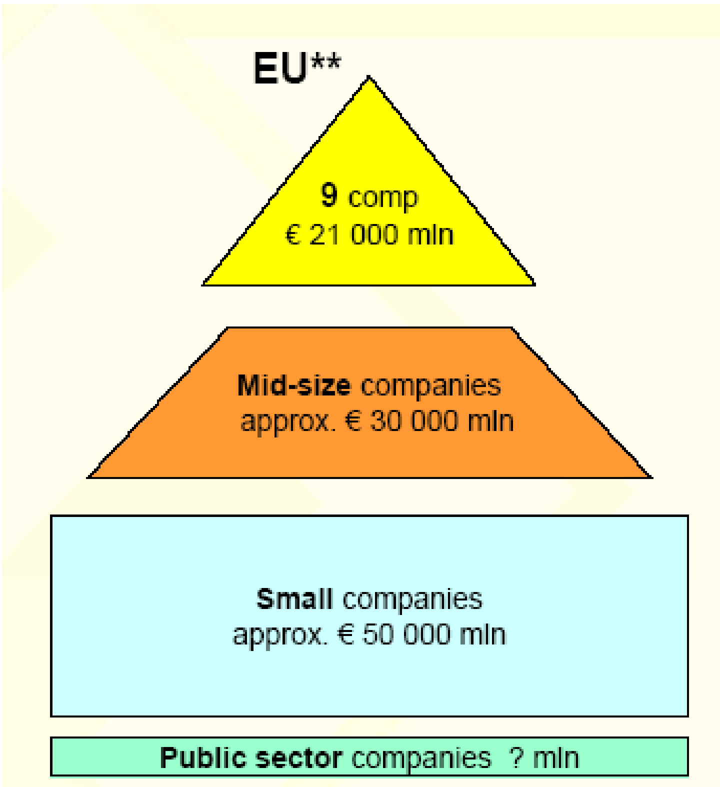
				Sales (in million EUR)	
	Parent company	**Parent country**	**Parent type**	**Europe**	**Global**
Veolia/Onyx	**Veolia**	**France**	**M**	**6600**	**8900**
Sita	**Suez**	**France**	**M**	**4500**	**5000**
Remondis	**Rethmann**	**Germany**	**P**	**2900**	
FCC		**Spain**	**M**	**2800**	
Urbaser	**ACS**	**Spain**	**M**	**1275**	
Biffa		**UK**	**M**	**1100**	
Alba		**Germany**	**P**	**1100**	
AVR/Van Gansewinkel	**KKR/CVC**	**(USA/UK)**	**PE**	**1030**	

Cespa	**Ferrovial**	**Spain**	**M**	**823**	
CNIM		**France**	**M**	**522**	
Shanks		**UK**	**M**	**509**	
Lassila & Tikanoja		**Finland**	**M**	**436**	
Séché		**France**	**M**	**379**	
Ragn-Sells		**Sweden**	**M**	**348**	
Delta		**Netherlands**	**Mun**	**336**	

This table shows very clearly the very uneven distribution of size within the sector.

A similar picture emerges from the following figure, taken from Hopstaken (2007).

Figure 21: Market consolidation at the EU level



According to Hall, all commentators and observers expect further concentration through acquisition.

According to Hall, the percentage market share of the three largest waste companies exceeds 40% in Spain, France, Netherlands and Belgium, and is close to it in Germany.

A high level of market concentration does not imply in itself that market power can be abused (see Section 2.2.1). Hall claims that there is evidence of established companies from western or central Europe exploiting business in Eastern Europe through contractual manipulation. We will come back to this issue in Section 13.2.1.

Table 39 : concentration by country 2006: percentage market share of largest three operators

Country	% share of largest 3 operators
Spain	57
France	47
Netherlands	44
Belgium	41
Germany	38
UK	23

6.2. PVC

6.2.1. Number of players

According to APPRICOD (2006, 19), around 3,000 companies in Europe are active in the mechanical *plastics* recycling industry, meaning that they actually have machines installed to either shred, grind, wash, regenerate and/or compound. About 80% of the total volumes that are mechanically recycled are, however, processed by less than 100 companies. This implies that the market contains a lot of very small companies. A lot of companies in the recycling market are still family-owned businesses, and certainly not only the small ones, but even the larger recyclers are still SMEs. Others, meanwhile, have links with either plastic converter groups or waste collection companies. Most companies specialise in recycling part of the plastics waste stream, doing for example only PVC waste and others doing only PET bottles.

According to Ingham (2005), the small scale of a typical firm in this industry is due, on the one hand, on the diversity of polymers and products, and on the other hand on the required (small) scale of investment.

According to AJI Europe (2006), the structure of post consumer *PVC* waste in the EU15 is rather concentrated. Among the 97 recyclers who provided data to AJI for their survey, the 10 largest have performed 51% of the total recycling. However, there are also a lot of SMEs who treat post consumer waste occasionally.

Since the AJI Europe study, several new recyclers have been identified. Most of these new players recycle directly from (mostly flexible) PVC waste into new materials (such as traffic cones). This activity is big in the UK, but is still developing in France and in the CEEE. In total, it is estimated that 30 to 40 companies in Europe are dealing with this. There is also some mechanical recycling to horse mats, carpet mats and stable mats (mostly from soft PVC). EuPR estimates that there are more or less 100 companies operating in Europe. There is a tendency now to integrate up- or downstream of the recycling stage. Until a few years ago, collectors were not interested in PVC because of its bulky nature. However, as Recovinyl only provides financial incentives if the waste goes to a certified recycler, it is becoming an advantage for a company to be an integrated collector and recycler.[198]

[198] Information provided by EuPC and EuPR in face-to-face interview.

According to a stakeholder who required remaining anonymous, incumbents in the recycling industry keep excess capacity and could increase supply at low cost in the case of entry. This has been confirmed by Vinyl2010[199].

EuPR and EuPC expect that REACH will lead to a complete restructuring of the recycling sector. Indeed, REACH entails some fixed costs that require economies of scale. For instance, for post-consumer waste, knowing what substances have been used would require analysing every single batch – EuPC and EuPR claim that this would make recycling up to 50 times more expensive[200]. Vinyl 2010 also take the position that REACH is not well adapted to waste recycling, especially the provisions mandating detailed information of downstream users.

On the demand side, there are some large players in the pipe manufacturing sector. As pipes are often used in sewage systems, this is also driven by public procurement.[201]

6.2.2. Geographical Size of the market[202]

Concerning the size of the market, it should be noted that with the Vinyl 2010 system, there are very little barriers to movements of PVC waste. Because of the high price of the raw material, the relative importance of transport costs has decreased. It is now cost-effective to drive up to 400 km per truckload[203].

In the New Member States, only Poland, Hungary, and the Czech and Slovak Republic are important. In the absence of producers, there will be no recyclers either, because they need an outlet close by.

6.2.3. Functioning of the market[204]

Both long term contracts and spot markets are used. The specifications needed are determined by the converter. It is possible that some users ask for material of an inferior quality, but these are niche markets. EuPC and EuPR think there is no need for formal dispute settlement systems. Web based exchanges are used. There are not many traders in post-consumer waste, but there are a lot for post industrial waste.

There are still standards at the European level preventing the use of recycled materials. For instance, waste bins cannot be made in recycled plastic!

The most important substitutes for recycled PVC are: in flooring: linoleum; in window frames: aluminium.

[199] E-mail of 08 July 2008.

[200] We have no independent assessment of this claim.

[201] Information provided by EuPC and EuPR in face to face interview. Confirmed by e-mail correspondence of 08 July 2008 by Vinyl 2010.

[202] Information provided by EuPC and EuPR in face to face interview, or by Vinyl 2010 per e-mail of 08 July 2008.

[203] A stakeholder has confirmed that it does not make sense to analyse the market for recycling following national boundaries.

[204] Unless stated otherwise, all information in this section was provided by EuPC and EuPR in a face to face interview.

However, due to the fact that PVC can substitute almost all materials depending upon size and application, almost all materials are potential substitutes of recycled PVC (wood, steel, aluminium, other plastics ...)[205].

Prices for recycled PVC are transparent and are quoted on websites and trade magazines.

It should also be noted that there is a lot of in-house recycling of post-industrial PVC waste. For instance, in calendaring, cut-offs go directly back to the assembly line without having been polluted.

A stakeholder who required to remain anonymous pointed out that mixed PVC streams- mixed material streams – make the sorting and purifying sometimes very costly, or even impossible. Breaking down to molecular size is still too expensive nowadays. The collection schemes for the flexible PVC are not yet in place, and landfilling and incineration are still possible and cheaper in many countries.

According to this stakeholder, the following 3 reforms would be the most effective in order to improve recycling:

- Complete ban of landfilling plastic material
- Set up a realistic regulation about heavy metals in plastic, allowing their use in known recycled articles
- Implement a mandatory content of recycled material in all public procurement , including PVC

Vinyl 2010 suggests the use of tax incentives to promote the use of recycled materials. With respect to standards, Vinyl 2010 thinks that standards targeted at the material composition of a product should be replaced by standards targeted at their performance – standards that specify that recycled materials cannot be used should be abolished. Mandatory sorting and clear end-of-waste criteria are also part of the tools favoured by Vinyl 2010.[206]

The International Recycling Federation (FIR) has also indicated some barriers to recycling PVC from C&D waste[207]. Sometimes municipalities own landfills and have no interest to divert waste from their landfill. In the case of C&DW in many instances the waste is used for backfilling of quarries. The FIR draws the rather radical conclusion from this that a ban on landfilling is the only way to promote recycling.

6.3. BATTERIES

6.3.1. Lead acid storage accumulators[208]

In order to understand the functioning of the market for waste lead-acid accumulators, it is essential to have a look at the evolution of the price of the primary product. Between 1991 and 2003, the price fluctuated around 500 EUR per tonne – by 2008, it had almost quadrupled.

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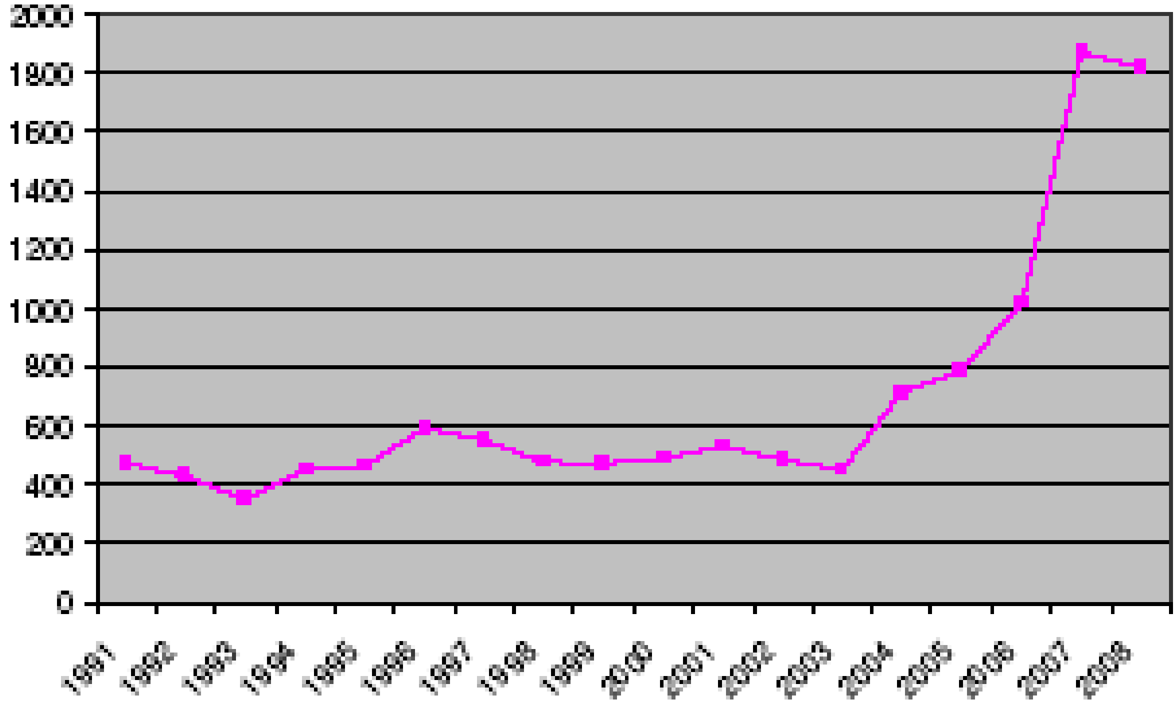
[205] Information provided per e-mail by an anonymous stakeholder.

[206] E-mail of 08 July 2008.

[207] E-mail of 23 May 2008.

[208] All information in this Section has been provided per e-mail by an anonymous stakeholder and Recybat.

Figure 22: Lead price on the LME



The major consumer of materials recovered from these batteries is the lead battery industry. Some of the battery producers are also recyclers[209]. Moreover, some recyclers are also vertically integrated in the collection and sorting of storage batteries. According to an anonymous stakeholder, this vertical integration constitutes a barrier to entry in the market for recycling. In these applications, the recovered materials compete mainly with primary lead. There are no legislative barriers to the export or the import of the recovered materials.

The International Lead and Zinc Study Group[210] publishes lists of secondary lead smelters. The supply side of the market is thus concentrated with a few large suppliers and a lot of small players. This is mainly due to the important investment outlays required for entry.

The pricing of primary and secondary lead, however, takes place according the respective LME settlement. Compared to the price of primary lead, the price of secondary lead is judged to be volatile.

Scrap dealers operate on the market as traders.

6.3.2. Functioning of the market

According to an anonymous stakeholder, there are important sunk costs (including due to environmental regulations) in the markets for batteries recycling. Also, in the case of electrolysis, there are economies of scale: a minimum level of collection is necessary for the technology to be viable.

Amongst the factors affecting the market equilibrium, this stakeholder mentions the perception that recovered materials are of inferior quality and the existing government policy does not internalize the

[209] In practice, this recycling is usually undertaken by subsidiaries.

[210] http://www.ilzsg.org/static/home.aspx

external costs of landfilling and incineration. Some European countries accept slag recovered from pyrometallurgical processes for use in road construction. This stakeholder considers this application as an example of valorisation but thinks it should not be included for the calculation of recycling rates.

In the current situation, some countries consider some materials as waste and it is not possible to use them for any other purpose while others allow their use for road construction. In general, some laws consider materials obtained from a recycling process as a waste or by-product and not as a product. In this way it is impossible to sell in the same conditions as the substitutes because more documentation is needed.

In order to create a level playing field, this stakeholder thinks that European law should be standardised, or the export of collected batteries within and outside the EU should be discouraged.

According to Mr Beaurepaire of EBRA[211], zinc and manganese do not allow to cover the operational costs of recycling. Nickel, however, can generate important revenues[212]. The presence of lead in a battery is sufficient in itself to justify the creation of a collection channel. For the following types of batteries, the revenues from recycled material cover the operational costs of recycling: Nickel Cadmium, Nickel Metal Hydride, Lithium Ion.

Mr Beaurepaire reckons that deposit-refund systems cannot work with batteries. Contrary to, for instance, the purchase of drinks, the purchase of batteries is often impulsive. According to Mr Beaurepaire, Denmark has tried a deposit refund system for NiCd batteries, but this has been a failure[213]. The system has created a lot of revenues for retailers but has not induced a behavioural change. One of the possible explanations is that, often, batteries are part of an equipment with a much longer lifetime. Therefore, the retailer who sold the original equipment will often no longer exist when the battery reaches its end of life. Also, people buy batteries in a wide diversity of places (including while they are travelling, or on the Internet). However, end-of-life batteries will tend to be brought to a few retailers, and this can create problems (including the management of the financial streams).

The objectives imposed by public authorities are based upon the individual responsibility of the producer, even if a collective organisation is created. However, Mr Beaurepaire points out that this collective organisation is a barrier to competition. Another drawback of collective organisation is understood when one realises that the lifetime of a battery is determined in the concept phase. In collective organisms, the contribution of individual producers does however not depend on the lifetime. Thus, a producer who markets poor quality batteries does not have to pay a higher contribution. According to the new Battery Directive, the producers have to mark the capacity of the battery. This could allow a differentiation of contributions according to the capacity of batteries.

According to RREUSE[214], the following reforms would be crucial to improve the recycling of batteries:

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211 Phone interview on 22 May 2008.

212 For NiCd, the figures provided in the 2003 EBRA study (see http://www.ebrarecycling.org/) are no longer representative.

213 We have no independent assessment of this claim. However, the Danish tax on NiCd batteries has been discussed elsewhere. See for instance :

http://www.economicinstruments.com/index.php?option=com_content&task=view&id=60&Itemid=96

214 Information provided per e-mail by RREUSE (Reuse and Recycling European Union Social Enterprises).

- Introduction of public collection schemes for batteries and battery-containing small appliances, guaranteeing easy access for the public to dispose of them correctly. Collection schemes where only separated batteries are collected miss a relevant amount of batteries which the consumers are not willing or even not able to separate from the product. Existing collection schemes by retailers are often not convenient for consumers (and often not promoted by the retailers). Financing of such schemes by producers, as required by EPR principles and the polluter-pays principle will be difficult to enforce.

- The WEEE directive demands to dismantle appliances and to separate batteries before any mechanical treatment that can destroy hazardous components (like batteries). RREUSE claims that there is a lack of enforcement by the Member States. Despite the legal requirements in the WEEE directive and in most national implementations, many treatment techniques are simple not able to separate batteries from the other material streams, making recovery of special materials nearly impossible. Therefore, many batteries are shredded within the treatment process of WEEE, with most battery-specific materials not separated afterwards.

- Ambitious recycling targets for batteries, probably best implemented via a system of tradable certificates for recycled content, would give an additional incentive for more and better recycling. RREUSE does not specify how they would see such a system function in practice.

- RREUSE is not convinced by the arguments of the industry concerning the possibility of working with a deposit refund system. Although many batteries will not come back to where they were sold, this could be solved, e.g. via a central fund into which producers pay according to the amount of batteries they put on the market, and out of which retailers get their money according to the amount of batteries they take back. RREUSE claims that the problems related to the financing of the take back of WEEE are much more complicated.

In a phone interview, Mr Craen of EPBA has clarified the view of EPBA on some aspect of the functioning of the market:

- The EPBA has confirmed that in some countries, free-riding is an important problem for the PRO. In some cases, this is due to a lack of resources that the public authorities invest in enforcement. In some countries, it is also very easy to set up a new company if controls become too tight. Batteries in toys are a specific problem. Currently, the batteries contained in WEEE do not always enter the battery channel.

- EPBA does not favour one specific system. Population density, geography, level of awareness and social conditions are very important factors in the design and the success of a system. EPBA takes the view that the system must be as easy as possible for the end user.

- The position of EPBA is that deposit-refund systems cannot cope with the wide diversity of sale and collection channels.

- Primary batteries remain an essential complement to rechargeables, for instance for applications with infrequent use or long term use with low drain rate.

- EPBA cannot provide specific data on the cost price of collection and recycling systems.

An alternative approach to introducing a deposit refund system could be to use the introduction of such a system as a threat should industry (or individual companies) not meet some specified target. This approach has been used in The Netherlands and Sweden[215].

Generally speaking, the market for battery recycling is very concentrated per battery type.

The table below gives the number of recyclers in Europe per battery type (data for 2005)[216]:

Table 40: Number of recyclers per battery type in Europe

Battery type	Number of recyclers in Europe
Primary battery recyclers	14
Secondary battery recyclers	
NiCd	3
MiMh	4
Button cells	6
Lithium-ion	3
Lead-acid	?

Concentration of a market does not imply in itself that abuse of market power will take place.

In 2003, the European portable battery recycling capacity was still much larger than the quantities collected.[217] This was due to the high expectations announced a few years ago by some countries who subsequently failed to put in place effective collection methods, largely as a result of the lack of ambitious objectives from the original Batteries Directive. It is believed that the French company Citron alone has enough capacity to deal with all collection required by the UK to meet the 2012 targets.

Table 41: Principal European Battery Reprocessors (Alkaline Manganese and Zinc)

Company	Process Category	Battery Chemistries Treated
Recupyl (France)	Hydrometallurgical	AlMn, ZnC, ZnO, Li, LiMn, Li-ion
Revatech (Belgium)	Hydrometallurgical	AlMn, ZnC, ZnO
G&P (UK)	Mechanical stage only	AlMn, ZnC, ZnO

[215] Veronika Langrová (2002), Comparative Analysis of EPR Programmes for Small Consumer Batteries. Case study of the Netherlands, Switzerland and Sweden. Thesis for the fulfilment of the Master of Science in Environmental Management and Policy, Lund, Sweden, September 2002

[216] Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries

[217] Economic and social aspects related to the collection and recycling of used general purpose batteries, EBRA, September 2003. http://www.ebrarecycling.org/

Citron (France)	Pyrometallurgical	AlMn, ZnC, ZnO
Batrec (Switzerland)	Pyrometallurgical	AlMn, ZnC, ZnO, Li, LiMn, Li-ion
Valdi (France)	Pyrometallurgical	AlMn, ZnC, ZnO

However, one stakeholder interviewed by the project team has made the following observation:

- Waelz kilns do have some market power. The prices they ask for the recycling of zinc-carbon batteries does not follow closely variations in the market price for zinc. Moreover, the vast majority of these kilns are owned by one single group (BEFESA).
- In some countries, almost all batteries are recycled within the national boundaries. Of course, transportation costs could play a role in this, but the stakeholder suspects protectionist motives to play a role as well. He does not provide hard facts for this, however.
- Industrial users are mainly located in France and Germany, the two countries that collect the highest amounts of batteries. This situation can be linked to the industrial past of these countries, with historically high rates of non-ferrous metal recycling.

Concerning the values of the recovered materials, the following observation can be made

- Steel follows the market price
- Recovered plastics are used as fuel in cement kilns, who require up to 150 EUR per tonne to accept them
- Recovered carbon is used as a reducer but has no economic value
- Manganese goes into the slag used for road construction and has no economic value.

The European Recycling Platform (ERP) claims that restrictions on transborder shipments affect the recycling of batteries negatively for the following reasons: [218]

- The share of transportation costs in total costs range between 15% and 50% depending on the number of collection points serviced and distances to recycling facilities. Due to the escalating global energy prices, this cost element is accounting for a larger and larger share of the total battery collection and recycling compliance costs for producers. ERP claims that opportunities to reduce these costs by leveraging co-transportation possibilities are hampered due to the fact that mixed waste batteries are designated hazardous waste and therefore fall under a stricter control regime under EU law.
- High quality recycling processes (both sorting and recovery) can only be performed economically when reaching economies of scale. The necessary feedstock for a single processing unit exceeds normally the volume generated in a single European member state. Therefore they claim that transborder-shipment within Europe is essential to achieve a cost-effective high-quality standard.

[218] Information provided per e-mail on 15 July 2008.

6.4. FOOD WASTE

6.4.1. Compost

This Section is based entirely on Barth et al (2008, pp 18-19).

Generally speaking, data are not consistent, and it is not easy to obtain reliable numbers on biowaste and green waste collection and potential as well as compost production.

Often, it is not possible to differentiate between biowaste and green waste since there is an important variety of collection systems for those fractions. The quantity of sewage sludge treated via composting is a specific problem.

Barth et al estimate that the collectable amount of compostable biowaste and green waste in EU 27 is 80.1 Mt whereof 29.5 % or 23.6 Mt are currently separately collected. Barth et al cannot provide the proportion that is composted or (pre-)treated in biogas plants, but they estimate that the total production of bio and green waste compost is 10.5 Mt.

Table 42: compost production in EU 27 in Mt

Biowaste compost	Green Waste compost	Sewage sludge compost	Mixed waste compost	Total
4.8	5.7	1.4	1.4	13.3

Barth et al reckon that biowaste and green waste composting correspond to a total compost potential of 35 to 40 Mt. They also point out that if 15 % of the total municipal sludge production (approximately 5.3 Mt fresh matter sludge) would be considered for being composted together with the same amount of bulking agents and green waste this would result in ca. 5 Mt of compost.

Barth et al have obtained data on compost market sectors from 12 countries, representing approximately 80 % of the EU compost production. The average distribution of the market shares is:

- Agriculture – more than 50% (increasing)
- Landscaping – up to 20 %,
- Growing media production (blends) and manufactured soil – around 20 %
- Private consumer market with hobby gardening and wholesales – up to 20 %

Countries with mainly mixed waste compost production and little developed markets strongly rely on agriculture (for instance Spain and France) or on land restoration/landfill covers (for instance Poland). In Poland, the low quality produced leads to 100% use in land restoration/landfill covers.

Table 43: compost market shares of various sectors in major European composting countries (%)

EU Market shares 2003-2006	**AT** **2003**	**Flanders** 2005	**DE** 2005	**ES (green waste compost) 2006**	**FI** 2005	**FR (mainly mixed waste compost)** 2005	**HU** 2005	**IE** **2006**	**IT** **2003**	**NL** **bio-waste** 2005	**NL** **green waste** 2005	**PL (mainly mixed waste compost)** 2005	**SE** 2005	**UK** 2005	**Mean** EU %
Agriculture	40.0	1.0	53.4	88.0	20.0	71.0	55.0	37.0	51.0	74.8	44.4	-	-	30.0	**48.0**
Horticulture & green house production	10.0	1.0	3.9	8.0	-	25.0	15.0	3.0	-	-	15.5	-	5.0	13.0	**11.3**
Landscaping	15.0	22.0	15.9	4.0	20.0	-	10.0	6.0	6.0	3.6	12.3	-	20.0	14.0	**12.4**
Blends	15.0	6.0	13.6	-	10.0	-	-	16.0		15.0	5.1	-		2.0	**10.3**
Soil mixing companies	2.0	21.0	-	-	-	-	-	-	-	-	9.4	-	10.0	-	**10.6**
Wholesalers	-	9.0	-	-	-	-	-	-	-	-	5.2	-	15.0	-	**9.7**
Hobby gardening	15.0	20.0	11.9	-	-	4.0	5.0	-	27.0	1.1	2.3	-	10.0	25.0	**11.0**
Land restoration and landfill cover	2.0	1.0	-	-	50.0	-	15.0	38	2.0	-	-	100.0	40.0	16.0	**26.4**
Export	1.0	7.0	-	-	-	-	-	-	-	5.5	5.0	-	-	-	**4.6**
Others	-	2.0	1.3	-	-	-	-	-	-	-	0.8	-	-	-	**1.4**

Application areas like agriculture require standard quality, while landscaping or even the growing media sector need upgraded and more specialised products, but compost type is of minor relevance as long as the plant performance is positive.

Barth et al reckons that at least in countries with an advanced biowaste and compost business, the market seems to be stable, though with a slight trend towards substrates and ready made products for landscaping and potting soil. They conclude:

- Countries with well established biowaste recycling are still faced with increasing amounts of green waste from private and public estates. Part of it – besides the use for energy recovery from biomass – will still go into composting;

- Sewage sludge is expected to be an increasing source for composting where direct use in agriculture and incineration are not the preferred options;

- Manure composting including separated (dewatered) slurry might be developed as an alternative treatment in areas with considerable excess of livestock (as a measure for organic sorption of organic nitrogen).

According to Bath et al (2008, p. 133), 95% of composting plants depend on the gate fee to make profits. Prices differ widely from country to country and from application to application, as can be seen in Table 44.

Table 44: National average market prices in different sectors (EUR/tonne per tonne fresh matter)

Sector	**BE/Fl**	**CZ**	**DE**	**Fi**	**ES**	**GR**	**HU**	**IE**	**IT**	**NL-bio**	**NL green**	**SE**	**SI**	**UK**	**EU Mean**
Agriculture (food)	1.1		14.0	0.0	27.0*	-	15.0	-	3.0	-4.0	2.0	0.0	-	2.9	**6.1**
vineyards, orchards	1.1	-	-	-	-	-	-	-	12.0	-	-	-	-	2.9	**5.3**
0rganic farming	1.1	-	-	-	-	42.0	-	-	-	-	-	-	-	2.9	**15.3**
Horticulture & green house production	1.1	-	15.0	-	-	42.0	-	-	-	-	-	-	-	2.9	**15.3**
Landscaping	2.5	4.5	15.0	2.0	-	-	18.0	-	25	4.0	-	-	-	6.5	**9.7**
Blends	1.1[2])	-	-	2.0	-	-	-		-	3.5	-	-	-	2.9	**2.4**
Blends (bagged[1]))	-	-	-	-	-	-	-	90.0	200.0	-	-	-	-	-	**(145)**
Soil mixing companies	1.1	-	-	2.0	-	-	-	-	-	-	-	-	-	6.5	**3.2**
Wholesalers	1.1	-	-	-	-	-	-	-	-	-	-	-	12.0	-	**6,6**
Wholesalers (bagged[1]))	-	-	160.0	-	-	-	-	-	-	-	-	-	-	-	**(160)**
Hobby gardening	7.2	4.5	-	10.0	-	-	20.0	-	13.0	0.3	-	-	21.0	20	**12.0**
Hobby gardening (bagged[1]))	-	-	-	-	-	300.0	-	-	-	-	-	-	-	-	**(300)**
Mulch	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	**3.6**
Land restoration, landfill covers	1.1	-	-	0.7	-	0.0	-	-	-	-	-	-	-	0.7	**0.6**

Barth et al point out that some municipality owned plants do not act with a profit motive and give the compost away for free. Another factor affecting prices is that in some countries the huge animal husbandry creates an excess supply of manure and subsidies of up to 30 EUR per tonne of manure are paid to the customers. In combination with a restrictive application policy, the market for agricultural applications in those countries is really limited (this is for instance the case in Flanders – see Section 7.9.2.4).

Traditionally in agriculture prices from 0 to 2 €/t are charged. But in some areas or even by individual composting plants with professional marketing and spreading service prices go up to 14 € per ton.

Better revenues can be obtained from high price professional markets (landscaping, horticulture, growing media and potting soils). This requires upgrading of compost by mixtures and the manufacturing of tailor made products. Experienced compost plants are gradually entering these markets.

Highest prices may be gained for low quantities of packed compost or compost blends (for instance hobby gardeners) at levels up to 150 to 300 € per tonne.

Barth et al (2008, p. 137) point out that the benefits of compost are not limited to their nutrient content but that one should also take into account its performance in humus reproduction, while arable farming without animal breeding is often connected with considerable losses of humus-C (this is the portion of carbon that contributes to humus production).

Barth et al provide the following list of possible substitutes:

- Agricultural residues like manure or straw are less efficient with respect to stable humus production and availability of nutrients. Barth et al reckon that compost could potentially substitute for 8 to 10% of fertilisers.

- Around 3.62 million tonnes (dry matter) of treated sludge from municipal waste water treatment plants in Europe provide a substitute to compost. Sewage sludge achieves only 10 to 20% of the humus value compared to compost.

- In the growing media sector compost is used as an alternative to peat. Advantages compared to peat are its nutrition and biological (disease suppressing) properties and the savings in $CO2$ release by protecting European bogs. The international Peat Society quantifies the alternative use of compost in growing media in 2005 with 0.95 million m³ and the use of bark with 2.05 million m³

- Barth et al estimate that in the EU27, residues from the food sector, from forestry residues, from the agro industry (incl. straw and animal excrements) and from some food and beverage waste amount to between 1.6 and 2.5 billions tonnes annually. The suitability of treating those materials in an aerobic composting process depends on the composition, degradability, water or nutrient content.

Barth et al reckon that there is a market potential twice the size of the maximum European compost production potential of 40 Mt. The agricultural sector alone would be large enough in nearly all MS to take up the entire compost production. On a European level only around 3 % of the arable land would be needed annually to apply all composts potentially produced from source separated organic. Even the non agricultural sector (e.g. landscaping, hobby gardens, growing media with peat replacement) supposedly shows already a sufficient market potential e.g. in Germany.

Barth et al claim that the market problems in some countries are caused mainly by low compost qualities and the lack of experience and knowledge about compost and the potential customers. End-of-waste standards could raise the awareness of the importance of the compost quality in the waste sector as a precondition for successful application and marketing.

For them, the two critical factors are:

- High qualities from separate collection and a quality assurance.
- The demonstration of the soil related benefits of compost (humus management) and the development of specialised compost products and blends.

Even though end-of-waste standards are intended to open the European markets for compost, the weight and the resulting transport costs limit the potential for importing and exporting compost.

Barth et al have detected no continuous commercial cross border compost material flow except for the cross border activities related to local markets in the direct catchment area of compost plants close to borders.

Important efforts to increase exports are only undertaken if there is a shortage of national agricultural markets due to fertiliser legislations or strong manure competition. Barth et al expect a maximum import and export potential of 1.8 million t of bio- and green waste annually.

A crucial point in the marketing of compost are quality assurance schemes.

According to Hogg et al (2002, p. 6), a review of standards for composting across Europe, North America and Australasia has revealed that 'systems' designed to promote composting in a manner which respects requirements to protect human, animal and soil health tend to have the following elements in place:

- Standards designed to regulate potentially harmful aspects of compost production and use. These are frequently of a statutory nature;
- Complementary standards governing, e.g., environmental/health aspects of application to land (usually of a statutory nature); and
- Standards (quality assurance systems) established to give confidence to consumers through quality assurance, as well as clear specifications for specific market outlets (almost always voluntary in nature).

Whilst these standards are essential for a successful use of compost as product, they come at a cost.

Barth et al (2008, p 101) point out the level of costs for monitoring is a continuous source of complaints by the plants at the quality assurance organisations.

Table 45 shows the cost of compost quality assurance in selected European countries. The costs reflect the expenses related to the renewal procedure of certificates or quality labels during the continuous operation of the plants. In the first application and validation period (first one to two years) costs are essentially higher on account of a first evaluation of the plants and the higher frequency of tests.

With average sales prices for compost of 3 to 6 €/ton, the unit cost of quality assurance systems can become critically high for small plants. Moreover, the cost aspect of quality assurance might become more critical in future if additional costly monitoring requirement for compost products will result from REACH.

Table 45: Unit cost of compost quality assurance in selected European countries

Quality assurance costs per t input and year in € (excl. VAT)										
Through- put /y (t)	**Austria Agricult. plants**	**Austria industrial plants**	**Germany**	**Italy**	**Netherlands (Green C. plants)**	**Netherlands (VFG plants)**	**Sweden**	**United Kingdom Use in Agric. +Horticulture**	**United Kingdom Other uses**	**EU Mean value**
500	2.15	3.36	-	-	-	-				
1,000	0.94	1.80	-	-	-	-				
2,000	0.97	1.32	0.82	-	1.62	1.87	1.21	1.13	1.10	**1.26**
5,000	0.63	0.67	0.52	0.48	0.76	0.86	0.48	0.45	0.44	**0.59**
10,000	0.44	0.58	0.34	0.46	0.53	0.58	0.29	0.28	0.27	**0.42**
20,000	0.26	0.44	0.31	0.45	0.39	0.43	0.15	0.23	0.22	**0.32**
50,000	0.17	0.36	0.19	0.43	0.21	0.22	0.06	0.20	0.19	**0.23**

6.4.2. Import and export

Barth et al have classified import and export activities as follows:

- **Close border activities**. The contacted plants described the typical catchment area of a home market with a circle of around 50 km and justified this with a distance which a large truck (25 tons capacity) can make within an hour for the costs of 50 to 60 €. These transport costs and the other marketing expenses are still covered by the prices in the mass markets of around 5 €/t (125 € per truck). All contacted plants close to borders (less than 50 km) underline the importance of this home market. They appreciate an end-of-waste standard because of the occurring constraints with selling compost over the border.

- **Export need**: Shortage in national demand because of extensive competition of other cheap organic materials (mainly manure) is for the moment the main driver for export activities like the situation in Belgium and the Netherlands show.

- **Import demand**: Real import demand could not be detected in the research. Shortage in organic source materials and the need for the improvement of soils affect the compost market at the moment only locally. The value of compost doesn't allow the transport to the area where the main need exists especially to the Mediterranean countries.

The main continuous import and export activities and potentials are connected to the growing media sector. Admixture of compost in various products based on green waste are a common business especially for the large international peat, soil and bark producing and dealing companies. However, in the blends compost is no longer subject to waste legislation and to the end-of-waste discussion.

Barth et al expect more mature markets, leading to higher compost qualities and more compost mix products for special application. The higher prices that would result from this would allow longer transport distances and thus more cross border business. They also claim that the establishment of European end-of-waste standards should develop the cross border compost business further.

6.4.3. Biogas production

According to a study undertaken by the French environmental agency ADEME[219], in 1999, there were 53 plants in Europe, with an annual capacity of 1,037,000 tonnes. 30 of these plants were located in Germany, and 12 in Switzerland.

6.5. CARDBOARD

6.5.1. Volatility of the market

On the one hand, in the short run, both the supply and the demand of waste paper are relatively own-price inelastic. On the other hand, the demand for paper and board tends to be rather sensitive to the level of economic activity. This would explain the volatility of prices in the market (Berglund, C. and Söderholm P (2003)).

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[219] Gabarda Oliva (2004), L'application de la methanisation aux déchets alimentaires des restaurants collectifs et commerciaux, ADEME "Centre de Sophia-Antipolis".

6.5.2. Collection

According to the CEPI Special Recycling 2005 Statistics, 10% of recovered paper comes from offices, 40% from households and 50% from trade and industry. Although these proportions vary widely between countries and collection systems, Miranda reckons that the future potential for recovered paper collection still lies in households. As households collection consist of numerous small sources, Miranda concludes that this will continue to create pressure on the costs and quality of recovered paper[220].

Based upon a CEPI survey of recovered paper collection in 30 countries[221], the Task Force "Collection systems" of the COST project "The Limits of Paper Recycling" has sought to identify the driving forces and influences on collection rates. The following points are noteworthy:

- The variation in GDP per capita explains 67% of the variation in collection rates
- The influence of population density *at the country level* on the collection rates is negligible (R^2 < 1%).
- The correlation between recycling and collection rates is rather low ($R^2 = 0.14$).
- There is a positive correlation between municipal waste generation and the collection expressed in kg per capita ($R^2 = 0.22$).
- There is a positive correlation between the expert panel's assessment of a country's environmental consciousness and the collection rates ($R^2 = 0.69$).

The quality of recovered paper has been declining in the last few years. This is directly related to the increases in collection rates. Indeed, when collection increases, the quality of the marginal ton tends to become lower as the "low hanging fruit" have already been recovered. The more sources are being integrated in the collection effort, the more mixed they are[222].

6.5.3. Sorting and pre-treatment

After collection, almost all waste paper and board is subject to a further sorting according to quality, and preliminary elimination of contaminations. The collected paper and cardboard is sorted into 2 larger parts:

- The "de-inking fraction" is recycled in paper mills,
- The "recovered cardboard" fraction is recycled in cardboard-mills.

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[220] Miranda, R (2006), Collection of recovered paper: Driving Forces and Trends, presentation given to the Task Force "Collection Systems", for "The Limits of Paper Recycling", COST Action E48.

[221] Quite significantly, CEPI requested data on collection costs but did not receive any (Miranda (2005)).

[222] Ecotarget (2007), FP6 Project "New and innovative processes for radical changes in the European pulp & paper industry, Deliverable 2.3.7 "Evaluation of potentials of recovered paper collection and process management for prevention/influencing the composition of coarse rejects (countries with high collection rates/utilization rate on the example of The Netherlands".

The collected cardboard is sometimes used for strengthening all kinds of plates/bricks/… in the construction-sector. This means that the fibre is recycled as a kind of "binder" for construction materials.[223]

According to an industry expert who required to remain anonymous, suppliers of recovered board can make significant profits from supplying material of inferior quality. There is also some scope to hide low quality of recycled cardboard and it is not always easy to verify the quality of the product. However, market interactions are frequent. No formal dispute settlement mechanisms exist, but contract often contain guarantee provisions. Therefore, the real significance of issues of asymmetric information seems to be rather limited. Other industry players also attached very little importance to these issues[224].

As shown above in the CEPI statistics (see Section 4.5.5), exports of recovered paper to Asia has grown significantly in the recent past. However, sales statistics in themselves give therefore little information on the final destination of waste.

This is due to the central role played by traders. A recent study undertaken for the Belgian Interregional Packaging Commission has pointed to the benefits traders bring to the recovery companies[225]:

- It is more likely that the exporter will get paid than when he delivers directly to the Far East
- The traders usually cover the exchange rate risk
- They take care of administrative compliance
- They find a market for the operator

As the specialised knowledge of the local market potential is a traders' main (intangible) asset it is therefore not surprising that traders prefer to remain discreet on this issue.

Thus, the supply of cardboard for recycling takes place in a competitive market with a lot of suppliers of different sizes: there are suppliers who own installations for the recovering activities, "small" traders and "large" traders. There is a growing tendency to more vertical integration [226].

The trading sector contains companies who try to build up long term relationships, but there is also a lot of entry and exit. One issue of concern is that small traders face higher incentives for trading goods of inferior quality (and to "vanish" when detected). There is no industry federation that can be used as a contact point[227].

Anyway, the above factors imply that the market for waste cardboard is really a world market and that the local mills have very little scope to exert market power[228]. Prices for recycled cardboard can easily be found in trading magazines.

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[223] Information provided by industry expert who required to remain anonymous.

[224] Information obtained in writing from Mr Vermoesen (COBEREC).

[225] Belconsulting (2006), Onderzoek naar de effectieve recyclage van het Belgisch verpakkingsafval.

[226] Information provided by the anonymous industry expert.

[227] Belconsulting (2006), Onderzoek naar de effectieve recyclage van het Belgisch verpakkingsafval.

[228] This has been confirmed by all, amongst other, Mr Huysmans (VAL-I-PAC) and Mr Vermoesen (COBEREC).

Also, both suppliers and the potential users are well known[229].

David Clapp[230] predicts that because of the soaring price of recovered paper, producers will begin to seek out alternative sources of fibre and invest into virgin pulping capacity. He believes that although recovered paper will still play a dominant role in paper making, new investments into recovered paper will decelerate while other pulp options are explored, such as bamboo and eucalyptus in South Asia and Latin America and spruce and fir in Russia[231].

Also, according to OVAM (2008b), due to the increasing scarcity of sea containers, the increasing freight tariffs and the weakness of the dollar, European prices for old paper have recently shown a tendency to decrease again.

Since the publication of the OVAM study, some factors have already changed again, most notably the value of the dollar.

The impact of freight tariffs is even less clear. The Transpacific Stabilisation Agreement bunker charge, a benchmark fuel surcharge imposed by shipping firms on sea freight, has risen from $455 per 40-foot equivalent unit in January 2007 to $1,130. Some argue that recent increases in transportation costs is wiping out the often slim margins of Chinese exporters and that many Western companies that now outsource their manufacturing to China might decide that it makes more sense to shift production closer to their customers at home – this would of course affect the availability of "free" shipping capacity. However, others point out that higher shipping costs are "not as big a factor" as the rising yuan or cost of raw materials[232].

6.5.4. Uses of recycled paper and cardboard

Recycled paper has a lot of applications: packaging, printed matter, napkins, handkerchiefs, writing and copying paper… One fibre can be used 2 to 7 times, depending on its application. However, after each application, the fibre becomes shorter. The higher the requested quality of the paper product, the higher the required proportion of new fibres (OVAM 2008b p. 92).

Grades for recovered paper and board are defined according to CEN standard EN 643 "The European List of Standard Grade of Recovered Paper and Board".[233] It divides recovered paper into categories[234]:

- Group 1: Ordinary Grades
- Group 2: Medium grades

[229] Information provided by the anonymous industry expert.

[230] Senior economist of recovered paper at RISI, a paper, paperboard, and recovered paper pricing forecasting company.

[231] http://www.packaging-online.com/paperboardpackaging/OBM+Breaking+News/Recovered-Paper-Prices-Will-Rise/ArticleStandard/Article/detail/525274

[232] From The Economist, 07 August 2008, http://www.economist.com/business/displaystory.cfm?story_id=11893725

[233] For a non-official version, see http://www.paperrecovery.org/files/EN-643-154434A.pdf .

[234] Ervasti, I (2007), Recovered paper – Calculating collection rate for individual recovered paper grades, presentation given at IPE, Bilbao

- Group 3: High grades
- Group 4: Kraft grades
- Group 5: Special Grades

The 57 trade grades are classified into 4 main grades for statistical use:

- Mixed Grades
- Corrugated and Kraft
- ONP & Mags (News and Magazines)
- High grades

However, according to the anonymous industry expert, these grades are less stringent that the CEPI standards. The CEPI standards are routinely used in contracts and CEPI provides procedures for verification[235].

Recycled cardboard is mainly used for[236]:

- Product packaging for non food products and for food products not in direct contact with food[237]
- Shelf ready packaging

Converters (packaging printers) buy recycled board from specialized mills and sell the printed and glued packs (flat delivered) to all types of food and non food companies. The supply side of the market is rather concentrated mainly because entry requires important investment outlays. However, recycled cardboard also competes with other packaging materials. Mr Cardon of ECMA thus claims that the product manufacturers have significant market power[238].

In general, it is difficult to compare the price for recycled cardboard with its substitutes, as this always requires an in depth calculation for the entire alternative packaging concept. For illustrative purposes, the price difference between recycled and virgin cardboard in the EUWID price publication for the first quarter of 2008 was:

- Duplex GD 2 : 750 - 865 € per Ton (recycled)
- GC 2 : 1050 – 1150 € per Ton (virgin)

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235 It should be noted that the European Federations of Waste Management and Environmental Services has requested an adaptation of these standards – see the comments on the "European Declaration on Recovered Paper" on www.fead.be .

236 Information provided per e-mail of 09 May by Jan Cardon of the European Carton Makers Association (ECMA). Mr Cardon has emphasized that all information provided reflected his own personal views.

237 This means that there are other packaging layers between the board and the packed food – see Section 3.6 for the regulatory constraints.

238 We have nor hard data neither independent assessments confirming these specific claims.

In many packaging concepts recycled cardboard is used in combination with other materials at the product level and for instance corrugated for the transport packaging.

In general, Mr Cardon reckons that recycled board qualities from reliable suppliers are well defined.

6.5.5. Structure of demand for production of cartonboard[239]

There are about 25 companies manufacturing this type of material in Europe with some 67 cartonboard machines. Cartonboard machines are large units some 100 meters long and varying in width from about 2 metres to over 7 metres. A totally new machine with all the necessary ancillary equipment would cost about €250 million and so it is more usual for existing machines to be rebuilt and modified rather than new machines installed. The last totally new cartonboard machine was installed in Sweden in the 90's.

The reasons why a brand owner may choose to have their boxes made from either virgin or recovered fibre will vary. Virgin fibre is generally stronger and so for a given performance level a lighter grade of virgin fibre based material can generally be used. In some packaging applications, speed of production is key. For example, the cigarette packaging industry has found that cartonboard made from virgin fibre gives them the speed of packaging they require. Also, aesthetics play a part in the choice of materials. Cosmetics products, for example, generally choose virgin fibre grades, whereas in other markets such as detergents, tissues and many food items, cartonboard made from recovered fibre is chosen. There are no "rules" regarding this choice and it is made usually by the brand owner, retailer or specifier of the packaging.

For all virgin fibre grades the basic raw material is pulp derived from forests mainly in Europe. For the cartonboard made using recovered fibre, the essential raw material is recovered fibre, usually sourced *from as close to the mills as possible* to reduce shipping costs. The type of recovered fibre used varies depending on need and is sourced from a variety of places such as recovered fibre companies, industrial sources (such a carton makers who incur waste during their production processes), local authorities etc. All mills, both virgin and recovered fibre based, use their own waste that is generated during the production process (machine trim, low quality, cutter trim etc.) and put it back into the manufacturing process.

The types of recovered fibre used in the cartonboard industry vary depending on the quality needs, the supply availability, the price and the products being manufactured. Industrial waste from other paper converting operations is widely used such as waste from the newspaper printing industry, the magazine printers, envelope manufacturers, corrugated box makers and a whole host of other paper converters. In addition, some mills use mixed waste paper and also paper that is supplied by local authorities following their collection systems. The recovered fibre market also supplies manufacturers of other types of paper such newsprint, corrugated base paper, magazine papers and a whole range of other types of paper manufacturers. The cost of recovered paper depends mainly on the supply-demand balance and can be affected by large exports to such countries as China. As a result they need to import recovered fibre and this can be exported not only from Europe but also from other countries such as the USA.

As stated, much of the output of the cartonboard manufacturers is used to make packaging for products that are sold in retailers. As a result these boxes end up in households and once used find their way into the waste stream. Most paper waste generated during manufacturing processes is collected and reused.

The demand balance between cartonboard made from recovered fibre and from virgin fibre has not changed greatly in recent years. A constant supply of new virgin fibre is needed as gradually, recovered

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[239] The information in this Section was provided per e-mail correspondence by Mr Richard Dalgleish of CEPI Cartonboard. For corrugated board, no additional information was obtained in the process of the study.

fibres get smaller and so cannot be used as they are washed away in the cleaning process. This constant input of new fibre therefore ensures continuity of production and also the quality that is required by the market.

6.5.6. The specific issues of beverage cartons

Unless stated otherwise, all information in this Section (including graphics) comes from the following sources:

- Tetra Pak brochure "Recycling of used beverage cartons in Europe".
- Tetra Pak and ACE website
- Information provided per e-mail by Hanneke de Leeuw of ACE
- Meeting with ACE of 30 May 2008 (including PPT presentation "Beverage carton recycling in Europe")

6.5.6.1. Collection

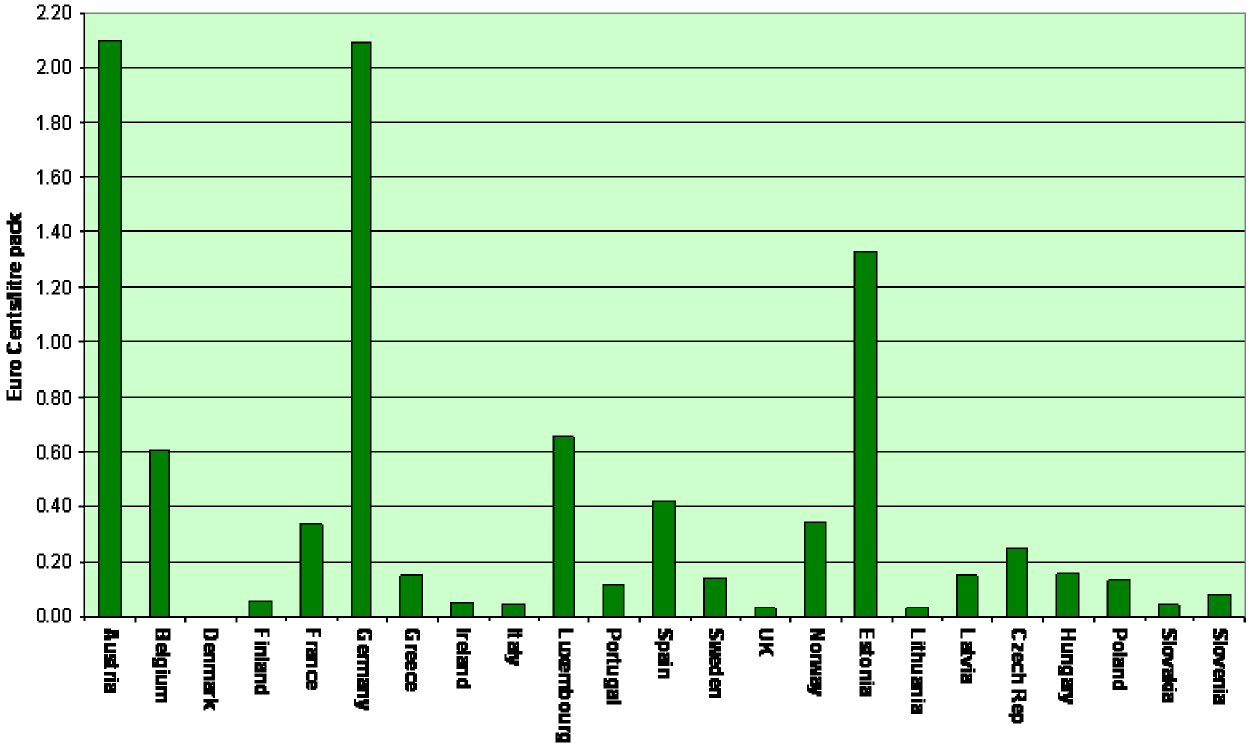
In most European countries used packaging is left at the doorstep for collection in special containers or bags (kerbside collection). Alternatively, people take their used packaging to drop-off containers or collection points (bring system). Kerbside collection is mainly used in urban areas whereas bring systems are used in both urban and rural areas. The choice between kerbside collection and bring systems is also affected by the target for recycling. In order to reach a high target, kerbside collection is a necessary condition. Otherwise, a bring system could suffice. However, separate kerbside collection comes at a cost.

The collection systems vary across Europe:

- Beverage cartons collected together with paper or other paper packaging: Czech Republic, Estonia, Finland, France, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Slovakia and Sweden.
- Beverage cartons collected together with plastic bottles and cans: Belgium, Czech Republic, France, Germany, Hungary, Ireland, Luxembourg, Slovakia, Slovenia and Spain.
- Beverage cartons collected separately. In Austria, citizens separate beverage cartons and either place them in a special cardboard box (Öko-Box) at their doorstep for collection or mail the Öko-Box directly to a nominated recycler.

Tetra Pak claims that, as a general rule, separate collection of beverage cartons tends to be the most costly solution, while beverage carton collection with other lightweight packaging is less expensive and collection with paper is the least costly alternative. However, they admit that it is difficult to give exact data because this depends on local logistics, what is included in the lightweight fraction etc.

Figure 23: Beverage Carton Collection Fees Europe



In Figure 23, the collection fees have been calculated by ACE. They have been converted from a variety of national systems: in some cases fees are based on weight, sometimes on volumes… It should be noted that there has been an attempt by Scandinavian ministers of environment at harmonisation but no agreement could be reached on a common calculation system.

The fees depend on a large range of local circumstances: choice between kerbside collection or a bring system, whether the PRO reimburses the municipalities for the full cost of the separate collection system or only the incremental costs, whether or not packaging unsuitable for recycling is also collected seperately (as in Germany) etc.

6.5.6.2. Sorting

Since beverage cartons are collected together with other packaging types from households, sorting is needed in many cases to separate different materials or paper grades for recycling.

The European List of Standard Grades of Recovered Paper and Board defines used beverage carton as a tradable waste paper grade (EN 643 5 03 00: Polyethylene coated used liquid packaging board, with or without aluminium, containing a minimum of 50% fibres). The EN 643 Standard is published by the European Paper Industry and the European Standardisation Organisation (CEN). Therefore, they can be sent from one EU member state to another for recycling in paper mills according to the EU Waste Shipment Regulation.

According to ACE, the paper mills that recycle post-consumer beverage cartons purchase used beverage cartons directly from the recovery organisations in most EU Member States. Therefore, recovery organisations are responsible for the collection and eventual sorting of post-consumer beverage cartons. When post-consumer beverage cartons are sold to paper mills, the ownership is transferred to the latter. Beverage cartons prices are negotiated between recovery organisations and paper mills according to tenders usually prepared once a year by those organisations.

6.5.6.3. Paper Mills

Over a hundred paper mills around the world recycle post-consumer beverage cartons. They vary in terms of size and type of production.

There are more than 20 paper mills in the EU recycling beverage cartons.

The paper mill that recycled the most cartons in 2007 is Papierfabrik Niederauer Muhle – PNM, in Western Germany. It recycles about 100,000 tonnes of cartons every year – the equivalent of 5 billion beverage cartons. Other important players in beverage carton recycling are Corenso Varkaus in Finland (30,000 tonnes, coming mainly from Germany) and Stora Enso Barcelona (35,000 tonnes, coming mainly from Spain, Portugal and southern France) in Spain[240].

It is thus a market with a few large suppliers and a lot of small players: PNM alone represents about one third of the market in Europe.

Beverage cartons are a competitive raw material for the production of paper boards. Therefore, the bargaining power of paper mills depends on the availability of other secondary fibre sources like old corrugated containers. Mixed household paper packaging and mixed paper are also substitutes. However, competing secondary fibres such as old corrugated cardboards are regularly exported from Europe to as far as China, and as well imported into Europe from other areas like North America.

Beverage cartons manufacturers use high quality fibres in their packages, fibres that never have been recycled before. According to ACE, the strength property of the fibres in beverage cartons is the key argument for recycling them at paper mills as the quality of pulp from used beverage cartons will be higher than from mixed paper.

To the best knowledge of ACE, all post-consumer beverage cartons collected for recycling in EU are recycled within EU. There are differences in targets for collection, but beverage cartons are traded without EU imposed regional barriers. ACE is however aware of some policies of some Member States (such as the UK) that call for local recycling of any collected recyclables. Flows of beverage cartons from one Member State to another can be explained by competition in terms of price, logistic, and spread of recycling capacity.

The recycling capacity available for beverage cartons in Europe is greater than offer. Most recyclers of beverage cartons have spare capacity to process additional tonnage.

ACE recognizes the following barriers to entry in the market:

- The incumbents keep spare capacity and could therefore increase supply at low cost in case of new entry.
- Entry requires important investment outlays and potential entrants face difficulties obtaining the required capital, while this is not the case for existing paper mills.

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[240] Information from Tetra Pak website, complemented with data obtained from Juan Vila of StoraEnso Spain.

- Some producers of primary products are vertically integrated with the potential clients for recycled materials.

The paper mills that recycle beverage cartons use no equipment which is not standard paper making equipment offered in the marketplace[241]. In other words, recycling of post-consumer beverage cartons require equipment that is also used for recycling other secondary fibres like cardboards and mixed paper waste. Generally speaking a paper mill can get in and out from recycling post-consumer beverage cartons, without needing to include or by-pass non-standard equipment.

According to ACE, the reluctance of some paper mills to use drink cartons is due to a lack of familiarity with the product. However, ACE claims that recyclers who know the product want to expand their business.

According to ACE, recycling of the Pe/Alu residual materials to more high quality end products requires large quantities of inputs. If there is little collection in a country, the mills will have to invest in small scale solutions. An example is provided by the agglomeration technologies in France and Italy: mixtures of plastics and aluminium that are sold as plastic products. Collection is thus the key issue to improving the quality of recycling.

Also, in some cases, the administrative costs linked to the acquisition of very small amounts of post-consumer beverage cartons are higher than the corresponding costs for primary products. Other secondary fibres such as old corrugated cardboards are normally purchased by paper mills in the spot market, with no strings attached rather than a volume/quality guarantee expressed for each purchased load. Conversely post-consumer beverage cartons are mostly traded through tenders that usually tie prices up for a year or longer. According to ACE, these latter conditions lead to increased bureaucracy and less flexibility. In countries where the quantities submitted for recycling are small, this can be a limiting factor for the competitiveness of post-consumer beverage cartons.

According to ACE, legislation should include

- Shared responsibilities between industry & municipalities for collection
- Clear definition of responsibilities
- Achievable targets and deadlines[242]
- Transfer of collection obligations by companies to 3rd parties
- Recognition of existing recycling systems[243]
- In case of recycling targets, to keep multi-materials under the category of predominant material

According to ACE, legislation should NOT include

- Request for a nation wide collection

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[241] See however above for the recovery of the polylaminate.

[242] A specific issue here is the availability of an appropriate infrastructure. For instance, some New Member States are just setting up their collection systems.

[243] For instance, the systems of paper collection by youth organisations.

- Deposits, refill quotas, packaging taxes

According to ACE, the most effective policy measure to increase recycling rates is to subsidize and promote mechanisms that enable increased household collection for used packaging containers, in terms or awareness, reach, and capture rates: public collection schemes, public awareness campaigns, mandatory sorting…

ACE also points out that low prices (gate-fee) on landfill and incineration without energy recovery negatively affect the build-up of collection systems for packaging in general and also for beverage carton collection. Incineration with energy recovery will have similar impact, but has better environmental impact than incineration without energy recovery. It should be noted that, in the Netherlands, policy makers concluded that, with the state of the art incinerators with efficient energy recovery in use in the Netherlands, incineration was a good solution and that no separate collection system for beverage cartons was needed.

6.5.7. Stakeholders' views on potential for improvement

Amongst the list of policy measures that could lead to an increase in the rates of paper and board recycling, the following have been mentioned by at least two stakeholders:

- Mutual recognition of "permits" for brokers, transporters etc across Europe
- End-of-waste criteria[244]
- Public collection schemes
- Mandatory sorting
- Landfill taxes

Mr Cardon of ECMA thinks that a further increase in recycling rates will be far from easy and would propose to promote cardboard as such.

Taking into account the possible use of recovered paper in composting, one stakeholder has strongly opposed the subsidisation of composting and anaerobic digestion!

Also, some stakeholders would like the export to be limited to recycling and recycling residue treatment in line with European Standards.

The view on standards and tradable credits for recycled contents is mixed.

For instance, the Belgian trade federations COBELPA and FETRA strongly oppose these instruments[245]. In further correspondence, FETRA has clarified that it opposes recycled contents targets because for some applications, virgin fibre is required. Also in some applications, the cardboard needs to be very robust. This requires either the use of virgin fibres or very heavy boxes. FETRA claims that it is not possible to verify ex post the origin of the fibres that were used in the production.

[244] Note also the position taken in Magnaghi, "The Evolution of the Recovered Paper Market: comparing 2006 with 2005": http://www.bir.org/pdf/Dec07MagnaghiReport2.pdf

[245] Position communicated by letter, 6 May 2008.

However, an anonymous industry expert has claimed that it is perfectly feasible to verify EN643 grades with detection systems in the NIR (Near Infra Red) spectrum, even though he admits that this can be costly.

According to Huhtala and Samakovlis[246], the reasoning behind recycled content requirements is that "even if sorting and collection of post-consumer waste are well organized by public authorities, these measures do not necessarily make firms utilize extensively the post-consumer waste collected." However, as Huhtala and Samakovlis point out, the higher the proportion of secondary material that is exported, the more difficult it is to meet the minimum standards of secondary material use by domestic recycled material. For instance, in Sweden, the ratio of waste paper consumption to total paper and board production is just 17%, but the ratio of waste paper recovery to total domestic paper and board production is 66. In countries such as Italy and Greece, the opposite is true: they have high utilization rates of recovered paper but low recovery rates.

The central point is that the determinants of recovery and utilisation are different. Section 6.5.2 provides an overview of determinants of collection rates (and thus also recovery rates). With respect to utilisation rates, the situation is slightly more complicated. On the other hand, a high consumption of paper compared to production will lead to a relative abundance of paper available for recovery and thus also to higher utilisation rates. Thus, one would expect some correlation between recovery and utilisation rates. On the other hand, utilisation rates will also be affected by the relative price of waste paper and board compared to virgin fibre. It is thus not surprising that affluent but forest rich countries will have low utilisation rates (even if their collection rates are high) (Berglund, C. and Söderholm P (2003)).

According to Huhtala and Samakovlis (2002), harmonized recycled content standards across countries would correspond to an implicit subsidisation of recycling in areas where waste management is not the most urgent environmental problem (such as sparsely populated Scandinavian countries). Strict harmonized standards would lead to trade effects (for instance, imports of cheap waste paper in order to meet recycled content standards) rather than environmental improvements.

As pointed out by Bergland and Söderholm (2003), if these trade effects result in additional transportation activity, the environmental effect may well be negative.

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[246] Huhtala, A. and Samakovlis, E. (2002), Does International Harmonization of Environmental Policy Instruments Make Economic Sense?, Environmental and Resource Economics, 21:261-286.

7. CASE STUDY: FLANDERS

7.1. STRUCTURE OF THIS CHAPTER

This Chapter takes a closer look at the specific situation of the four waste streams under consideration in the Region of Flanders (Belgium). We begin the chapter with some basic information on Flemish society (Section 7.2) and waste policy (Section 7.3). Section 7.4 provides key waste statistics. Extended producer responsibility plays a central role in Flemish waste policy – an overview is given in Section 7.5. Cardboard and beverage cartons' recycling fits within the policy on packaging waste, which is described in Section 7.6. The detailed analysis for the different waste streams follow then in Section 7.7 (PVC), 7.8 (batteries), 7.9 (food waste) and 7.10 (cardboard). A general conclusion is offered in Section 7.11.

7.2. GENERAL INFORMATION

In the Belgian federal state structure, the Regions are responsible for environmental issues[247]. There is no hierarchy of legal systems in Belgium, which means that the regions are effectively sovereign in the fields that fall within their area of competence (see also Bracke and De Clercq (2005)). There is thus neither coordination nor harmonisation of regional legislation.

On 1 January 2007, 6,117,440 people lived in Flanders, with a population density of 452 people per square km.[248]

Belgium's GDP per capita relates as follows compared to the EU average[249]:

	2006 GDP per capita (PPP)	2006 GDR per capita (EUR°
Belgium	28,900	30,000
EU27	23,500	23,500

This makes Flanders one of the most affluent and densely populated regions in Europe.

7.3. GENERAL REGULATORY CONTEXT

Flemish waste policy is determined in the Flemish Waste Decree and its implementation order, the Order of the Flemish Government for the Establishment of the Flemish Regulations relating to Waste Prevention and Management (VLAREA).

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[247] With a few exceptions such as product standards, nuclear waste, waste transit over Belgian territory, criminal sanctions in case of violations of the law and the negotiation and implementation of international agreements.

[248] http://aps.vlaanderen.be/statistiek/cijfers/stat_cijfers_demografie_nieuw_excel.htm

[249] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001-01/EN/KS-CD-07-001-01-EN.PDF

According to the Waste Decree, each municipality, whether or not in cooperation with other municipalities, takes care of prevention, frequent collection and sound treatment of *household* waste.

Industrial waste, on the other hand, can be recovered or disposed of:

- within the company where it is generated
- by handing over to a company permitted for the treatment of waste
- by handing over to a company licensed for the collection of waste
- as a secondary raw material
- by handing over to a foreign company licensed for disposal or recovery

The Public Waste Agency for the Flanders Region, OVAM, is an internal autonomous incorporated agency under the authority of the Flemish Environment Minister. The OVAM is responsible for:

- Sustainable waste and materials management
- Prevention of soil pollution
- Organisation of soil remediation

It can use three different set of tools (OVAM 2008, p. 7):

- legal: take-back and acceptance obligations, dumping bans
- taxes: levies, grant schemes,
- social: awareness raising and information

Its responsibilities include the preparation of waste management and soil remediation legislation, and the implementation and supervision of this legislation (see Parent et al).

OVAM was created in 1981 following the Waste Decree of 2 July 1981 on the Prevention and Management of Waste, which resulted in subsequent Waste Plans (see Parent et al, p. 3).

- The first municipal Waste Plan (1986-1990) had as main objective the closedown and sanitation of landfills and the optimisation of incineration capacity. The price of landfilling and incineration was raised.
- In the next municipal Waste Plan (period 1991-1995), emphasis was shifted to the implementation of separated collection of municipal waste. A specific infrastructure was developed for the collection and processing of garden and food waste. There was also a clear focus on waste minimisation and recovery.
- The Waste Plan for the 1997-2002 period further encouraged the separate collection of municipal waste. Composting at home was encouraged. Construction of new incineration plants was postponed. (Parent et al).
- The 2003-2007 Waste Plan further consolidated the obtained results.

Gradually, policy priorities moved to recycling and prevention of waste (Bracke and De Clercq (2005)).

The Flemish region adheres to the principle of self-sufficiency with respect to final disposal. The intentions are to increase the required processing capacity by means of mechanical-biological processing plants and fluidised bed incineration plants. Landfilling of recyclable and incineratable wastes should have been stopped in 2005 (Parent et al p.6).

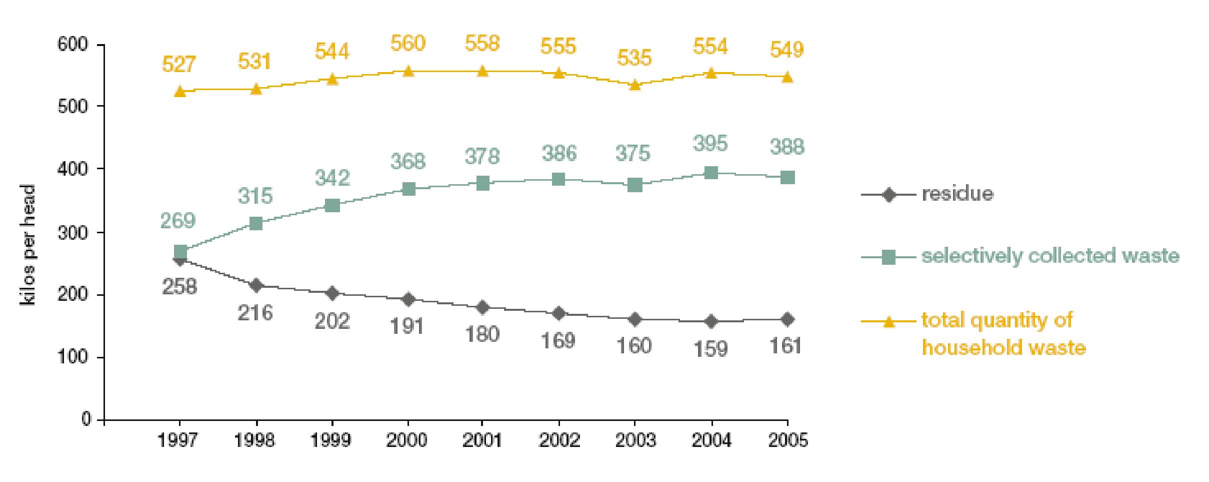
An important role is played by the so-called environmental agreements or covenants. These are voluntary agreements between the Flemish government and municipalities. Municipalities receive financial support if they meet some specific targets, for instance for setting up infrastructure for selective waste collection. The revenue from landfill and incineration taxes is used to fund, inter alia, the environmental covenants (Parent et al and OVAM 2006, p. 14).

On 1 January 2007, a new law came into effect, simplifying existing environmental levies. There is now one single rate for the incineration or co-incineration of waste materials (OVAM 2006, p. 20).

7.4. SOME BASIC STATISTICS

As shown in the following table, there has been a steady increase in the amounts of waste collected selectively (OVAM 2006, p.12):

Figure 24: Selective collection in Flanders



Evolution of total quantity of household waste: the selectively collected waste and the residue in kilos per head of the population in the years 1997-2005 in the Flanders Region.

In 2005, 70.7% of all household waste was collected selectively to be reused, composted or recycled. In weight, the composition of this selectively collected waste in 2005 was (OVAM 2006, pp 12-13)

Table 46: composition of selectively collected waste

Construction and demolition waste	21.7
Textiles	1.2
Garden waste	21.2
Plastics, glass, metals	2.9
Organic	13.1
Other plastics	0.8
Metals	1.9
Glass	7.7
Wood waste	6
Paper and cardboard	19.2

WEEE	1.9
Other	2.4

Industrial primary waste is composed as follows (in percentages, out of a total of 21.4 million tonnes) (OVAM 2006, p. 15):

Table 47: Industrial primary waste

Packaging waste	2
Metal waste	3
Wood waste	4
Several types of waste	5
Paper and cardboard waste	5
Ashes and slags	6
Earth	8
Animal and vegetable waste	8
Wastewater sludge	11
Mixed and undifferentiated waste	11
Construction and demolition waste	21
Other	16

7.5. EXTENDED PRODUCER RESPONSIBILITY IN FLANDERS

The Waste Decree of 1994 introduced the principle of extended producer responsibility in Flanders.

According to Article 3.1.1.1. of VLAREA, for the following wastes there exists an acceptance obligation for the final seller, the intermediary and the producer:

- printed matter waste materials;
- waste batteries and waste lead starter batteries;
- old and expired medicines;
- vehicles intended to be scrapped;
- waste tyres;
- discarded electrical and electronic equipment
- waste oil;
- animal and vegetable waste fats and oils;

- waste photographic chemicals;
- waste agricultural foils;
- lamps;

According to Article 3.1.1.2. of VLAREA, the acceptance obligation for the final seller entails the final seller having to accept the product the customer wishes to discard that corresponds to the new product with no charge to the customer. However, the obligation to take back the goods at no charge can be cancelled in the environmental agreement or in the waste prevention and waste management plan if the producers organise the return of the goods, even when the consumer does not purchase replacement products, at civic amenity sites or other collection points with comparable geographical distribution and cover.

In the initial phase, producers were only bound to this take-back obligation of the consumers purchased new products (1/1). However, in 2004 the 1/0 principle was installed as general principle (Decision of the Flemish Government of 14 July 2004, published in the Official Journal of 8 October 2004). As described above, this principle holds producers responsible for all waste products even if the consumers do not purchase a new product.

Producers have expressed the fear that the adoption of the 1/0 rule could lead to a significant import of waste products from neighbouring countries, that would have to be accepted[250].

According to Article 3.1.1.4. of VLAREA, the way in which the acceptance obligation is complied with is described in:

- either an environmental agreement as referred to in the decree of 15 June 1994 concerning environmental agreements, which is concluded by the representative umbrella organisation for enterprises of which the producer is a member. Within the framework of the environmental agreement, a management body is set up that carries out the tasks in name of the representative organisation(s). Each year the management body submits a management plan for approval to the OVAM in which it indicates how the provisions of the agreement will be complied with. A representative of the OVAM will be invited to each meeting of the board of management and general meeting as an observer. The obligation to establish a management body can only be derogated from if the representative umbrella organisations demonstrate that they can obtain the same results using another body;
- or a waste prevention and waste management plan submitted by the producers for approval to the OVAM.

In practice, the second option has never been used.

7.6. BELGIAN POLICY WITH RESPECT TO PACKAGING WASTE

7.6.1. The Inter-regional agreement

The following text combines a non-official translation of the "Interregional Co-operation Agreement on the prevention and management of packaging waste" as found on the website of Fost+ with information found on the Fost + website[251].

[250] Social Economic Council for Flanders, letter to the Minister of the Environment of 20 January 2003.

[251] http://www.fostplus.be/tpl/main.cfm .

The basic principle of the Belgian approach to packaging waste is the "polluter pays principle". Although Belgian waste policy has been decentralised to the Regions, it was deemed essential that collective measures concerning the prevention and management of packaging waste should be taken in the three Regions. This resulted in an Interregional Co-operation Agreement with force of law which was signed on 30 May 1996. It entered into force in 1997 for household packaging and in 1998 for industrial packaging.

The legal foundations for this agreement are:

- At the European level, the Waste Directive on the one hand, and the Packaging and Packaging Waste Directives on the other hand.
- At the Belgian level, the decree of the Flemish Council of 2 July 1981 on the prevention and management of waste, the decree of the Walloon regional council of 5 July 1985 on waste and the ordinance of the Brussels Capital Council of 7 March 1991 on the prevention and management of waste;

The agreement applies to the removal and the processing/handling of packaging waste of both household and industrial origin. In this light, the agreement lays down a series of obligations imposed on the businesses responsible for putting packaged products on the Belgian market. The agreement also makes provisions for the setting-up of an Interregional Packaging Commission to deal with a number of administrative and supervisory tasks and formulate opinions.

As explained in the FOST Plus Activity Report 2006, a new text must implement the new EU Directive on packaging waste into national law. The draft new Interregional Agreement has not been approved yet. It is expected to enter into force by the end of this year. Nothing fundamental will change compared to the current situation[252], except that it is proposed to have a specific recycling target for beverage cartons[253].

We summarize here the contents of the existing agreement.

7.6.1.1. Definitions

The following definitions are important:

- "Recycling": Reprocessing of waste materials for the original purpose or for other purposes, excluding incineration with energy recovery.
- "Incineration with energy recovery" (or energy recovery): Use of combustible packaging waste as a means to generate energy through direct incineration with recovery of the heat.
- "Packaging" shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or consumer;
- "Sales packaging or primary packaging" shall mean packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase;
- "Grouped or secondary packaging" shall mean packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units, whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it may be removed from the product without affecting its characteristics;

[252] Information provided by Mr Van Gaever, Technical Director of Fost + by telephone interview 29 April 2008.

[253] Information provided during meeting with ACE of 30 May 2008

- "Transport or tertiary packaging" shall mean packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packaging in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship or air containers;
- "Reusable packaging" shall mean any packaging conceived and designed to accomplish within its lifecycle a minimum number of trips or rotations, in which it is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reusable packaging will become packaging waste when no longer subject to reuse; "One-way packaging" shall mean any packaging which is not reusable packaging in the sense of section 8;
- "Party responsible for packaging" shall mean
    a) any party who packages or has had goods packaged in Belgium with a view to or as a result of marketing them,
    b) where products brought on to the Belgian market have not been packaged in Belgium, the party importing the packaged goods who does not consume them,
    c) where industrial packaging waste is concerned of products that have not been packaged by a party as referred to in a) and have not been imported by a party referred to in b), the one that consumes the packaged goods[254];

7.6.1.2. Recovery and recycling targets

The agreement sets explicit minimum overall recovery and recycling targets for packaging waste, expressed in terms of weight percentage, in relation to the total weight of one-way packaging on the Belgian market. These targets have to be met in every region, for both household as industrial packaging waste.

The recovery and recycling targets which have to be met are calculated pursuant to the methods established by the Interregional Packaging Commission. The total recovery target is equal to the sum of the achieved recycling, organic recycling and energy recovery targets.

Currently, the Cooperation Agreement lays down a minimum recovery rate of 80%[255]. The recovery of packaging waste consists in waste treatment via recycling or incineration with energy recovery. It also requires that a minimum of 50% of industry packaging be recycled, with a minimum of 15% recycling per material: plastics, paper/cardboard, wood, metal and glass[256].

7.6.1.3. General prevention plan

Every three years, all parties responsible for packaging waste who have packaged or caused to package products with at least ten tonnes of packaging per year are obliged to present a general prevention plan to the Interregional Packaging Commission.

In each sector of economic activity, the party responsible for packaging may by agreement entrust the obligations arising from this article to a legal body[257].

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[254] Basically, this refers to companies who purchase packaged goods abroad (commodities, spare parts) and unpack them for their own use. See VAL-I-PAC website.

[255] Note that this is more than with is required according to the Packaging Waste Directive.

[256] See VAL-I-PAC website.

[257] As explained on the VAL-I-PAC website, in practice, this means the professional association of the sector.

7.6.1.4. Management of packaging waste

All parties responsible for packaging are subject to a take-back obligation: this refers to the obligation imposed on parties responsible for packaging to meet the recovery and recycling quotas referred to in the co-operation agreement.

For the implementation of this obligation, the party responsible for packaging may either discharge its duty itself or, where appropriate, conclude an agreement with a third party in the form of a public or private organisation for the full or partial fulfilment of the take-back obligation.

All parties responsible for packaging who do not wish to fulfil the take-back obligation themselves may entrust an accredited body with the fulfilment of their take-back obligations.

Parties responsible for packaging are deemed to have fulfilled their take-back obligation if they may show that they have – either directly or through the offices of a natural person or legal entity which is authorised to represent them – concluded an agreement with this accredited body, and that the latter is fulfilling its obligations.

The accreditation application must be submitted to the Interregional Packaging Commission and must contain the information on, amongst other points:

- If the accreditation concerns *household* packaging waste, a model contract concluded in pursuance of the regional waste management plans with the public entities with territorial responsibility for the collecting of household packaging waste.
- If the accreditation concerns *industrial* packaging waste, a study with regard to the technical means and infrastructure that will make it possible to achieve the targets which are provided for in the agreement and with regard to the way in which the body intends to safeguard and develop employment in associations or non-profit- making associations whose object is the recycling and recovery of packaging waste.

The accredited body is obliged to, amongst others:

- fulfil the conditions of the accreditation;
- attain the recycling and recovery objectives for all parties responsible for packaging that have concluded an agreement. These targets are expressed as a percentage weight of the total weight of one-way packaging for which their contracting parties are responsible;
- collect in a non-discriminatory way contributions from the contracting parties to cover the real and complete costs of the obligations incumbent upon it in pursuance of the present agreement;

If the take-back obligation concerns *household* packaging waste, the accredited body is performing a mission of public service and should, *amongst others*:

1. cover in a homogeneous way the whole of the Belgian territory on which the parties responsible for packaging market their products;
2. calculate the contribution of the contracting party per packaging material in proportion to:
    - the real and complete costs attributable to every material;
    - the proceeds of the selling of collected and sorted materials; this latter with a view to the financing of the real and complete cost price of:
        - existing and future collections according to the modalities fixed by the public legal entity with territorial responsibility for the collection of household waste products;
        - operational information and public-awareness campaigns regarding these collections;
        - the sorting of collected packaging waste;

  - the elimination of the residues from the sorting, recycling and energy recovery of packaging waste as well as possible chain deficit;
3. safeguard and develop employment in associations or non-profit- making associations whose object is the recycling and recovery of packaging waste;[258]
4. conclude an agreement with any public legal entity with territorial responsibility for household waste products;

Every seller of *household* packaged goods is obliged to accept, on his own responsibility, in the receptacles provided for this purpose, all transport or grouped packaging that is used as sale packaging and that is returned or left behind by the consumer, insofar as the packaging originates from products that have been marketed by him.

For packaging waste of industrial origin and when the party responsible for packaging is that referred to a) or b) of the definition, the consumer of packaged goods must:

- either return the packaging waste to the party responsible for packaged goods or to the party that is assigned therefore pursuant to article 7;
- or return the packaging waste to the accredited body which is assigned here for pursuant to article 8;
- or recycle or recover the packaging waste itself, and give proof hereof to the party responsible for packaged goods, either directly or via the seller of packaged goods.

7.6.1.5. Information obligation

Every year the party responsible for packaged goods is obliged to provide information the Interregional Packaging Commission per packaging type.

Every party responsible for packaging may entrust these obligations to a legal entity.

If the party responsible for packaging entrusts an accredited body with the execution of its take-back obligation, this latter shall supply the Interregional Packaging Commission with the information required.

As regards household packaging waste, the public legal entities with territorial responsibility for collecting household waste products are obliged to inform the Interregional Packaging Commission yearly of the quantities and proceeds of sale of sorted materials.

7.6.1.6. The Interregional Packaging Commission

The regions have established the Interregional Packaging Commission as a common institution.

The task of the Interregional Packaging Commission (IPC) is to ensure compliance with the provisions of the Interregional Cooperation Agreement.

The Regions have set up the Interregional Packaging Commission which comprises a decision-making body of 9 members (3 per region) and a permanent secretariat. The main responsibilities of the Packaging Commission are:

[258] In practice, this means that Fost+ has awarded one recycling contract to a firm in the social economy. Also, one intermunicipal association also promotes social employment in one of its own sorting plants. Fost+ does not receive a financial compensation for this. Information provided by Mr Van Gaever.

- to approve the manner in which the parties responsible for packaging that have not asked an accredited body to fulfil their take-back obligation satisfy the obligations incumbent on them;
- to grant, suspend and withdraw accreditation for each accredited body;
- to verify how the minimum recovery and recycling percentages are achieved by the parties responsible for packaging and the accredited bodies;
- to verify such information as it requires to be submitted to it.

The co-operation agreement also contains far-reaching clauses containing the supervision and the enforcement of the agreement. For instance:

- The Interregional Packaging Commission may question the auditors of the accredited body. If the accredited body has not appointed any auditors, the Interregional Packaging Commission may have the accounts examined by an auditor appointed by the Commission.
- The government of each region has the right to appoint and remove from office one representative at the accredited body for domestic packaging waste, as well as his deputy; these latter supervise the public service mission and the obligations imposed by the present agreement.

Penalty clauses for non-compliance include: warnings, suspension or withdrawal of accreditation, release of all or part of the financial guarantees provided by the accredited body administrative penalties and even imprisonment.

7.6.2. Fost Plus

Unless stated differently, all the information in this Section has been obtained from the Fost+ website or the Fost+ 2006 Annual Report.

7.6.2.1. Mission

Fost Plus is the only body accredited by the Interregional Packaging Commission in the field of household packaging waste[259]. It was set up in March 1994 and now has 57 associate members representing producers and importers of packaging, packaged products or packaging materials, distribution companies and trade federations.

It is a company incorporated on the initiative of the private sector, initially in the form of a cooperative (on 28.3.1994) and reincorporated as a non-profit organization on 1.1.1996.

Fost Plus takes responsibility for the legal obligations regarding packaging waste of household origin incumbent on private firms that choose to join Fost Plus as members.

Fost Plus also takes on the obligations of information and prevention as laid down in the Interregional Cooperation Agreement.

Fost Plus also takes all measures necessary to promote, coordinate and finance selective collections, sorting and recycling with a view to achieving the recycling and recovery rates laid down in the Interregional Cooperation Agreement.

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[259] Fost Plus was recognized as an accredited body by the Interregional Packaging Commission for the first time on 18 December 1997. The accreditation was renewed on 23 December 1998, with its period of validity running until 31 December 2003. A new application for accreditation was submitted in June 2003. Fost Plus has had its accreditation renewed on 31 December 2003 for a further five-year period.

7.6.2.2. Membership

In 2006 the slow erosion in the number of FOST Plus members was stopped and membership rose from 5,829 to 5,898 members. Fost Plus claims that this was the fruit of a change in the approach towards debtors. Since 2006, defaulters are no longer excluded, but their file is passed on to a debt collector agency or a lawyer. Likewise, a more active approach towards free riders, both on the part of FOST Plus and the Interregional Packaging Commission (IVCIE), often in cooperation with the industry federations concerned, supposedly has had a positive impact on the number of members.

7.6.2.3. The collection system

The role of the different actors in the system can be described as follows:

- the regional public authorities accredit Fost Plus;
- producers of materials and packaging, importers and distributors pay a contribution to Fost Plus for the packaging put on the market;
- members of the general public buy packaged products and sort the packaging;
- the intermunicipal authorities and operators, financed via Fost Plus, collect and sort the packaging;
- the recycling channels and purchasers of secondary materials buy up the sorted waste and take care of its recycling.

Fost Plus has to pay the cost for the complete chain: collection, sorting and recycling.

Fost Plus has opted for a mixed collection system:

- door-to-door collection rounds;
- voluntary input from the public via container parks and the bottle bank network.

The areas in which such a collection system is proposed to the public are covered by what is called "intensified projects". At the end of 2004, 99.7% of the population was covered by an "intensified project". Moreover, under a Fost Plus intensified project, a number of intermunicipal authorities have opted for a more demanding scenario (providing, for example, for a greater frequency of certain types of waste collection).

By the end of 2006 only one municipality in the whole of Belgium did not have a contract with FOST Plus and consequently failed to comply with legal requirements.

7.6.2.3.1. Contracts with local governments[260]

The local authorities are responsible for the collection and sorting phase. As stipulated in the Interregional Agreement, the accreditation application of the accredited body contains a model contract with the intermunicipal associations. This model contract defines the required service for each type of material (for instance, frequency of separate collection).

[260] Information provided by Mr Van Gaever.

Fost+ pays the total cost of collection and sorting if it takes place according to the specifications of the contract.

If an intermunicipal association undertakes the collection and sorting activities in-house, the amounts reimbursed are the subject of negotiations between Fost+ and the association. However, Fost+ has enough benchmarks to have a strong negotiation position.

If an intermunicipal association does not undertake these activities in-house, it must award the contracts respecting the terms of Belgian public procurement legislation. Fost+ supervises the awarding process, and reimburses the price of the tender if the award complies with the relevant legislation and contractual provisions.

7.6.2.3.2. Contracts with recyclers[261]

As a rule, Fost + awards the contracts for recycling. Fost+ is not subject to public procurement legislation.

Until the end of the 1990s, Fost+ had to pay recyclers for accepting the materials. Since 2000, all prices (*except for drinks cartons*) have been positive.

In some cases, the contracts for recycling are awarded by the intermunicipal associations, but the revenues always accrue to Fost+.

The prices for materials are determined in contracts ranging from 1 to 5 year. Fost+ thinks that it is necessary to have contracts of this length in order to make investment in recycling facilities possible. However, the Competition Guidelines suggest a maximum of 5 years for service contracts.

7.6.2.3.3. Reporting

On the one hand, many companies send detailed information to FOST Plus every year about the packaging they put on the Belgian market. On the other hand, FOST Plus collects information from its operational partners about the quantities of collected, sorted and recycled packaging. After the necessary controls and approvals, this information is passed on to the Interregional Packaging Commission.

7.6.2.4. Packaging covered by Fost Plus

Fost Plus is accredited to administer packaging waste of household origin, i.e. waste from normal household activity, together with packaging waste that may be assimilated to it, such as defined in the Cooperation Agreement.

The total market for this packaging (including service packaging from retailers < 200m²) is estimated at 765kt a year.

Fost Plus takes on the take-back obligation of all its member companies for all household packaging, regardless of the packaging material used, the product packaged or the business sector involved.

The take-back obligation for industrial packaging is taken on by another accredited body, VAL-I-PAC (see Section 7.6.3). There is an exhaustive list which makes a clear distinction between household waste and industrial waste.

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[261] Information provided by Mr Van Gaever.

Fost Plus only collects that packaging for which it judges that recycling is economically and ecologically justifiable and for which it thinks outlets can be guaranteed in the long term: glass, paper, cardboard, plastic bottles and flasks, metal packaging and drinks cartons[262].

However, all Fost Plus members contribute to the recycling and recovery of high levels of packaging waste with their financial contribution – as expressed by the Green Dot[263]. The Green Dot rates are discussed more in detail below (see Section 7.6.2.6).

Overall, nearly 90% of the total tonnage of packaging put on the market is covered in the collection and sorting scenario advocated by Fost Plus[264].

7.6.2.5. Recycling rates

The global recycling percentage for 2006 amounted to 91.20%, i.e. 659.7 kton out of the 723.3 kton placed on the market by FOST Plus members. When taking into account the 24.4 kton of PMD production residue incinerated with energy recovery, the total recovery rate reached 94.58%.

In 2006 FOST Plus recycled 91.2% of the quantity of household packaging put on the market by its members. FOST Plus members represent 92% of the total Belgian market. In relation to the total market, the recycling rate therefore amounts to 83.9%

Recycling household packaging in Belgium has gone up from 28.1% to 83.9% between 1995 and 2006. In the meantime, the quantity of packaging incinerated with energy recovery has dropped to 10.4%, while the quantity of packaging landfilled or incinerated without any energy recovery has been brought down to 5.6% .

Table 48: Recycling and recovery in Fost+ (time series)

Year	Recycling	Incineration with energy recovery	Disposal without recovery
1995	28.1	25.6	46.3
1996	44.2	19.5	36.4
1997	53.9	19.1	26.9
1998	58.4	18.5	23.0
1999	68.0	15.3	16.7
2000	72.2	14.2	13.6

262 Some plastics (for instance, yoghurt packaging) are not recycled. In order to comply with European legislation, drinks cartons are reported under the heading "cardboard". Information provided by Mr Van Gaever

263 The "Green Dot" logo on a package means that the company putting this product on the market is participating in the financing of selective collection, sorting and recycling of household packaging.

264 The remaining 10% is an estimation of the amounts put on the market by free-riders. Information provided by Mr Van Gaever.

2001	74.3	14.2	11.4
2002	78.6	12.3	9.1
2003	79.9	11.4	8.7
2004	81.8	10.9	7.3
2005	83.1	10.6	6.3
2006	83.9	10.4	5.6

This shows that Fost Plus has exceeded the targets laid down in the Cooperation Agreement and also the requirements laid down in European Directive 94/62/EC on packaging and packaging waste and even the revised higher requirements in the proposal to amend this directive, providing for a recycling rate of 55% by weight of the totality of packaging materials.

The recycling and recovery results for 2006 can be summarized as follows:

Table 49: Recovery in Fost+ (details 2006)

Materials	**Quantities (tonnes)**			
	Market	Members' declarations	Recycling	%
Paper-cardboard (total)	181,740	158,206	197,677	124.9(1)
Paper-cardboard	*161,040*	*137,812*	*183,890*	*133.4(1)*
Drinks cartons	*20,700*	*20,394*	*13,787*	*67.6*
Glass	317,093	296,583	316,668 (2)	106.8(3)
Plastics	192,539	179,257	61,113 (4)	34.1
Bottles and flasks	*82,300*	*81,119*	*56,675*	*69.9*
Metals	90,572	85,757	84,234(4) (5)	98.2
Others	3,955	3,543	17(4)	0.5
Total recycling	**785,900**	**723,346**	**659,710**	**91.2**
PMD residue (energy recovery)			24,410	3.4
Total recovery			**684,120**	**94.6**

Materials	**Recycling results per region (tonnes)**		
	Brussels	Wallonia	Flanders
Paper-cardboard (total)	13,733	54,833	129,112
Paper-	*13,679*	*50,282*	*119,929*

cardboard			
Drinks cartons	*54*	*4,551*	*9,183*
Glass (6)	21,095	100,942	183,688
Plastics (4)	1,843	20,433	38,837
Bottles and flasks	*1,843*	*20,128*	*34,704*
Metals (4) (5)	10,951	25,240	48,043
Total recycling (6)	**47,622**	**201,448**	**399,681**
(1)	The recycling rate is over 100: this is due to the fact that not all the parties responsible for packaging are FOST Plus members and that for paper-cardboard, households put out for selective collection some types of packaging that cannot be called household packaging according to the strict definition of the term.		
(2)	Including glass from the catering sector: 10,943 tonnes.		
(3)	The recycling rate is over 100. A strong drop has been noted in the volume put on the market for certain drinks, mainly in the wine and spirits sector. There is also the impact of an increase in parallel imports estimated at 30 Ktonnes		
(4)	Including materials recycled outside the basic scenario (cf. Article 8 of the accreditation agreement).		
(5)	Including metals from household refuse incinerators or from ash maturing centres: 40,438 tonnes		
(6)	Excluding glass from the catering sector: 10,943 tonnes		

7.6.2.6. Revenues

The revenues of Fost+ are two-fold:

- Sales from materials
- Green Dot contributions

In 2006, FOST Plus generated over 32 million euros' income from the sale of materials, which is the highest result ever recorded.

Table 50: Fost+ revenues trough time

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
Revenues from Green Dot	48.6	61.1	78.1	87.4	85.7	81	81.8	82.7	81.3
Sales of materials	0.8	1.3	12.9	10.6	15.9	15.7	18.8	24	32.1

Fost Plus admits that this record is also due to the high prices of raw materials. However, Fost Plus claims companies' efforts in terms of recyclability of their packaging have also played a role.

The following table gives detailed proceeds per material in 2006 in million EUR:

Table 51: Fost Plus proceeds per material

Glass	1.08
Paper-cardboard	10.58
Steel	4.63
Aluminium	2.29
PET	11.21
HDPE	2.58
Drinks carton	(0.25)

With respect to the determination of the Green Dot rates, one must note that each type of material entails different recycling costs and results. The sale price of the various secondary materials also varies greatly. A scale of rates is therefore used for each material.

However, strict allocation of actual costs would mean a zero rate for materials and packaging not covered by collections. Hence, materials which are hardly if ever recycled pay more than their true cost in order to finance and reduce the real costs of materials whose recycling cost is greater.

Accordingly, the materials or packaging that are not collected thus pay the highest rate.

The contributions in the Green Dot system are not negotiated. They are calculated following a pre-determined formula that cannot be made public. However, the contributions are published in, amongst other, the annual reports. They are influenced by several factors, including the prices of the materials on the markets for recycling[265].

On average, Green Dot rates slightly went down in 2007 compared to 2006. This is mostly due to an increase in the income generated by the sale of materials. Total Green Dot contributions registered a drop of EUR 1.2 million down to EUR 80.3 million.

A number of factors have significantly influenced the setting of Green Dot rates for 2007:

1. The contribution from the sale of materials on the recycling market continues to increase.
2. In relation to 2006, we note again – in 2007 – a general diminution of unit rates for collection and/or sorting, which brings down operational costs for the various materials. This diminution can be primarily accounted for by the ongoing optimization process for collection and sorting (automation in particular). Another factor to be taken into account is the sharp rise in fuel prices, which has had a considerable impact on collection costs.
3 At the request of the FOST Plus Board, a blanket reduction of 2% on all Green Dot rates has been granted in order to lower reserves.

[265] Information provided by Mr Van Gaever.

The table below gives an overview of Green Dot rates for 2007 for the various relevant materials (expressed in cents per kg):

Table 52: Green Dot rates 2007

	2005	2006	2007
Glass.	2.90	2.80	2.90
Paper-cardboard.	1.75	1.77	1.74
Steel.	5.37	2.83	2.34
Aluminium.	14.00	13.77	15.08
PET +.HDPE.	28.54	26.08	22.94
Drinks cartons	22.32	25.61	26.62
Others -.recoverable	36.76	37.09	35.11
Others -.non-recoverable	40.43	40.80	38.62

For the streams that we investigate in this study, the main underlying reasons for individual trends per material are the following:

- Paper-cardboard shows a very slight decrease, down from 1.77 to 1.74 eurocents per kilo. This can be almost entirely accounted for by the 2% blanket reduction granted by the FOST Plus Board.
- The rate for drinks cartons has gone up by 3.9% to 26.62 eurocents per kilo. In spite of a strong increase in the tonnages to be recycled (+ 20%), the rise of gross operational costs is limited to 3.6%, thanks to better rates for collection and sorting.

7.6.2.7. Collection and sorting costs

The graph below reflects the trends in average collection costs per tonne for glass, paper-cardboard and PMD as well as for PMD sorting since 2001.

Table 53: Fost + collection and sorting costs (in EUR/tonne)

	Collection costs for glass	Collection costs for paper-cardboard	Collection costs for PMD	Sorting costs for PMD
2001	47.51	43.94	181.59	203.78
2002	47.75	43.43	178.98	192.38
2003	47.95	44.69	178.14	187.48
2004	48.43	44.24	175.39	188.50
2005	48.53	43.84	177.81	184.84
2006	43.94	45.59	185.11	181.00

The increase in collection costs is almost exclusively due to indexing adjustments. For collection, the cost price determinants are essentially salaries and fuel prices.

7.6.2.8. Cost per inhabitant

The total cost per inhabitant is determined to a large extent by the operational costs for waste collection and sorting.

For all types of packaging combined (glass, paper, cardboard, sorted PMD), Fost+ reports that the operational costs for collection and sorting total 85 million EUR, while their total value as materials equals 41 million EUR. On top of the operational costs, one must add the costs for communication and the overhead costs.

This means that, as a whole, the system would not be viable without the contributions from the members. However, for some specific waste streams such as paper and cardboard, the results are positive. For metals, the system is not self-supporting for packaging waste (although a collection system limited to large items could be)[266].

The table below gives an overview of the costs per inhabitant in 2006.

The increases recorded for collection and sorting costs can be almost exclusively ascribed to the important indexing adjustments carried out on 1 January 2006 as a result of price developments for fuel.

A strong increase in the proceeds from the sale of collected and sorted material explains the strong reduction in the net cost per inhabitant. According to Fost+, the lesser contribution per inhabitant for communication costs can be accounted for by the fact that all the projects have now gone past their start-up phase. The budget set by contract for local communication is actually higher in the start-up phase than in the years that follow.

Table 54: Fost+ cost per inhabitant

2005		2006
Glass	1.47 EUR	1.49 EUR
Paper-cardboard (30%)	0.92 EUR	0.97 EUR
PMD - collection and sorting	5.16 EUR	5.34 EUR
Communication - collection and sorting	0.48 EUR	0.41 EUR
Other costs	0.63 EUR	0.64 EUR
Total	**8.66 EUR**	**8.85 EUR**
Recycling proceeds	-2.30 EUR	-3.07 EUR
Total balance	**6.36 EUR**	**5.78 EUR**

Fost + claims that costs in Belgium are two and a half times less high than in Germany for equivalent recycling results.

However, it is in general difficult to compare costs between different countries. One important factor is that Fost+ can impose the collection system on the intermunicipal associations. In other countries, the

[266] Information provided by Mr Van Gaever.

PROs must bear the cost of more frequent collection, and the cost per ton is very sensitive to the frequency of collection[267].

7.6.2.9. Data management

Collection, sorting and recycling data are recorded on an Internet-based central server. These data can therefore be accessed by all the parties involved. As soon as a collector has delivered materials to a buyer[268] or a PMD sorting centre, these enter basic data such as the weight and type of material.

7.6.3. VAL-I-PAC

Unless stated differently, the following information has been obtained from the VAL-I-PAC website or during an interview with Mr Francis Huysman of VAL-I-PAC on 18 April 2008.

VAL-I-PAC has been established in 1997 as a non-profit organisation. It is the only body accredited by the Interregional Packaging Commission in the field of industrial packaging. The most recent accreditation runs from 2007 to 2011.

As in the case of household packaging, companies can also choose to comply individually with the take-back obligation.

In the terminology of VAL-I-PAC:

- Operators are companies who collect or recover packaging waste: collectors, sorting centres, recycler etc. There exists a list of operators recognized by VAL-I-PAC
- The final waste holders are the parties who unpack the purchased goods. They are not member of VAL-I-PAC and are not obliged to work with recognized operators.

The system works as follows:

- The members of VAL-I-PAC are parties responsible for packaging. They inform VAL-I-PAC of the amounts of industrial packaging they have put on the market.
- The operators recognized by VAL-I-PAC inform VAL-I-PAC of the amounts of industrial packaging they have collected, recycled or recovered from final waste holders.
- VAL-I-PAC submits this information to the Interregional Packaging Commission.

There are three financial flows:

- The parties responsible for packaging pay an annual contribution to VAL-I-PAC.
- VAL-I-PAC pays a premium to final waste holders who sort their plastic or wooden packaging waste before collection. In the case of wood, it is also required that the wood is composted or recycled as chipboard. VAL-I-PAC also subsidizes the rental price of selective containers. As an incentive to work with recognized operators, the premiums are only paid if the waste is collected and recycled by a recognized operator.
- VAL-I-PAC pays the recognized operators.

VAL-I-PAC has also created a specific collection system for plastic foils and covers on construction sites.

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[267] Ibid.

[268] For PMD, buyers pick up materials at the sorting centres where data are encoded.

The VAL-I-PAC system basically is a push system: its approach is based on the assumption that if you stimulate selective collection, the market will find itself an application for the material.

There are two reasons why VAL-I-PAC offers a higher premium to firms who sort their plastic packaging waste:

- Plastic has the lowest recycling rate amongst packaging waste and the best approach for waste management is to have a separation at the source.
- The Belgian authorities apply the "polluter pays" principle. In the case of packaging waste, the authorities take the approach that the party responsible for packaging is the polluter, and not the final waste holder.

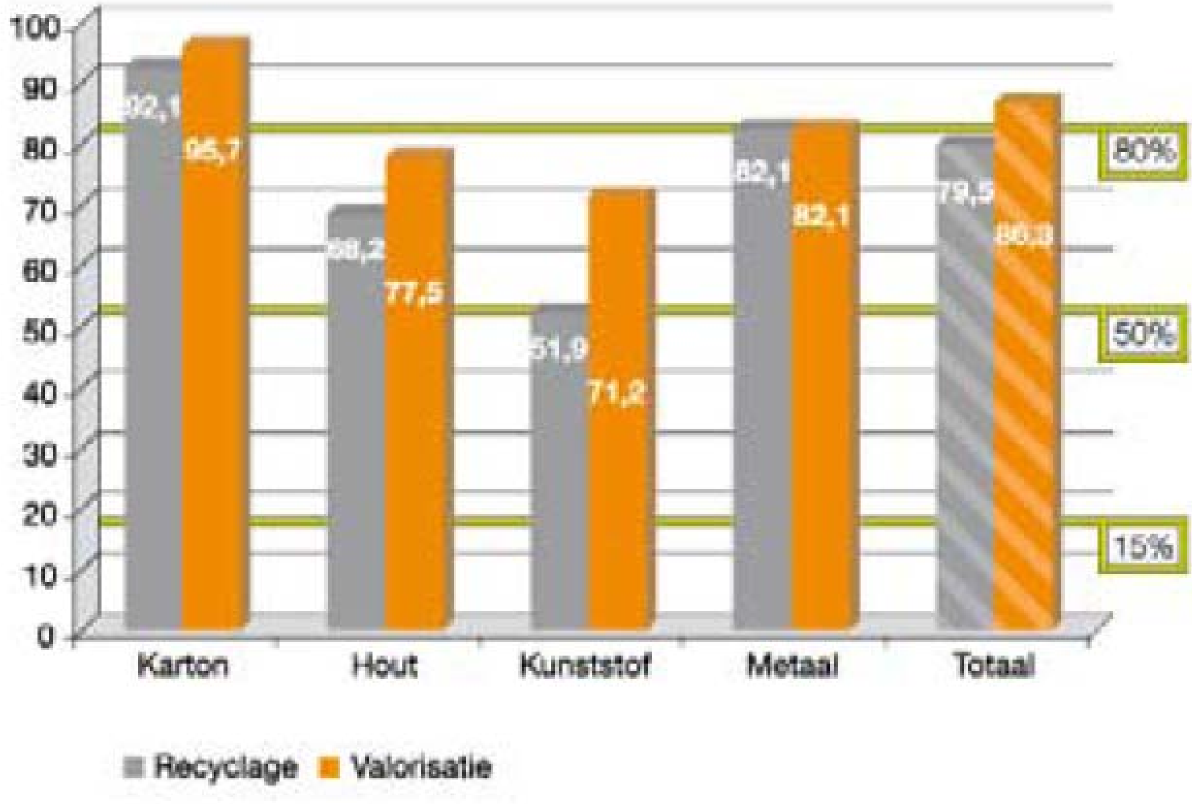
Paper, cardboard and metals have a positive market value anyway, so no premium for separation at the source was necessary for these materials. In the last 10 years, the market value of plastics has also increased significantly. 10 years ago, firms had in generally to pay to have their plastic waste taken away, while now they are often paid for the waste they offer. This explains why the premium for separation at the source of plastic packaging waste has gone down.

VAL-I-PAC is a free market based initiative; waste collectors are competing between each other, but report the collected and recycled amount to VAL-I-PAC. A system where the collection would be attributed by tender (as in the case of BEBAT – see Section 7.8) would never work since the collected materials have a positive value.

It is estimated that more than ca. 95 % of the waste collectors participate in the system. For them, the main advantage of participation is that it allows them to pay a premium to their clients. Therefore, non-affiliation is limited to a few niche markets.

In 2006, 79.5 % of industrial packaging was recycled, and 86% recovered. Cardboard obtained the highest score for recycling (92.1%).

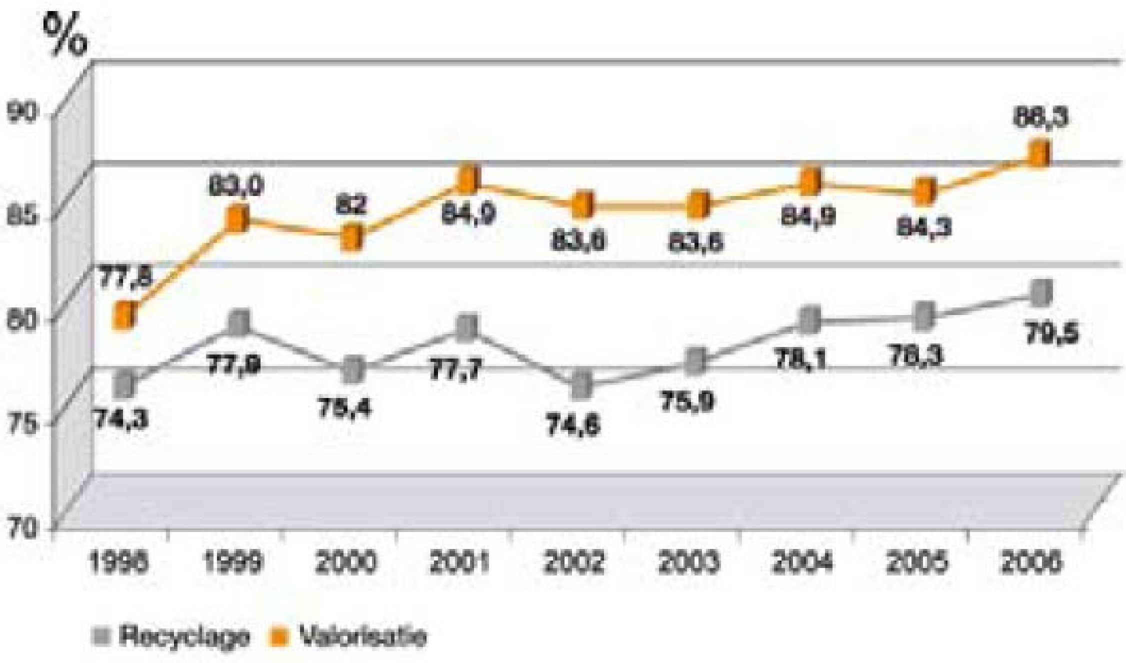
Figure 25: VAL-I-PAC recycling and recovery rates according to material



In this figure, "karton" stands for "cardboard", "hout" for "wood", "kunststof" for plastics and "metal" for "metal".

Throughout time, there was a steady increase of both recycling and recovery figures.

Figure 26: VAL-I-PAC recycling and recovery throughout time



7.7. PVC

OVAM has confirmed that it does not collect specific data on PVC waste arising[269].

According to a stakeholder who required to remain anonymous, due to the small size of the country, the collected PVC can go easily to another European country for recycling. Actually, as there are no official reporting requirements on PVC waste, this stakeholder reckons that it does not make sense to use a country-per-country approach for statistics[270].

In 2004-2005, the following intermunicipal associations have participated in a pilot project for the selective collection of municipal PVC waste: IOK Afvalbeheer, EcoWerf, IMOG, IVAREM. These pilot projects were limited to 1 or 2 container parks per association. As there is no obligation to collect PVC seperately, no data are available and each municipality (or association of municipalities) is free to participate or not in such a system. Due to the bulky nature of household PVC waste (pipes, floorings, etc), separate collection is also interesting from a logistical point of view, providing an important incentive for municipalities to create such a system[271].

The PRO for WEEE, Recupel, has not been able to provide us with data on PVC originating from this waste stream.

[269] E-mails by Johan Verlinden (OVAM) of 04 June 2008 and Marc Leemans (OVAM) of 05 June 2008.

[270] E-mail of 29 May 2008.

[271] Information provided per e-mail and phone by Lieselot Decalf of VVSG on 17 and 18 June 2008.

For ELV, the PRO, Febelauto, has referred to a recent study that is however subject to confidentiality clauses[272].

It is also indicative for the status of data availability that the recent OVAM study on markets for recycled products has not covered PVC as a separate waste stream.

However, with respect to plastics in general, OVAM has concluded, amongst others, that (OVAM 2008b, p. 131):

- Recycling requires a steady supply of sufficiently high quality. This requires more sorting at the source. However, it should be noted that the PVC industry is a forerunner in this perspective.
- In Flanders, too many recyclers are SMEs working in niche markets. Traders could also play an important role in matching supply and demand.
- There is still need for more "design for recycling".
- If recyclers would integrate vertically with manufacturers of finished products, this would make it easier to find high value applications of the granulates. Attempts at vertical integration have been undertaken in the 1980s. However, large plastics producers were insufficiently flexible to compete in local recycling markets.
- Plastics' recycling is hampered by perception problems. In a business-to-business environment, there is no problem when dealing with large companies. However, SME may lack the necessary competence.
- There is an important role for public procurement.

OVAM estimates that 13% of the plastics waste in Belgium is recycled, a third of which in Belgium. The vast majority is landfilled or incinerated.

Following an initiative taken by OVAM, plastics producers, plastics converters, recyclers and the accredited bodies for the collection of household and industrial waste have created a permanent discussion forum for the mechanical recycling of plastic waste in Belgium, called PLAREMEC.

5 priority actions have been planned for the short and medium term:

- Research on potential markets for recycled products
- Stimulating the demand for some recycled products in some specific waste streams
- Voluntary agreements with and between the regional and federal authorities
- Campaigns promoting recycling and recycled materials
- Discussion and evaluation of the acceptance obligations.

7.8. BATTERIES

Unless stated otherwise, all information in this Section comes from the BEBAT website. The annual reports are not made available to the public[273].

[272] E-mail by Catherine Lenaerts, CEO of FEBELAUTO of 23 May 2008.

[273] E-mail by Vincent Quidousse of BEBAT on 14 July 2008.

7.8.1. General regulatory framework

In Belgium, the federal government imposed a tax on all sold batteries (16 July 1993) with the context of the general "ecotax" law. The battery industry opposed this law and proposed a voluntary collection scheme as an alternative.

The ecotax law for batteries was amended on 7 March 1996: batteries are exempted from the ecotax if a voluntary collection and recycling scheme is set up and certain collection percentages are met. The battery industry set up BEBAT (21/08/1995) as a waste management organisation to co-ordinate the collection and recycling of batteries. The system is financed by a collection and recycling contribution which is chargeable to the consumer. The amount is 0.1239 EUR per battery (0.20 EUR per flashlight)[274]. In addition, all collected batteries must have an appropriate recycling process. Non compliance of the law will result in sanctions or even the end of the return-system.

The non-profit organisation BEBAT vzw is active since January 1996 with the objective of organising the collection management and useful recycling of used batteries in Belgium.

The Flemish government also submitted used batteries to a duty of acceptance from June 1998 on and started negotiations with the battery industry to reach an agreement as described in Article 3.1.1.4 of VLAREA. Participation to the BEBAT system is available for all companies subject to environmental taxes on batteries, also to companies subject to regional return-duties. Today, more then 800 companies are registered with BEBAT to comply with these environmental regulations.

The battery industry insisted to keep the federal ecotax in force in order to be able to motivate all individual battery producers to keep financing BEBAT (SERV, 2003, quoted in Bracke and De Clercq).

Since 2005 BEBAT also collects and recycles flashlights via the same collection channels as batteries (including municipal container parks). The Association of Flemish Cities and Municipalities has argued that this approach would create confusion, as other small equipment containing batteries is not included in this system[275].

BEBAT is supervised by the federal and the 3 regional authorities.

Finally, Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC has entered into force on 26 September 2006.

The scope of BEBAT activities covers portable and industrial batteries and accumulators. Automotive accumulators are covered by another organism, RECYBAT.

7.8.2. Automotive accumulators

According to VLAREA[276], lead starter batteries are subject to a take-back obligation according to 1/0 principle. This implies that each importer of lead starter batteries is required to take back for free any

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[274] The fact that the fee is fixed by law is a particularity of the Belgian approach. A variable battery fee proportional to the weight of the battery has been much more commonly used through Europe. See EPBA and Recharge (2007), Compliance Blueprint, A guidance document for setting up a Battery Compliance Organisation.

[275] Letter to BEBAT of 23 July 2004 by the Association of Flemish Cities and Municipalities (Vereniging van de Vlaamse Steden en Gemeenten - VVSG). Transmitted per e-mail by Lieselot Decalf of VVSG

[276] Decision of the Flemish Government of 05 December 2003, published in the Belgian Official Journal of 30 April 2004.

accumulator supplied by a wholesaler or retailer. The same requirement applies to wholesalers with respect to retailers and to retailers with respect to consumers.

According to Art. 3.6.1. of VLAREA, the objectives of this obligation are to obtain:

- a collection percentage of over 90 %, and of over 95 % from 1 January 2005;
- for waste materials resulting from the processing of the waste lead starter batteries:
    - 95 % recycling of lead;
    - 100 % recovery of the synthetic materials or 30 % recycling;
        - complete recovery or neutralisation of the electrolyte;

A voluntary agreement was also reached with FEDERAUTO with respect to accumulators. The PRO, RECYBAT, was created in 2003.

According to Art. 3.6.2. of VLAREA, the waste prevention and waste management plan and the environmental agreement particularly regulate the following if appropriate:

- the obligation of the final sellers of lead starter or other batteries to accept each waste battery and waste lead starter battery presented by the consumer;
- the obligation of intermediaries in lead starter or other batteries to, on a regular basis, collect all waste batteries or waste lead starter batteries accepted in pursuance of this order at the final seller and present them to the producer of lead starter or other batteries;
- the obligation of producers of lead starter or other batteries to on a regular basis collect all accepted lead starter or other batteries at the intermediary, or if there is not one at the final seller of lead starter or other batteries, and arrange their processing at their own expense at an establishment licensed for this purpose.
- the way in which the use of rechargeable batteries was encouraged.

According to Art. 3.6.4., each producer of lead starter and other batteries has to make the following information relating to the previous calendar year available to the OVAM:

- the total quantity of lead starter and other batteries, expressed in kilograms, that was consumed in the Flemish Region, per type;
- the total quantity of waste batteries and waste lead starter batteries, expressed in kilograms, which within the framework of the exercising of the acceptance obligation have been collected, subdivided by types;
- the installation(s) where and the way in which the collected waste batteries and waste lead starter batteries were processed;
- the quantity of recycled wastes;
- an overview of the preventive action.

Contrary to other PROs, RECYBAT is not required to organise a collection and recycling system for waste lead start batteries. The main role of RECYBAT is to manage and to coordinate the collection of statistics and the administration. However, the environmental agreements with the Regions stipulate that

RECYBAT would become responsible for the effective organisation of a collection system if the objectives of VLAREA are not met, if it is requested explicitly by the public bodies in charge of household waste or if the value of the batteries would turn negative. The fees paid to REYCBAT by its members are determined by the quantity of lead start batteries put on the market in the previous year[277].

According to Recybat, thanks to the high value of lead, collection functions well – garages are even being confronted with thefts of waste lead start batteries. Based upon data obtained from recyclers, RECYBAT claims that 100% of the acid contained in the collected batteries is neutralised and recovered, and that 95% of the lead is recycled. Data on the amounts of batteries that were collected by the recyclers is confidential[278].

7.8.3. Collection of portable batteries

Today, there are more than 20.000 BEBAT-stalls where used batteries and flashlights can be returned free of charge. The stalls can be found in hyper- and supermarkets and local shops, jewellers, photo shops, do-it-yourself stores, toy stores, electrical stores, pharmacies, etc., as well as schools, public and private institutions. Moreover, there exist regional and municipal collection programs (ex. district collections, the collection box for small hazardous waste of the Flemish Region).

Figure 27: BEBAT collection cube for batteries in Belgium, used in schools

Batteries originating from WEEE are removed by the PRO for WEEE, Recupel, and subsequently integrated in the BEBAT system[279].

The batteries are then collected by a specialised company[280]. The contract with the collector is awarded by BEBAT following a public tender. The public authorities require this contract to be re-tendered periodically. All waste collectors can introduce an offer. The main reason why collection is organised by one single firm is the existence of important economies of scale in collection. Batteries are a rather small fraction and the collection network is very dense. BEBAT pays a fixed price per tonne to the collector; this price cannot be made public for reasons of commercial confidentiality.

277 Recybat, De aanvaardingsplicht en de VZW Recybat, Synthesedocument.

278 Recybat, Jaarverslag 2007, transmitted by e-mail.

279 Information provided by Mr Peter Sabbe (Recupel) (phone interview of 20 May 2008). Confirmed by e-mail by Mr Vincent Quidousse (BEBAT) by e-mail of 21 May 2008.

280 Currently, this is SITA BELGIUM.

It should be noted that the collector does not pay the waste holders for the batteries that are collected, as they are considered to just fulfil an obligation imposed by law[281]. Local authorities are reimbursed for the direct costs linked to the system. The Association of Flemish Cities and Municipalities has argued that only a reimbursement of all costs, including the indirect costs, would be consistent with the principle of extended producer responsibility[282].

Batteries are sorted by type:

- button cells;
- rechargeable batteries with nickel-cadmium;
- rechargeable batteries with nickel-metalhydride;
- rechargeable batteries with lithium-ion;
- lead batteries;
- other types, especially alkaline and zinc-carbon batteries (the most common).

Since the beginning of BEBAT in January 1996, the amount of collected batteries has grown steadily (see graph).The collection percentage, before correction for rechargeable batteries, is 51% in 2004. After correction and based on a household waste analysis that was carried out in Flanders in 2005, the efficiency of the BEBAT collection system is 86 %, and even 88,5 % in the Flanders region!

BEBAT claims that, with these results and an average of 236 grams of collected batteries per inhabitant and per year, Belgium is the best performing country in the world with respect to the collection rate.

The main reason why recycling percentages are so high in Flanders is linked to[283]:

- the combination of the Federal eco-tax legislation and the Flemish acceptance obligation
- the high density of the collection system compared to other countries. For instance, few countries involve schools in the system!
- the continuous public awareness campaigns.

External observers have slightly different views on this. Mr Beaurepaire of EBRA thinks that the system works very well, because there is one single organism, one-voice communication and because important resources have been invested (including in awareness campaigns). For Mr Gilles Gros of the French battery PRO COREPILE, the strict enforcement of compulsory participation in Belgium has been the essential factor in the success of BEBAT with respect to collection rates[284]. Indeed, participation determines the financial resources of the PRO and affects the density of the collection network. BEBAT can denounce free-riders - this affects directly its resources. Other players have confirmed the essential role played by the awareness raising campaign. One would almost need a permanent information campaign. However, at a certain stage, saturation is reached. In some other European countries, selective collection has now to be developed from scratch and it can take a while before awareness reaches the sale levels as in Belgium.

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[281] Information provided during an interview of Mr Vincent Quidousse (BEBAT) on 14 April 2008.

[282] Letter to OVAM of 14 April 2003 by de Verenging van de Vlaamse Steden en Gemeenten (VVSG). Transmitted per e-mail by Lieselot Decalf of VVSG.

[283] Information provided by Mr Quidousse.

[284] Telephone interview on 28 May 2008.

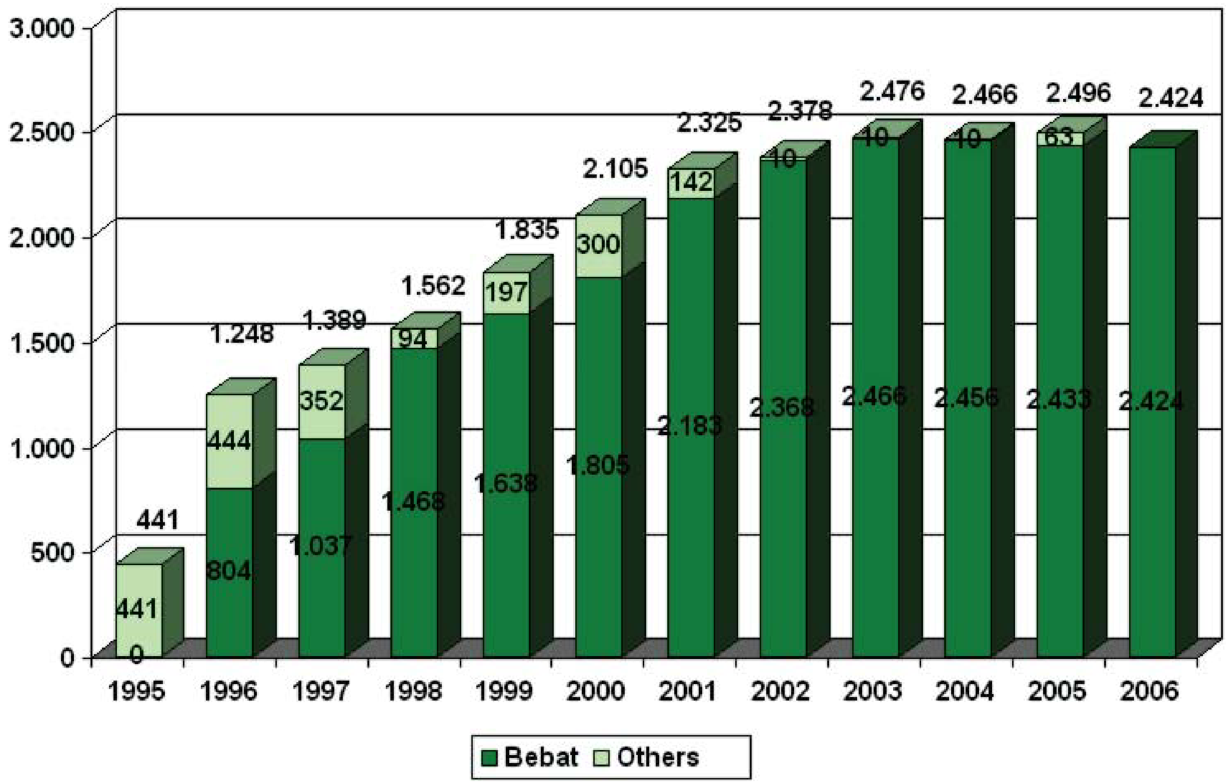
One should of course keep in mind that these high collection rates come at a cost. One interviewed stakeholder has referred to a European benchmarking study of battery PROs showing that the Belgium collection system has a very high unit cost. As the data is confidential, it is not possible to confirm or to invalidate this claim. However, other players contacted during this study have confirmed this view.

For instance, in 1999, Belgium spent 2.820 EUR per tonne on promotional activities. In Germany, this was just 160 EUR and in the Netherlands 870 EUR! [285]

In order to put the collection rates in perspective, one should also keep in mind that Belgium is a very small country.

Another controversial issue are the incentives BEBAT uses in order to stimulate higher collection rates, such as lotteries (see http://www.bebat.be/pages/en/main.html). At least one stakeholder thinks that this type of incentives send a (wrong) signal and distracts the public from the fact that there are environmentally superior alternatives to battery recycling (such as using rechargeable batteries or using mains electricity).

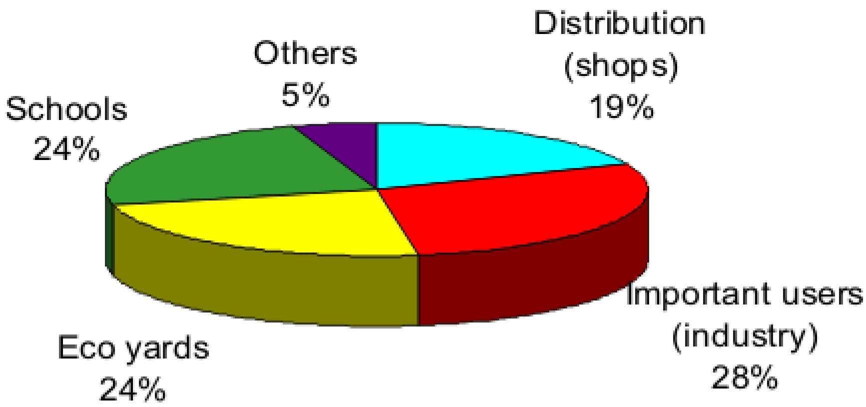
Figure 28: Batteries collection in Belgium



285 Scottish Environment Protection Agency (2005), National Best Practice Project, Phase 1: Waste Batteries, p. 48.

The figure below gives the relative importance of collection channels in 2005:

Figure 29: BEBAT collection channels in 2005



BEBAT expects that public information campaigns will lead to even better results in the coming years.

Mr Quidousse does not see a direct alternative to the current system where individual citizens have to bring their batteries to collection points. For instance, he does not favour a system where batteries would be recuperated from the garbage backs after collection.

7.8.4. Impacts on the retail sector[286]

The impact of the take-back obligations on the retail sector depends on whether one considers portable batteries or batteries included in WEEE.
The take-black obligation for WEEE entails several costs for the distribution sector: the labour costs linked to taking possession of the WEEE and sorting them, the storage room that is required, adapting the price lists every time there is a change in the Recupel rates, the information campaigns targeted at the consumers... Once a minimum quantity has been reached, the retailer has to contact Recupel for the collection of the WEEE (alternatively, he can bring it back to a distribution centre of the chain he belongs to).
FEDIS has obtained that Recupel reimburses part of the costs linked to the take-back obligation. This reimbursement is based upon (1) the surface required for the temporary storage of the WEEE (2) the transport costs linked to the centralisation of the WEEE. There is no reimbursement for the other cost categories. Moreover, the reimbursement of transport costs is based upon market prices for recovery operations (these are based upon the costs for recovery professionals, which are lower than the actual costs for the retail sector).

On the other hand, the personnel costs linked to the take back of portable batteries are very small, and BEBAT works with a scheduled collection round. FEDIS also thinks that working with a unique PRO (as is the case in Belgium) is better for the retail sector.

7.8.5. Recycling and processing

The recycling-processing of the different types of batteries are (Article 3.6.1 to 3.6.4 of VLAREA):

[286] All information in this Section was provided per phone interview and e-mail by Nathalie De Greve (FEDIS) on 05 June 2008.

- button cells : recycling of mercury and the ferrous materials;
- rechargeable batteries with nickel-cadmium : recycling of cadmium (in metal form) and nickel (as iron-nickel alloy);
- alkaline and zinc-carbon batteries: recycling of the ferrous materials, zinc, manganese and other materials (such as paper, plastics). Due to new investments in 1999, it is now possible to extract zinc and manganese sulphate. This will then be purified into a zinc-manganese salt-solution. This solution is then used in the production of electronic components (such as computer and TV screens).
- lead batteries are recycled for the lead.

These articles of VLAREA also contain the recycling targets.

The recycling is currently assigned to INDAVER (Antwerp) for the button cells, S.N.A.M. (France) for the nickel-cadmium batteries, CAMPINE (Beerse) for the lead batteries and REVATECH (Liège) for the other types. Large investments at REVATECH have made it possible to reuse +/- 70 % of the battery materials.

The recyclers are also contracted on a periodic basis by BEBAT. These contracts contain a price structure and levels of recycling. BEBAT verifies whether these recycling targets are met. Recyclers themselves prefer long term contracts because the recycling targets imply specific investments. For BEBAT, working with long-term contracts makes it easier to verify whether recycling targets are met. The main reason why all recyclers are located in or close to Belgium lies in the high transportation costs, but also because BEBAT applies the proximity principle of European waste policy. Again, the prices are confidential. The recyclers are free in the choice of the markets for the recycled metals. The price paid by the recyclers to BEBAT depends on the value of the metals contained in the batteries, and can even be negative for low value metals[287].

In the case of NiCd and nickel-metalhydride, the collection cost is amply covered by the value of the metal that is collected. This is not the case with alkaline and zinc batteries, which would not be collected if it weren't for the environmental motive[288].

BEBAT claims that the spectacular growth of recycled materials is not only due to the growing collection efforts, but also to the ever improving recycling techniques. For example, the recycling percentage of zinc-carbon and alkaline batteries increased from ± 20 % in 1996 to over 60 % in 1999. According to Mr Quidousse, the main barrier to more recycling are illegal exports (for instance, of built-in batteries in cell phones and laptops).

7.8.5.1. Zinc-carbon-, alkaline-, and other batteries

By far the most important category, it accounts for 66 % of the total collected weight. A lot of effort has gone into optimising the recycling processes for these batteries.

In 1996 they started to grind the batteries, only to recycle the metal parts. In 1998, also the plastics were recycled. Since 1999, zinc and manganese are recycled.

Revatech (Liège) is responsible for recycling these batteries – see Section 5.3.3.

[287] Information provided by Mr Quidousse.

[288] Information provided by Mr Quidousse.

Further improvements of the sorting machines and recycling research will allow for recycling of new types of batteries, like lithium-ion and lithium-polymer.

7.8.5.2. Button cells

All button cells, 1 % of the weight collected by BEBAT, are processed by INDAVER (Beveren) regardless of their mercury content. Indaver distils the mercury first and then recovers the ferrous materials.

However, this volume is very small (2.500 to 3.500 kg per year) and is decreasing further under the influence of the Battery Directive[289].

7.8.5.3. Rechargeable batteries

The market share of rechargeable batteries is growing because of wireless appliances and mobile phones. They make some 8 % of BEBAT collections. The lifespan of these batteries is quite long (5 to 20 years). Thus the batteries collected today are mostly the nickel-cadmium and nickel-metalhydride ones. SNAM (St. Quentin-Fallavier, France) is responsible for recycling.

7.8.5.4. The rechargeable lead batteries (or accumulators)

Mostly used for starting internal combustion engines (for this purpose, they are exempt from environmental taxes, and not collected by BEBAT), but also used for emergency lighting, alarm systems, and household appliances. BEBAT collect the accumulators that are not exempt from environmental taxes. They represent 25 % of collected weight.

CAMPINE (Beerse) is responsible for recycling.

7.8.5.5. The rechargeable lithium-ion rechargeable batteries

This is the newest category of rechargeable batteries. Umicore has developed the "Val'Eas" recycling process for this type of batteries – see Section 5.3.5.

7.9. FOOD

7.9.1. Generalities

Flanders does not have a policy on "food waste" as such.

Food waste is affected directly by the policies on organic-biological waste and on animal by-products. However, both policies also cover waste streams that are not, strictly speaking, food waste. Moreover, the treatment of food waste is also heavily influenced by seemingly unrelated policies (such as energy policy) and products (such as manure). We briefly summarize the main points here.

7.9.1.1. Policy on animal by-products

At the end of 2006, the Flemish government approved the new Decree on Animal Waste, which implements the European Regulation 1774/2002 on animal by-products. This Regulation determines what

289 Information provided by Mr Van Wayenberg, Marketing Manager Specialties, INDAVER in e-mail of 27 May 2008.

is allowed or not with waste streams of an animal origin (incineration, technical applications (for instance in oleochemical plants), composting…) and puts a heavy emphasis on traceability of this type of waste. It is discussed elsewhere in this report (see Section 3.5.3). Some organic waste (such as brewery waste) was used for animal food in the past, but this has become more difficult due to these more stringent food safety regulations. New solutions are being investigated (OVAM 2008b, p.52). Regulation 1774/2002 also affects, amongst others, the policies on composting, on waste fried fats and oils and the policy on fallen stock (OVAM 2006, p. 19). We will have a closer look at this in the relevant subsections.

Table 55: Flemish Implementation of ABPR[290]

	Diverting National regulation or full implementation of Annex VI ABPR	Time/temp regime	Max particle size	Closed reactor or open windrow	Final product testing		Waiting period for grazing/harvesting of feeding stuff
					Indicator pathogens tested	Requirement/limit	
Catering waste from households	VFG-waste (Vegetable, fruit and garden waste) from households per definition is **not** containing meat products. However some treatment plants do allow ABP Cat 3 catering waste and have recognition. Either 1 h 70°C 12 mm is reached during the biothermic heating process or is reached in the composting phase which follows anaerobic digestion, although transitional measures are still allowed for 2 existing plants.	1h/70°C	12 mm (?not sure about particle size)	closed possibly open windrows in maturing phase after hygienisation	E.coli or Entero-coccaceae Salmonella	n=5, c=1, m=1000, M=5000 in 1 g n = 5, c = 0, m = 0, M = 0 in 25 g	3 weeks

[290] From Barth et al (2008, Annex 3, p 32-33).

Catering waste from central kitchens	There is no difference between Catering waste from households or central kitchens.	1h/70°C	12 mm (?not sure about particle size)	closed, possibly open windrows in maturing phase after hygienisation	E.coli or Entero-coccaceae Salmonella	n=5, c=1, m=1000, M=5000 in 1 g n = 5, c = 0, m = 0, M = 0 in 25 g	3 weeks
Former foodstuff	Differentiation between sort of former foodstuff. (a) Bakery products e.g. .bread, cake, chocolate, cookies, … containing ABP for instance fat, milk, dairy products, eggs, honey, … but these ingredients are not the main ingredient: 1774 is not applicable when not containing raw meat, fish or products derived from raw products and have not been in contact with these. (b) for small amounts produced of products containing ABP that have been packed before becoming ABP and with max of 10 kg/week can go to incineration together with residual waste (exception for small shops). (c) all other	1h/70°C	12 mm (?not sure about particle size)	closed, possibly open windrows in maturing phase after hygienisation	E.coli or Entero-coccaceae Salmonella	n=5, c=1, m=1000, M=5000 in 1 g n = 5, c = 0, m = 0, M = 0 in 25 g	3 weeks

	former foodstuff: recognised biogas or composting plant according to treatment measures in Annex VI of ABPR.						
All other Cat. 3 material							
Manure	Full implementation of Annex VI ABPR	1h/70°C	12 mm	closed	E.coli or Entero-coccaceae Salmonella	n=5, c=1, m=1000, M=5000 in 1 g n = 5, c = 0, m = 0, M = 0 in 25 g	3 weeks

7.9.1.2. Policy on organic-biological waste

The policy of the Flemish government on organic-biological waste was established in January 2000.

The Flemish legislation distinguishes between the following types of biowaste (OVAM 2008a, p. 7).

- **Green waste**: separately collected compostable organic waste from private gardens, sport pitches, landscaping, parks… It is obtained by door-to-door collection from households, or carried by citizens to municipal recycling parks. Green waste from landscaping etc is presented directly at the gate of professional green waste composting plants. These plants are *required* by law only to accept green waste.
- **VFG waste**: separately collected Vegetable, Fruit and Garden waste from *private* households. In specific regions in the Flemish region, the door-to-door collection of VFG waste is carried out. There is a limitative list of inputs that are allowed to be a fraction of this VFG waste[291].
- **Industrial organic waste** including industrial sludge: originating from industrial (food and feed), agricultural or scientific processes that can be of plant or animal origin. Expelled from professional composting plants for the production of fertilisers or soil improvers are sewage sludge, sludge from drinking water production, septic sludge …

Organic-biological waste is thus not subject to a selective collection system as a whole, and a part of it "disappears" in the non-selectively collected waste streams. For instance, the commercial sector is not subject to separate collection for VFG waste.

Flanders has adopted the following three-tier policy for organic waste (see Parent et al):

- Waste prevention (encouraging home composting and waste free gardening through the Master Composter programme)
- Maximising the composting of garden waste through the waste yard network and the development of 19 composting companies, usually per association of municipalities
- Maximising bio waste composting (9 processing plants, two of which with digesters)

We shall not delve further into the issue of prevention of organic-biological waste, but it is a high priority for the Government. According to the latest evaluation plan (OVAM 2006b) the Government has set itself as objective that 36% of the population should be actively involved in prevention (46% in the municipalities where there is no selective collection VFG waste). Home composting plays a central role in prevention policies.

7.9.1.3. Energy policy

The existence of Green Stream Certificates provides strong incentives for energy recovery[292]. However, these streams can also provide benefits in other applications. Therefore, a trade-off exists between the objectives of energy recovery on the one hand and other aspects of resource policy on the other hand. According to the Decision of the Flemish Government, no Green Stream Certificates are awarded for waste streams if these materials can be recycled and if energy recovery does not fit within the relevant

[291] Basically, animal by-products from kitchen waste can only be added if the processing plant has received an authorization as laid down in Regulation 1774/2002.

[292] According to the Decision of the Flemish Government of 5 March 2004, Green Stream Certificates are allocated to the production of electricity from renewable energy. This includes: solar energy, wind energy, water, biomass, organic-biological waste (animal by-products, VFG waste, fried oils, sewage sludge, organic-biological waste that is selectively collected or sorted from non-selectively collected waste).

implementation plan. Following the Flemish government's approval of the Green Electricity Action Plan, OVAM was asked to make an inventory regarding the availability of biomass, considering that industrialists will only build or adapt the necessary installations if they can be certain of the availability of biomass (OVAM 2006, p. 19). Recently, new initiatives have been taken for the refermentation of organic waste, manure and energy crops in the context of bio-mass energy production ("green electricity") (OVAM 2008b, p.52).

7.9.1.4. Manure policy

The Waste Directive excludes manure from its scope. Nevertheless, co-treatment of organics and biological waste and manure becomes more and more important because:

- The Nitrate Directive (see Section 3.5.5) and the necessity to treat the surplus of manure
- The certificates for Green Energy that can be obtained

In execution of the European Nitrates Directive, the Flemish Community promulgated a decree limiting the use of nutrients in Flemish agriculture, the so-called Manure Decree[293]. According to this decree, compost and digestion residue from aerobic or anaerobic treatment of separately collected biowaste (without co-treatment of animal manure) is considered as an organic fertiliser as it contains nitrogen and phosphorus.

7.9.1.5. Approach of this chapter

In order not to create artificial and meaningless boundaries, this chapter will thus not limit itself to food waste in the strict sense.

We will have a closer look at the market for compost in Section 7.9.2. The only food stream that is currently subject to an acceptance obligation are frying fats and oils – these are covered in Section 7.9.3. Other industrial organic waste is discussed in Section 7.9.4. Finally, Section 7.9.5 provides a summary of a recent study undertaken by the University of Ghent on the economics of other animal by-products.

7.9.2. The market for compost

7.9.2.1. Structure of supply

Compost and digestates are produced using VFG waste, green waste and organic-biological industrial waste. Co-treatment of these sources with manure, energy crops and secondary materials is also possible (OVAM 2008b, p.52).

Originally, compost in Flanders was produced from mixed residual waste and suffered from poor quality (OVAM 2008a, p. 7). Following stricter acceptation rules, the quality has gradually improved. In the early 1990s, Flemish municipalities were obliged to implement separate collection from households and treatment plants were built. Only biowaste that fulfils end product standards is accepted as an input.

In order to coordinate the implementation, to monitor the quality of the process and to promote sales, the VLACO (Flemish Composting Organisation) was established in 1992, a partnership between OVAM, the association of municipalities and the producers. (Parent et.al., p. 15) The VLACO certifies the

[293] The official name is 'Decree concerning the protection of water against the pollution by nitrates from agricultural sources'. The latest version is from 22 December 2006.

following streams: VFG and green compost, compost or digestate from organic-biological industrial waste.

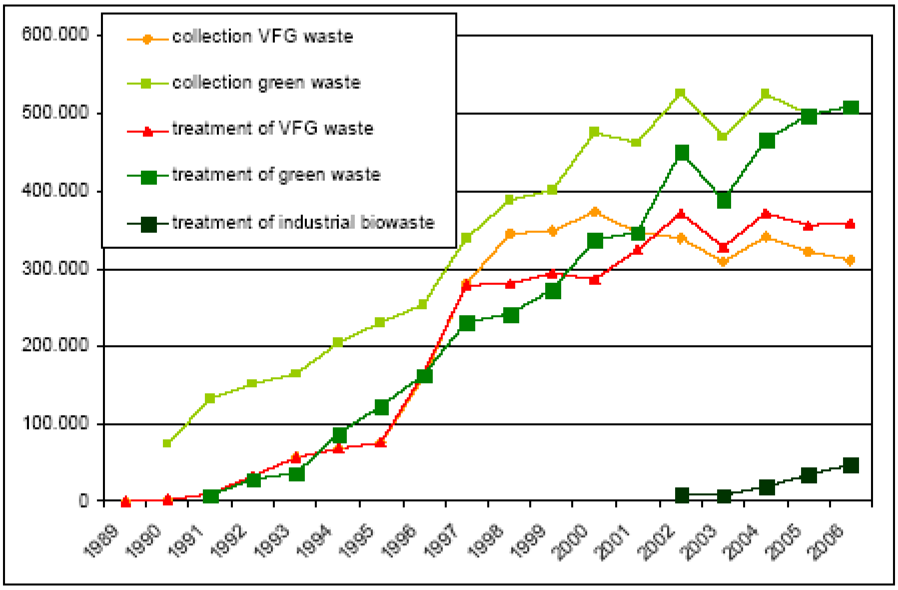


Figure 30: History of separate collection and biowaste treatment in Flanders (source: OVAM 2008a, p. 9)

Although no foreign companies have been certified, there is also some (limited) import, mainly from the Netherlands, but no exact figures are known (OVAM 2008b, p.55).

The following quantities have been brought to the installations followed up by the VLACO (OVAM 2008b, p.53):

- VFG waste from kerbside collection: 310.000 ton in 2006 (no export)
- Green waste: 500.000 ton in 2005 (no export)
- Organic-biological industrial waste: 47.000 ton have been treated under VLACO supervision in 2006. An unknown quantity of this waste stream has been exported, mainly to the Netherlands and Germany.

The Flemish Region actively promotes composting. For instance, local authorities are eligible for subsidies in a wide range of activities: home composting, low waste gardening, prevention of VFG waste… (OVAM 2006b, p 59).

7.9.2.2. Treatment capacity

OVAM reckons that there is sufficient capacity for the treatment of VFG and green waste. (OVAM 2008b, p.53).

In 2006, 35 professional composting plants accounted for the compost production with an average treatment capacity of 16.792 tonnes/year of green waste and 39.817 tonnes/year of VFG waste respectively. These treatment plants are more or less equally distributed over the surface of the Flemish region. About 8 other plants are producing organic biological compost or other types of fertiliser or soil improver based on other input than separately collected biowaste, of which some are digestion plants. (OVAM 2008a, p. 10-11).

The last 3 years, there is an increase in the construction of treatment plants for biothermic drying and anaerobic digestion. These plants are mainly focused on the treatment of manure, as a result of the Flemish Manure Decree which forces the treatment of animal manure for export of nutrients from the Flemish region. Biowaste is in many cases co-treated with animal manure. (OVAM 2008a, p.11).

7.9.2.3. Quality control

OVAM (2008a, p.8) emphasises that a clear supervision of the treatment process (both internally and externally) and product testing is necessary. Compost can no longer be produced from mixed municipal waste, even when proper posttreatment techniques should be available.

The two main work domains of VLACO are compost quality assurance and compost marketing.

Since its start-up in 1992, VLACO has considered quality as a key issue. A quality assurance system (QAS) has been put in place, which is obligatory for all professional composting and digestion plants in Flanders. This QAS is based on the principles of integral chain management. The QAS takes into account all aspects of the composting chain, from the acceptance of biowaste, the quality of the treatment process, end product quality up to customer support for a reasoned use.

The outcome of the QAS on treatment plant level is one or several product certificates. Without the control certificate, treated biowaste cannot be used as a secondary material. Control of compliance with this certification scheme is done through means of regular audits and product sampling (OVAM 2008a, p. 12).

The most important aspects of the VLACO quality assurance system are:

- *a strict acceptance protocol*: Treatment plants must have procedures describing the acceptance of inputs for green waste composting or VFG waste composting. Only separately collected biowaste is allowed to be used as an input. Regular sorting analyses must be carried out. In case of non-conformity with the acceptance criteria, the biowaste is refused, and the cause of incompliance has to be dealt with. The acceptance of a fraction of industrial biowaste from food industries is only possible when regular analyses on agricultural and environmental parameters are carried out.
- *process management according to ISO-principles*: VLACO has set up a QAS for professional treatment plants of biowaste according to the principles of the ISO 9000 certification standard and integral chain management. The whole chain of biowaste treatment is monitored using an integral quality management system as experience had shown that a quality assessment only based on end product testing is insufficient.
- *quality monitoring of the end product*: The VLAREA-legislation for use of treated biowaste as a secondary material (fertiliser or soil improver) sets up limit values for the most important environmental parameters, both organic (PAH, PCB, volatile compounds, …) and inorganic (heavy metals) . The VLACO QAS is based on limit values that are even stricter than these values.
- *reasoned use of the end products*: the VLACO QAS imposes the professional composting plants to inform the consumers about the use of the product(s), in all possible applications.

In 2006, VLACO members have produced 333.000 certified tons of compost. There is also an (unknown) supply of not-certified compost, mainly for own-use. The OVAM is currently taking initiatives to submit this small-scale composting to the supervision of VLACO, in order to create a level playing field (OVAM 2008b, p.54).

7.9.2.4. Interaction with policy on manure

Due to the excessive production of animal manure in the Flanders, applications of compost in agriculture are limited. Because of beneficial effects of the use of compost against prevention of soil erosion (through enrichment with stable organic carbon), the Manure Decree allows an annual extra compost application in some situations (see OVAM (2008a, p. 17) and (OVAM 2008b, p.55)).

However, there is no level playing field between all fertilisers/soil improvers. For instance, manure is not subject to regulations with respect to heavy metals, but compost is. Also, the VAT applied to fertilisers and peat is 6%, while in some Belgian regions, the VAT tariff for compost is 21% (OVAM 2008b, p.56).

According to OVAM, high competition between animal manure and compost due to this decree is the main reason of the poor marketing potential of compost on agricultural land in Flanders.

7.9.2.5. Interaction with policy on animal by-products

As far as the green composting plants are involved, the co-treatment of biowaste of animal origin is prohibited by regional waste law (VLAREA).

VFG compost can contain up to 25% of organic-biological waste[294]. However, the majority of the VFG composting plants are not approved for the treatment of animal by-products[295]. This is because some inter-municipalities have explicitly excluded animal by-products by using the definition of VFG waste (vegetable, fruit and garden waste with exclusion of catering waste), and is in some cases affirmed by the environmental permit not allowing the treatment of biowaste of animal origin.

Only few biowaste treatment plants in Flanders have actually chosen for a recognition according to the EC Animal By-Products Regulation, which allows them to treat animal by-products through composting or anaerobic digestion (OVAM 2008a). The main reason why most biowaste treatment plants in Flanders have chosen not to obtain a recognition according to the Animal By-Products Regulation is that such would require stringent hygienic standards for the whole supply chain (not just for the treatment plants themselves). For instance, household bins and refuse lorries containing food waste would have to be cleaned frequently, and it would not be feasible to enforce this. Therefore, the definition of Fruit, Vegetable and Garden Waste is never enlarged to animal kitchen waste. Also, using a clear and unique message in the entire region of Flanders reduces the risk of confusion with respect to what is allowed and not[296].

Taking into account the points made in Section 3.5.6.5, it is not clear however why this exclusion also applies to catering waste.

7.9.2.6. Uses of compost

Due to the specific characteristics of compost, there are few competing products. Its main applications are soil improving, substrates and biotechnical applications (OVAM 2008b, p.55).

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[294] Once the threshold is exceeded, the final product is labeled as a compost or digestate of organic-biological waste.

[295] According to Regulation 1774/2002 , composting and biogas plants are subject to approval by the competent authority if they process animal by-products.

[296] Information provided per e-mail by Kathleen Schelfhout of OVAM (05 June 2008).

There is also still some market potential in public parks. For instance, compost is a perfect substitute for peat, which is still widely used (OVAM 2008b, p.56).

On the demand side, the use of VFG or green compost certified by VLACO is now part of standard specifications for municipal or provincial requests for tender. The use of compost has also been integrated within the current cooperation agreement with municipalities (OVAM 2008b, p.56).

94% of the compost is destined for local use, and only a small amount is used on agricultural soil (9%). Some of this compost is used in private gardens (OVAM 2008a, p. 9).

It is estimated that 6% of the compost produced was exported in 2006 following the "green list" procedure.

6 plants export quantities between 1000 and 3000 tonnes. 4 plants export smaller quantities - all is green waste compost. Most of the plants are situated near the border. Precondition for export is a certification according the VLACO standard. No additional requirements have to be fulfilled by the plants for the 20 % of the compost which goes to the Netherlands. The other 80 % which are exported to France have to meet the French NF U 44051 compost product standard which means that the Belgium plants send compost sample for analysis and certification to French labs. For transport of compost in Flanders or export the manure policy also requires some administrative paper work (transport documents). Flanders can export compost to France and the Netherlands but not to Wallonia (Barth et al p 176).

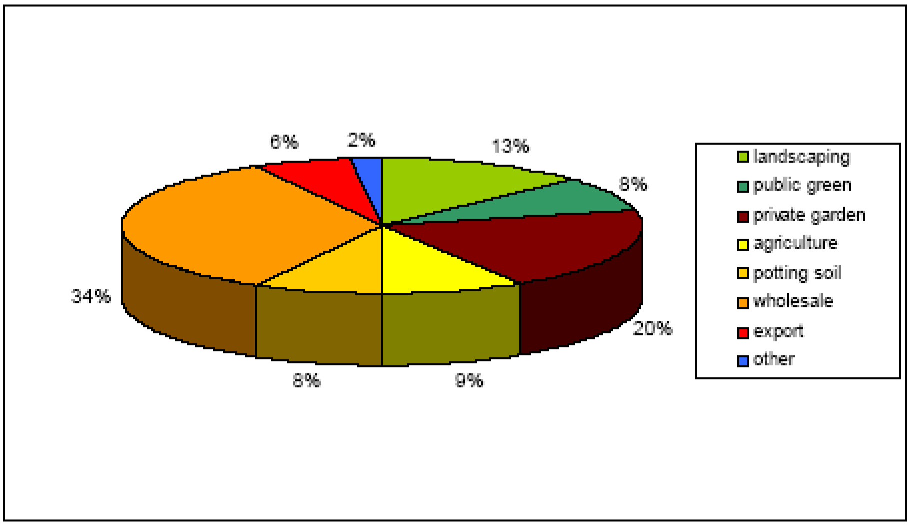

Figure 31: Marketing of Flemish compost from treated biowaste in 2006

7.9.2.7. Environmental Benefits of composting

Research has shown that the application of compost has a positive effect on the amounts of organic matter in the soil. It also leads to higher yields and better quality of crops, and a more stable acidity (OVAM 2008b, p.55).

OVAM (2008a, p. 5) estimates that through the separate collection of biowaste and its application as compost, mineral fertilizers can be substituted by 8 to 10%. Moreover, it is estimated that reduction of landfilling biodegradable waste by 65% in the EU15 could save 74 million tonnes of CO2 equ.

Besides its positive impact on organic matter levels, compost also has value as carbon sink (OVAM 2008b, p.56).

7.9.2.8. Evaluation of the selective collection with a view to composting

The University of Ghent (UGent, 2006) has developed a generic model for the evaluation of selective collection schemes of waste. The model uses a multi-criteria analysis to evaluate whether the selective collection of specific waste streams is superior to a non-selective collection system.

The criteria used include:

- Financial parameters: cost of kerbside collection, cost of municipal collection facilities, (including the opportunity costs of households), costs of house composting
- Environmental parameters: emissions, land use, energy and fossil fuel consumption, resource use, local disamenities, etc
- Compliance with the waste hierarchy

The model also takes into account constraints with respect to the service levels.

This model was applied to organic waste.

The evaluation compared the separate collection of vegetable, fruit and garden waste (VFG) or exclusively green waste with a view to its professional composting (possibly combined with home composting) with the scenario of putting all waste in one single bag for incineration.

The base line scenario consisted in a biweekly kerbside collection of small household waste and collection of "large" household waste through municipal container parks, followed by incineration with energy recovery.

On the one hand, the additional kerbside collection of VFG waste required a significant additional cost. For one million ton of household waste, the cost of separate collection is 110 EUR per ton compared to 47 EUR per ton in the baseline scenario. On the other hand, it is cheaper to collect green waste through municipal container parks. Moreover, the treatment of the selectively collected wastes is cheaper than incineration. Globally speaking, the selective collection of VFG waste is slightly superior from a financial point of view.

The environmental benefits however turned out to be significant. With selective collection, there is a decrease in air pollution and resource use. The use of compost in agriculture leads to a decrease in erosion. An environmental disadvantage of selective collection is its negative impact on energy consumption and land use: not-selectively collected waste is incinerated with energy recovery in incinerators that require less space.

The study concluded that the additional cost of setting up a selective collection system can thus be justified if there are significant cost savings and environmental benefits in the treatment phase.

7.9.2.9. Market and policy failures

Thanks to the strict quality assurance and certification process, asymmetric information is now no longer an issue. Treatment technology is mature as well. Moreover, selective collection is superior, even from a purely financial point of view.

Flanders currently is amongst the 5 most successful "countries" in the EU when it comes down to the source separation of biowaste. However, this success is to a large extent due to extensive garden waste collection and composting (Barth et al, 2008, p. 127).

The composting plants are entirely reimbursed for their treatment costs by the waste suppliers[297].

The two main problems are:

- The market price of compost[298] does not reflect its environmental benefits. It should be noted, however, that OVAM cannot provide estimates of the cost of organic matter deficits (OVAM 2008b, p.56).
- As explained in Section 7.9.2.9, compost and manure compete with each other in applications as fertilizer but there exist several regulations discriminating against compost.

Another problem is that some inputs in the composting process are also in high demand in other areas (the production of "green" electricity and the use of green waste as mulch material[299]).

Finally, OVAM has always been in favour of a Biowaste directive, also stimulating separate collection of biowaste and leading to clear standards. In this, it has the full support of the two other Belgian Regions.

7.9.3. Frying fats and oils

3 categories of frying fats and oils can be distinguished depending on their origin:

- Private use: frying fats and oils originating from households; they are collected through container parks, or through separate kerbside collection or neighbourhood collection systems
- Professional use: frying fats and oils originating from catering providers, restaurants, hotels, fast-food… This is brought to container parks and further collected by licensed collectors, or collected directly by licensed collectors.
- Food industry: frying fats and oils originating from, for instance, the potato or meat processing industry. This is collected directly by licensed collectors.

7.9.3.1. Processing and disposal

7.9.3.1.1. Regulation (EC) No 1774/2002

The recycling of frying fats and oils is regulated by the ABPR (see Section 3.5.3). Its main implication of for frying fats and oils is that they are no longer allowed back in the food chain.

Depending on their origin, frying fats and oils can be classified as follows

- Waste originating from private use or professional catering is only allowed in technical applications (NOT in animal food) according to Article 22 of the Regulation
- Waste originating from the food industry: can be used as feed material under certain conditions – see below.

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[297] Information provided by Kathleen Shelfout per e-mail on 07 July 2008.

[298] Currently, between 4 and 10 euro per 1000 liter for compost purchased in bulk - see: http://www.detuingids.be/pages/detail.asp?Id=2729 .

[299] A mulch is any material applied to the soil surface for protection or improvement of the area covered.

7.9.3.1.2. Restrictions on transport

A transporter of waste materials must be accredited and be included in the register of transporters (see Chapter 5 of VLAREA). Any person or entity ordering the transport of frying fats and oils, and any professional waste producer is required to keep a registry of documents that allows a perfect traceability of the waste streams.

For international transports, the following European regulations apply:

- Regulation (EC) No 1774/2002 (Article 8) applies to all frying fats and oils originating from households or from the hotel and catering industry *destined for composting or fermentation*. It also applies to *waste from the food industry*. All shipments must be accompanied by accompanied by a commercial document or, when required by this Regulation, a health certificate.
- Regulation (EC) no 1013/2006 applies to all frying fats and oils originating from households or from the hotel and catering industry and shipped *for technical applications* (oleochemical applications, biodiesel…). This waste is considered to be on the "green list".

7.9.3.1.3. Use as feed material

In case the ABPR applies, companies involved in the storage, in the treatment of frying fats and oils in cattle food, in composting or fermentation or in technical applications of frying fats and oils are subject to approval (see Chapter III).

Frying fats and oils originating from the food industry, from animal origin or from vegetal origin but containing animal proteins, cannot be used directly as an input for the feeding of farmed animals – they need to be processed further in a Category 3 processing plant (Article 19 of Regulation 1774/2002).

Frying fats and oils originating from the food industry, from vegetal origins and free of animal proteins, can be used directly for the feeding of farmed animals.

7.9.3.1.4. Incineration

According to Article 5.4.2 of VLAREA, it is forbidden to incinerate frying fats and oils from a private or professional origin, but exemptions can be obtained from the Minister. Frying fats and oils from the food industry can be incinerated with energy recovery if they are from vegetal origin.

After a study by the Flemish Institute for Technical Research (VITO) has concluded that there are no environmental arguments in favour of such a ban[300], OVAM has recently advised the Ministry of the Environment to also grant exemption to frying fats and oils of mixed origin as long as the standard emission standards are respected. This advice has been followed and the new approach will enter into force on 01 January 2009.[301].

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[300] http://www.ovam.be/jahia/Jahia/op/edit/pid/547?matrix=647yes

[301] Announcement by the Flemish Ministry of the Environment on 19 August 2008.

7.9.3.1.5. Technical applications

Vegetal and animal fats and oils can be used as an input in the oleochemical industry, for the production of fatty acids, fatty acidic, esters, glycerine, etc. These can then be used as an input in for instance soap production or the cosmetic industry.

Vegetable and animal fats and oils can be used in the production of biodiesel if, following further treatment, it satisfies the European norms for biodiesel NBN EN 14214.

Frying fats and oils can also be used in composting and fermentation, and in the production of chipboard.

7.9.3.2. The acceptance obligation[302]

Since 1 July 2004, there is an acceptance obligation for animal and vegetable waste fats and oils within the Region of Flanders. It covers all the animal and vegetable oils and fats that are sold to and collected from both private and professional users[303]. The producers, importer and retailers of animal and vegetable waste fats and oils are responsible for the complete life cycle of the products they sell or import. They are compelled to collect used oils free of charge and must prove that 90% of the waste products are collected and processed.

The producers, importers and retailers of animal and vegetable waste fats and oils have signed an agreement with the Flemish Government on 13 July 2006[304], resulting in the creation of a PRO, called VALORFRIT[305]. This agreement does not cover the used fried fats and oils from the food industry[306].

The objective of the agreement is to collect 90% of all potentially available fried fats and oils. The quantities of fried fats and oils potentially available for collection are determined as the difference between the quantities of fried fats and oils used by the households and professional users, and the quantities used in the preparation and consumption of oils and fats. The collected waste must be processed in compliance with existing legislation. This objective can and will be reviewed in light of the results obtained, as the initial objective was set without any knowledge of the current situation.

Companies who do not wish to participate in the system have to submit a waste management plan to OVAM, explaining how they intend to comply with the acceptance obligation.

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[302] Unless stated otherwise, all information in this Section is publicly available on the VALORFRIT website or has been provided by Mr Tom Smidts of VALORFRIT in a telephone interview on 08 May 2008.

[303] The acceptance obligation is currently only applied in Belgium. Indeed, following the so-called "dioxin crisis" in 1999 (see http://en.wikipedia.org/wiki/Dioxine_affair), container parks had to pay very high prices to get rid of their waste. The main objective of the acceptance obligation was to shift the financial burden of waste disposal to the producers.

[304] Milieubeleidsovereenkomst betreffende de uitvoering van de aanvaardingsplicht voor gebruikte eetbare oliën en vetten die voor het frituren van voedingsmiddelen gebruikt kunnen worden.

[305] Separate agreements were signed with the Brussels and Walloon Regions.

[306] Companies in the food industry must have their waste fried fats and oils collected seperately, but they are not subject to the VALORFRIT system. Indeed, the objective of the VALORFRIT system is to prevent that waste fried fats and oils return into the animal food industry, but waste streams from the food industry are much easier to trace than waste coming froom the household and catering sectors. Moreover, according to the Animal By-Products Regulation, their waste fried fats and oils can go the animal food industry under certain conditions. Information provided per e-mail by Kathleen Schelfhout of OVAM (05 June 2008).

The VALORFRIT system accredits two types of operators:

- Operators who collect fried fats and oils from container parks, restaurants etc
- Operators who render and purify the fried fats and oils as a pre-treatment before recycling, incineration etc

In some cases, both activities are integrated within one company. All collectors need to be registered and approved by the regional authorities.

The system works as follows:

- The affiliated producers and importers inform VALORFRIT of the quantities of animal and vegetable oils and fats that they produce, import or sell on the Belgian market. The financial contribution to VALORFRIT is based upon these quantities. Items exported or sold to the food processing industry are not covered by the VALORFRIT system.
- The used animal and vegetable oils and fats are collected from end users and container parks by operators accredited by VALORFRIT. Professional end users can freely negotiate the frequency and mode of collection with the operator. VALORFRIT reimburses the public bodies involved in the collection of waste fried oils and fats.
- These accredited operators report the collected and treated quantities of waste. They also provide information on final disposal (recycling, trading). VALORFRIT refunds (part of) the costs of administration[307].
- VALORFRIT compares the reported quantities of collected and treated quantities of waste with data on the percentage of the used edible animal and vegetable oils and fats that are potentially available.
- VALORFRIT submits an annual report to OVAM.

The following table gives the VALORFRIT contributions as from 1 January 2007:

Table 56: VALORFRIT contributions

	Fats (kg)		Oils (litre)	
Private use	< 2.5 kg	0.030 EUR/kg	< 3 litre	0.0276/liter
Professional use	> 2.5 kg	0.009 EUR/kg	> 3 litre	0.00828/liter

Currently, VALORFRIT represents 90% of the producers, importers and retailers of animal and vegetable waste fats and oils.

Currently, the collection system for households is purely a bring system.

[307] VALORFRIT admits that this compensation is negligible compared to the current market prices.

7.9.3.3. Evaluation

7.9.3.3.1. Demand side

Currently, the post-collection market functions quite well. After the dioxin food scare in 2000 and the subsequent ban on the use for feeding farmed animals, the sector went through a significant temporary problem. However, since then, the market has found new applications.

The following table gives the relative importance of the different end uses in 2007 (information from the VALORFRIT website):

Table 57: End uses of used frying fats and oils

Biodiesel	63%
Chipboard, plastics, industrial soaps, lubricants	14%
Incineration with energy recovery 'green energy'	23%

The reader should keep in mind that, at the time of writing of this study, incineration takes place outside Flanders but that this is about to change.

Currently, the price for technical applications (co-incineration and biodiesel[308]) is higher than the price that can be obtained for animal feeds. In April 2008, the average price of recycled fats and oils (in bulk) attained approximately 700 EUR per ton. Currently, the prices for the technical applications are so high that there is no risk that used fried fat and oils will be brought back in the food chain.

As the incineration ban in Flanders is about to be lifted, this will lead to higher prices for the producer of pet foods, who currently process Category 3 animal by-products. Energy producers will be put at a competitive advantage here because they can obtain Green Stream certificates.

For applications in incineration, waste fried fats and oils compete with biomass (coleseed, maize, palm oil, category 3 animal by-products) because other products do not allow to obtain Green Stream Certificates. In the food chain, the virgin products are the most important competitors.

7.9.3.3.2. Supply side

The biggest problem with the recycling of frying fats and oils lies in the collection phase.

This is easily understood when one has a look at the amounts that are collected. Based upon the information provided by the affiliated producers and importers, VALORFRIT estimates that 86,000 tonnes of animal and vegetable oils and fats have been produced, imported or sold on the Belgian market[309]. Internal VALORFRIT calculations conclude that, out of these 86,000 tonnes, 28,000 have been used in frying by households and 34,600 by professional users – the difference was used as salad oil etc. A recent study undertaken by VALORFRIT in collaboration with the University of Ghent has taken a closer look at Belgians' frying habits and concluded that:

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[308] The price that can be obtained for use as an input in the production of biodiesel follows closely the prices for coleseed and palm oil.

[309] Information on the retail market is obtained from AC Nielsen. The picture with respect to the professional market is less complete, mainly due to parallel imports.

- 21,500 tonnes of waste (76.8% of the 28,000) are potentially available from households on a yearly basis, 7,350 ton of which is collected.
- 21,200 tonnes of waste (61.5% of the 34,500) are potentially available from professional users on a yearly basis, 18,000 ton of which is collected.

Thus, less than half of household waste fried oils and fats are indeed collected. There is thus a significant potential for improvement there. The system does not provide formal incentives to households, but VALORFRIT thinks it is too easy for households to dispose of frying fats and oils together with other waste streams. However, recent information campaigns have had a positive impact on households' behaviour (+11% in one year).

With respect to the professional users, the figures are those obtained through the accredited operators.

However, due to the high demand for used fried fats and oils, parallel collection circuits, with less demanding standards, have developed. In the "accredited" circuit, the price for used fried fats and oils is around 15 EUR per 100 kilo; in the parallel circuit, the price can vary between 20 and 30 EUR.

7.9.3.3.3. Issues of market organisation

The operators prefer homogeneous streams to waste oils coming from container parks (which are completely mixed). The European norm for biodiesel takes diesel produced with coleseed as the reference point. It is impossible to comply with this norm without mixing recycled oils with virgin oils.

Formal quality control takes place at a very late stage within the supply chain. In the case of contamination, the origin of the contamination can be traced up to the collector, but not further upstream. Therefore, collectors must be able to proof that they are covered by a liability insurance (which is more stringent for household applications). However, as the waste fried fats and oils are not allowed back in the food chain, the real risks are very low.

Price transparency in the market is obtained through the use of intermediaries.

7.9.3.3.4. Perspectives

For the collection of household waste, VALORFRIT is currently considering using other systems in densely populated areas. Taking into account the high current market prices, some collectors might be interested in such a system. The main barrier to such a system is that, according to Flemish regulations, used fried fats and oils are considered to be hazardous waste and cannot be left on the kerbside.

The main difference between the VALORFRIT system and the system for the collection of industrial packaging waste is that VAL-I-PAC can work with large waste collectors and that it can provide subsidies for participation in the system. In the VALORFRIT system, many collectors are small companies. As professional users do not sign contracts with the collectors, it is difficult to monitor what is going on. VALORFRIT thinks that the collector sector needs to be better regulated and that the barriers to entry on the market for collectors should be higher. The approval of collectors by OVAM is mainly an administrative procedure; the VALORFRIT criteria are more stringent. Therefore, VALORFRIT thinks that its own, more stringent, accreditation should be a pre-condition for the OVAM accreditation.

One possible solution that is VALORFRIT is currently considering is to equip all collectors with PDA for their drivers. Through a "track and trace" system, VALORFRIT will then be able to monitor the activities of the collectors. When the software for collecting will have been developed this will be an advantage for the accredited operators.

VALORFRIT favours following policy changes:

- Lift of the ban on incineration
- Mandatory sorting of recyclables
- Clear end-of-waste criteria

7.9.4. Other Industrial organic waste

According to OVAM (2008c, p. 179), in 2005, a total 1.528,7 Ktonnes of waste of animal or vegetable origin was produced by the industrial sector. This total can be split up as follows according to type:

Table 58: Industrial waste of animal or vegetable origin in 2005

Type	Weight
Vegetable origin	735
Animal origin	700
Mixed origin	77
Fried fats and oils	23

And as follows according to destination:

Table 59: Destination of industrial waste of animal or vegetable origin in 2005

Landfill	6.1
Incineration	187.6
Recycling	839.2
Secondary material	274.4
Conditioning	221.1

This can be split up as follows according to the sector of origin:

Table 60: Waste of animal and vegetable origin according to sector

Sector	Total waste produced (in Ktonnes)	Share of waste from animal or vegetable origin (in %)	Quantity
Waste management	10,131.10	3.00	303.93
Administration	280.50	2.00	5.61
Chemical	1,048.70	2.00	20.97
Culture, sports, leisure	61.80	7.00	4.33
Water supply	72.30	2.00	1.45
Wholesale	604.50	9.00	54.41

Catering	234.40	2.00	4.69
Retail and repair shops	452.00	4.00	18.08
Laboratories	20.80	8.00	1.66
Agriculture	281.80	35.00	98.63
Aviation	22.20	5.00	1.11
Social sector	127.30	5.00	6.37
Education	107.00	6.00	6.42
Municipalities	235.60	21.00	49.48
Transhipment companies	206.60	2.00	4.13
Supermarkets	163.10	10.00	16.31
Textile	164.50	6.00	9.87
Meat production and processing	682.30	59.00	402.56
Food sector	1,494.70	32.00	478.30
Hospitals and rest homes	129.70	5.00	6.49
Others	10.30	97.00	9.99

In order to put these figures in perspective, one should note that:

- For the sectors "culture, sports, leisure", "agriculture", and "municipalities", most waste is green waste.
- In supermarkets, most of the waste are products that have passed the allowed selling date.
- In practice, most "mixed waste" from the catering sector is actually kitchen waste (this corresponds to 58% of the total).
- Waste from the food sector is a very diverse waste stream. Some items can be used as fertiliser (waste from oil seeds used in the production of oils and fats) or as input in animal feed.

Clearly, when one looks at total qualities, the largest share of industrial waste of animal or vegetable origin comes from the "meat production and processing", "food sector" and "waste management".

Since 01 June 2004, green waste and waste vegetable and animal oils and fats originating from companies are also subject to selective collection according to VLAREA.

This requirement does not hold for other organic-biological waste. However, OVAM reckons (OVAM 2006b, p. 37) that selective collection is becoming the optimal solution for an increasing number of companies (at least partially due to the landfill ban for organic-biological waste).

7.9.4.1. Uses of industrial organic waste

A significant part of the waste products from the food industry has been used in the past as feed material. Although these quantities could be raised, this would now enter in conflict with Regulation 1774/2002. Although the use of organic-biological waste as feed material falls within the competence of the Federal Ministry of Public Health, enforcement is an issue for the Flemish Government.

VLAREA considers organic streams suitable for use as feed material as a secondary resource and not as waste – in some cases this requires some pre-treatment. Therefore, the sector has developed a standard for the production of animal food (the so-called GMP standard) within the framework of OVOCOM, the consultative body for animal food[310]. The objective of the GMP is to prevent non-compliant waste streams to enter the animal food chain. Of course, all this is subject to the constraints imposed by Regulation 1774/2002. However, according to the more recent Regulation 79/2005, Member States authorise the collection, transportation, processing, use and storage of milk, milk-based products and milk-derived products, falling within the definition of Category 3 material, that have not been processed in accordance with the Regulation, provided that these activities and products comply with the requirements set out in this Regulation.

Other possible applications for organic-biological waste lie in the production of compost (see Section 7.9.2) or in co-fermentation with manure. The main obstacle as perceived by the sector is the multitude of regulatory constraints (Regulation 1774/2002, VLAREA, the Manure Decree…). According to OVAM, Regulation 1774/2002 in particular is an important source of confusion. This uncertainty acts as a disincentive for potential investors.

7.9.4.2. Standard setting and information exchange

OVOCOM is collaborating with similar bodies in the Netherlands, Germany and the UK to integrate the GMP in the international food safety standards of the International Feed Safety Alliance (IFSA).

The Belgian Federation for the Food Industry (FEVIA) and the "Hogeschool West-Vlaanderen" (University College West Flanders) have developed a website promoting alternative or innovative treatment technologies for the processing of organic-biological by-products of the food industry.[311] The objective of the website is to make it easier for the food industry to find markets for their by-products.

OVAM has created web-based applications in order to facilitate the contacts between the producers or organic-biological commercial waste and licensed processors or transporters.

7.9.4.3. Pilot project for restaurant kitchen waste

As explained by Faché et al (2002), the waste from the restaurant sector can be classified as follows:

- For some waste categories, selective collection is imposed by law: glass, paper and cardboard
- For some waste categories, selective collection is not imposed on the sector but possible: PMD, compostable kitchen waste,
- Waste that cannot be reused or recycled

A few years ago, several stakeholders (the Province and the Chambers of Commerce of Flemish Brabant, some waste collectors, OVAM, VLACO and the professional associations of restaurant business) have

[310] http://www.ovocom.be

[311] http://www.valorbin.be/

participated in a three-month pilot project, investigating the economic feasibility of the selective collection of compostable kitchen waste from the restaurant business.

Globally speaking, participants in the project were positive. Unfortunately, no hard data on costs and benefits were provided. However, the following points are indicative of the issues:

- In the inner cities, restaurants often lack the place for separate containers. One of the waste collectors involved in the project offered 60-liter compostable bags for compostable kitchen waste as an alternative.
- In other cases, the amounts of compostable kitchen waste were just too low to justify separate collection.
- Sorting at the source did not seem to cause any major problems. The main difficulty was how to keep the kitchen waste free from meat and fish waste.
- The benefits of this type of project would increase with a denser network of collection points.
- The financial support from the Province has allowed to decrease the collection fees – of course, this has contributed to the success of the project.

Unfortunately, no follow-up of this study has taken place. The collection of commercial kitchen waste is an activity of the private sector, and the reporting to OVAM does not allow to verify how this has evolved further.

7.9.5. Other animal by-products

The text in this Section is a summary of a study undertaken by the University of Ghent on behalf of OVAM (Gellynck et al (2005)). Although the study has been published three years ago, Professor Gellynck has confirmed that its main conclusions are still valid[312].

In Flanders, about 375000 ton of animal by-products were produced in farms, slaughterhouses, boning plants and butcheries in 2005. It is expected that, due to reductions in livestock, this will decrease with 18% by 2010.

Several factors contribute to explaining this expected decrease: the problems related to excess manure supply, the food scares of the last few years…

Due to recent changes in legislation, many animal by-products are now classified as Category 1 in the ABPR.

Since the entry into force of the ABPR, all collectors of animal by-products need to be approved by the competent authorities.

As explained in Section 3.5.3, trade in animal by-products of Category 1 and 2 is prohibited in principle (although exceptions are possible in accordance with the Regulation). International trade in Category 3 products is allowed.

As all waste from animals that are slaughtered in a slaughterhouse are considered fit for human consumption after inspection by the Food Agency, market conditions determine whether this waste will be used for human consumption, for technical applications or as a waste of Category 3. Slaughterhouses and boning plants constantly search for new markets in order to avoid the disposal costs linked to Category 3 waste.

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[312] Phone interview on 27 May 2007.

Due to the extension of the list of Category 1 products on the one hand and the increased use of animal by-products for human consumption or for technical applications on the other hand, processors of Category 3 products need to import animal by-products as an input in their production processes. Therefore, in the last few years before the study was undertaken, imports were increasing (mostly fats and bones from the neighbouring countries).

It is not possible to quantify the exports of animal by-products. However, the authors of the study reckon that export mostly takes place as part of the optimisation process of animal by-products logistics within international processors (such as Rendac within the international group Sobel).

7.9.5.1. Prices for animal by-products

Slaughterhouses and bone cutters pay waste collectors for the collection of animal by-products of Category 1 and 2. The most important determinants of price are the material, the yields obtained in processing the material and the cost linked to the destruction of meal and fat. Due to recent reductions in the price for incineration, the price for collection has also decreased. Since 2005, the cost for blood products from bovines has increased because they are no longer treated together with blood products from pigs and poultry. Collection of animal by-products from butcheries has also become more expensive – collectors claim that this is due to the collapsing prices for fats.

Since the feedban was introduced in 2001[313], the suppliers of bone waste have to pay for collection[314]. However, collectors pay for fats and poultry by-products of Category 3.

The transport costs linked to collection are highly variable.

7.9.5.2. Waste processing

The processing of waste is very standardized and most take place within approved plants. First, the waste product is subject to a heat treatment (described in the ABPR). Next, proteins and fats are separated. Proteins are further processed into meal, and fats are purified through decantation. The yields from the treatment are determined by the amounts of water in the waste product on the one hand, and the quantity and quality of meal and fats that are produced.

Products of Category 1 and 2 are mostly processed together. As everything is incinerated anyway, the quality of the final product is of secondary importance. For products of Category 3, there is now a tendency amongst waste processors to process each stream of animal by-products separately in order to obtain a better quality and thus to improve marketing prospects for the final products. This allows to differentiate prices according to quality. Note that this price differentiation also takes place on the input side: processors require now a higher price for waste with low yields.

The direct processing cost for animal by-products as 40-50 EUR per ton. 40 to 50% of this cost is linked to energy consumption. There are important economies of scale in processing plants.

[313] See Section 3.5.3.

[314] While the opposite was true before the introduction of the feedban.

7.9.5.3. Possible uses of animal by-products

The possible uses of animal waste, meal and fats are determined by the Animal By-products Regulation. However, Member States can impose more stringent regulations. For instance, Flemish regulations prohibit the landfilling of animal waste. The feedban also imposes stringent restrictions.

Fat and animal meal of Category 1 must be incinerated. The prices for both products fluctuate together with fuel prices. It must however be noted that the returns to meal incineration were still negative in 2005.

Fat of Category 3 are mostly used for feeding farmed animals – technical applications are very limited. The quality of the fat determines the price. The price of fats fluctuates together with the international market for vegetable fats. The authors expect an increase in the supply of vegetable fats and thus a decrease in their prices.

The feedban has drastically modified the market potential for animal meal of Category 3. Following the disappearance of the major market of feeding farmed animal, collectors initially required being paid for incineration. However, existing applications (as a fertilizer or for dry pet-food) were further developed and prices turned positive again by the beginning of 2005.

7.9.5.4. Collection of fallen stock

With respect to the collection of fallen stock, three periods can be distinguished.

Before 1993, the market for animal by-products was unregulated. The prices on the world markets for meal and fats were high and the collection and processing was a profitable business.

Between 1993 and 2000, profitability in the sector decreased significantly and several companies went bankrupt. The Flemish government and the cattle industry therefore decided to provide a guaranteed turnover for Rendac[315]: any deficit at the end of the year was compensated. This has resulted in a de facto monopoly for Rendac.

Since 2000, animal meal can no longer be used for feeding farmed animals. Moreover, the costs for the collection of fallen stock are much higher than the costs of other offal[316]. The Flemish Government and the cattle industry therefore agreed that the Government would pay 70% of the costs and the cattle industry 30%. Subsequently, the Government contribution was brought back to 50%. This system is compatible with the Community guidelines for State aid concerning TSE tests, fallen stock and slaughterhouse waste[317].

The decrease in the contribution of the government is based on the intention to better apply the "polluter pays principle". Large and medium-sized cattle holders can choose between two systems:

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[315] Rendac BV is a Dutch company with production seats in The Netherlands (Rendac Son BV) and Belgium (Rendac NV). Rendac is specialised in the treatment of carrion and offal. Rendac owns some companies in Germany and Eastern Europe. Rendac is a part of VION nv, a large international concern with 15.500 employees active throughout the world in the agro-industry, with its head quarters in The Netherlands. It also owns the second largest treatment company for offal, Van Pollaert.

[316] This high cost is mainly due to the requirement that carrion is collected without delay in order to avoid contamination.

[317] Official Journal C 324 , 24/12/2002 P. 0002 - 0007

- They can pay a contribution that depends on the type of animals held and on the size of the business, but that is independent of their actual production of animal by-products.
- They can pay per animal that needs to be collected. The maximum price is fixed by the Minister of the Environment in the approval of the collector.

The Flemish government also contributes to the funding of the system. Until 2004, the Flemish government guaranteed a return on capital on top of the reimbursement of all costs. The financial information on costs is verified by an independent auditor. Gellynck et al think that sufficient controls have been put in place to avoid fraud in the allocation of subsidies for the collection, treatment and disposal of fallen stock. An advantage of this system is that it limited monopoly profits. However, in the last few years, the equity capital of Rendac has increased consistently, leading to a higher cost per ton.

Therefore, the system has been modified. The collector now receives 17 EUR per ton on top of the cost of collection, treatment and disposal of fallen stock in Flanders. The main disadvantage of this system is that it does not provide incentives for cost efficiency.

7.9.5.5. Market structure

The market for the processing of Category 1 products is open. However, in practice, Rendac has a monopoly position.

For Category 2 and 3 products, Rendac also has an important market share, but there are also a few other players.

Gellynck et al (2005) suggest the following reasons for this dominant position:

- The length of the approval procedure for the processing of Category 1 waste
- The high quality of the services provided by Rendac
- The uncertainty with respect to the size of supply
- The capital intensity of the sector
- The frequent changes of the regulatory framework
- Potential entrants are deterred because Rendac is part of a large international group
- The relative small size of the Belgian market compared to the potential economies of scale

There is also some potential for cross-subsidisation:

- The subsidies Rendac receives for the collection and processing of fallen stock allow it to realise economies of scope in the processing of Category 3 waste
- It is possible to combine the collection of fallen cattle with the collection of dead pets

With respect to the second issue, a competitor of Rendac has filed a complaint against Rendac. The Belgian Competition Council concluded that Rendac was abusing its position, but was overruled by the Brussels Court of Appeal.

Gellynck et al (2005) also argue that all direct eligible costs can be identified and are verified by an independent auditor. However, they also admit that the allocation of indirect costs and overhead is somewhat arbitrary. To avoid this would however require a complete physical and financial separation of all activities, which would not be an efficient solution.

Taking into account the limited size of the Belgian market and the required size of investment, Gellynck et al (2005) doubt that public tendering would lead to lower prices for the collection and processing of Category 1 waste.

An alternative approach would be to work with fixed prices, which would decrease throughout time in real terms in order to take into account efficiency improvements. Such fixed prices would prevent abuse of monopoly power and provide incentives for efficiency improvement. However, in case costs drop faster (more slowly) than anticipated by the regulator, this could lead to excessive profits (losses) of the monopolist.

7.10. CARDBOARD

7.10.1.1. Supply of paper and cardboard waste

OVAM has calculated that, in 2004, the following volumes of commercial waste were produced (OVAM 2008b, p.90):

- 1.015.557 ton of paper and cardboard (excl of paper and cardboard packaging)
- 216.823 ton of paper and cardboard packaging

FOST Plus gives the following estimates for the composition of paper and cardboard waste (see FOST Plus website):

Table 61: Composition of paper and cardboard waste

Press (newspapers, magazines)	30%
Advertising (printed matter, catalogues)	25%
Packaging	25%
Others[318]	20%

Regarding paper-cardboard packaging, FOST+ notes one dominant type of packaging, boxes, which represent 50% of the total. The other 50% are distributed among various packaging items, the most important of which being bags (7%).

Cardboard from ELV is limited to old models from Central and Eastern European producers[319].

In 2003, paper and card were collected separately in all Flemish municipalities. Besides kerbside collection, each container park accepts paper and card. In some municipalities, collection is still undertaken by local associations. These associations need to have a permission from the municipality and need to report the collected quantities to the municipality (OVAM 2005, p.33).

However, according to FETRA[320], there is still some untapped potential for the selective collection of waste paper.

For instance:

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318 This includes: production waste, destroyed archives…

319 Information provided by Catherine Lenaerts, General Manager of FEBELAUTO (PRO for ELV) in e-mail of 23 May 2008.

320 FETRA is the Belgian Federation of Paper and Cardboard Processing Industries. The information was provided by Ilse Vervloet, Environmental Advisor, in a telephone interview on 16 May 2008.

- in the case of apartment blocks, owners' associations are very reluctant to have separate containers for waste paper. They are afraid that these might get contaminated by non-paper waste.
- paper from office use

According to Bracke and De Clercq (2005), paper waste is subject to a duty of acceptance because of the high volume of this waste stream and the resulting financial burden on the waste management budget.

Paper and cardboard are also covered by three agreements with the industry:

- Both household and industrial packaging waste are subject to a take-back obligation (see Section 7.6).
- The publishers of the printed advertisement sector deposit 0.37 eurocent into a fund for each kilo of paper they have put on the market in the Flemish Region. These contributions are then transferred to the municipalities depending on the amount of paper waste that was separately collected.
- The publishers of the informative press fulfil their financial responsibility by granting advertising space to the Flemish Region for a total value of € 3.22 million, VAT excluded, on a yearly basis.

According to Bracke and De Clercq (2005), these agreements are unique as they only deal with the financial responsibility – municipalities remain legally responsible for the collection of waste paper. They also point out that both agreements are the target of fierce criticism. First of all, municipalities claim that the cost of collecting waste paper amounts to 5 eurocent per kilo. Secondly, many question the link between the achievement of waste management targets and the grant of advertising space. This requires very little effort as the publishers can just add an additional page in their publication and the authorities have to finance the design of the advertisements.

At the time of the writing of this study, the agreements with the printed advertisement sector and the informative press were in the final phase of a revision, which does however not imply a fundamental modification compared to existing policy[321].

FOST Plus also questions the current burden-sharing for the financial responsibility for packaging[322].

In practice, 70% of the cost of collecting and sorting paper and cardboard are covered by the intermunicipal associations (rather than by the newspaper and advertising sectors). However, given the current high prices for paper and cardboard, this does not lead to problems[323].

In 2006, FOST Plus collected 119.929 ton of paper and cardboard – this includes packaging that, strictly speaking, does not comply with the definition of household packaging. FOST Plus puts 40% of the collected paper and cardboard on the market. The other 60% are subject to direct contracts between intermunicipal associations and the recyclers. (OVAM 2008b, p. 90)

FOST Plus provides the following figures on paper-cardboard *collection* rates (kg/inhabitant/per year):

Table 62: Paper-cardboard collection rates

Year	Packaging alone	Packaging and

[321] See OVAM website. The public consultation phase has just been closed.

[322] Annual Report 2006.

[323] Information provided by Mr Van Gaever.

		waste paper
1994	6.51	26.04
1995	9.04	36.17
1996	9.62	38.49
1997	11.71	46.82
1998	14.18	56.72
1999	14.7	58.80
2000	15.67	62.67
2001	15.95	63.81
2002	15.98	63.90
2003	15.94	63.76
2004	16.95	67.81
2005	17.40	69.61
2006	17.72	70.88

In Belgium 60.7% of old paper is collected, which is slightly above the European average.

FOST Plus estimates the average transport cost to be 45.59 EUR/ton.

The obligation of acceptance for packaging waste and for printed matter waste also contributes to a fairly homogeneous waste stream. However, the quality of the collected fractions is affected by the presence of non-paper matter, certainly in the case of paper collected through container parks. It is not clear whether the uncertainty regarding the true level of contamination is due primarily to the complexity of the complaint procedures or to the quality of the waste (OVAM 2008b, p. 91).

The FOST Plus 2006 Activity Report raises one specific issue concerning sorting. In the basic scenario, paper-cardboard and PMD waste flows are collected together in container parks, by analogy with door-to-door collections. However, a number of intermunicipal and municipal authorities want(ed) the paper segment to be separated from the cardboard segment in container parks, while other authorities separate(d) PMD into at least three different segments. FOST Plus claims that:

- This separation led to an increase in the costs to be borne by the public administrations concerned, while being a source of confusion for citizens since the sorting message differs from that of door-to-door collection.
- The growing importance given to the quality of secondary materials anyway requires an additional sorting operation among selectively collected materials.
- There is also the problem of the lack of space facing certain container parks.

7.10.2. Sorting

The near total of the Belgian paper-cardboard mix is acquired by Belgian companies and sorted into different quality grades before being submitted to mills for further processing (FOST Plus). Some large retail chains sell their own bailed cardboard directly[324].

The most important administrative restriction is that, according to Flemish legislation, traders, transporters and buyers who purchase waste paper in Flanders are required to have a permit. However, within Belgium, there is no mutual recognition of the respective regional permits[325].

In order to deal with possible issues of asymmetric information, the Belgian Recycling Federation COBEREC has created a certification procedure for paper recovery companies. Certification depends on, amongst others, the following criteria[326]:

- Compliance with Federal and Regional regulations (including with respect to occupational safety and environmental performance)
- Insurance
- Compliance with all European agreements related to delivery and classification of waste paper and cardboard
- Training of personnel
- Management of the waste streams and contamination

According to Mr Huysman, China and Indonesia (and to a lesser extent India) are important export markets. He estimates that 50% of waste cardboard is exported to the Far East. However, it is difficult to make any precise estimation because waste collectors often sell the waste to traders (see also Section 6.5.2).

In China, there are 2 important industrial concerns who buy waste cardboard. They produce mostly for the local market and need to import a lot (there are very few forests that are suitable for paper production and there is very little selective collection in China). These concerns have their own procurement offices in Europe[327].

The prices that can be obtained on the export markets are higher than what can be obtained on the Belgian markets. Until recently, the transport costs also played an insignificant role (prices range from 350 to 1000 USD per container, and one container can hold up to 20 tonnes) – this specific situation is changing quickly though (see Section 6.5)

However, sales to China are mostly limited to large companies, for the following reasons[328];

- Special licences are needed to be active as exporter to China (AQSIQ certificate) and the administrative and transaction costs linked to trading with China are important. For small companies, these costs can be prohibitive.

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[324] Information obtained in writing from Mr Vermoesen (COBEREC).

[325] Information obtained in writing from Mr Vermoesen (COBEREC).

[326] Information obtained from COBEREC website.

[327] Information provided by Mr Huysman.

[328] Information provided by Mr Huysman.

- As large segments of the Chinese economy are still centrally planned, some decisions taken by the central authorities can completely change the market situation. Therefore, exporters still need to diversify to other markets. This is only feasible for large companies.

As explained before (see Section 6.5), the market for recovered paper and board is really a world market and prices are transparent[329]. For instance, every month, the Belgian Recycling Federation COBEREC publishes the price in the financial press[330]. For final waste holders, the price of waste products is less transparent, but the market for waste collection is very competitive. Therefore, Mr Huysman does not think a study on the local determinants of demand would make a lot of sense.

FOST Plus gives the following figures concerning the average "purchaser-delivered price" for paper-cardboard in EUR/T from 1997 to 2008:

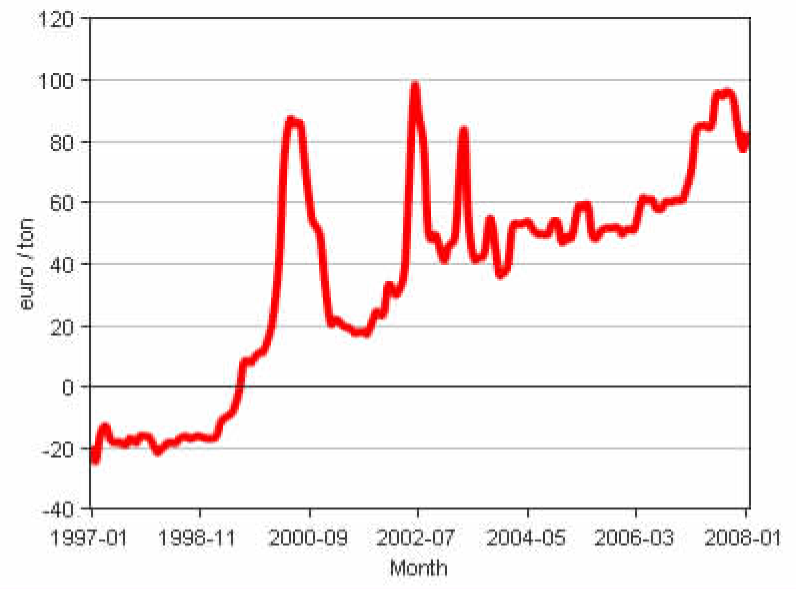

Figure 32: Prices for paper-cardboard

7.10.3. Recycling

In Flanders, most contracts between collectors and recyclers are short term contracts. This allows the collector to obtain international prices for the paper and card he puts on the market. However, as a result, recyclers are confronted with unstable prices and uncertainty with respect to supply in the long run (OVAM 2008b, p. 91).

Belgian paper producers consume up to 1 million ton of old paper per year. In Flanders, there are 4 important paper/cardboard producers (OVAM 2008b p. 91):

- Stora Enso at Langerbrugge, which de-inks for the newspaper and magazines market. However, StoraEnso does not use recycled cardboard in its production process[331].

[329] According to Fost Plus, the average value on an annual basis has always varied between 50 and 60 EUR/tonne.

[330] Information obtained in writing from Mr Vermoesen (COBEREC).

[331] Information provided by Mrs Lieven Vanderscheuren (StoraEnso) during a telephone interview on 14 May 2008.

- Oudegem Papier, member of the VPK Group. It is noteworthy that it sells most of the recycled paper to VPK Packaging, who uses it for the production of cardboard boxes. VPK also owns an installation for the recycling of paper fibres originating from multi-layered packaging.
- Catala only recycles paper for its own production of cardboard.
- Sint Leonard produces solid cardboard.

There are also some mills in the North of France and in the south of the Netherlands and Germany where Belgian cardboard is recycled[332].

For cardboard, the required investment for a recycling unit is much higher than for waste plastics. Therefore, the market concentration is more important than in the case of plastics. The required amount of investment constitutes a significant barrier to entry[333].

7.10.4. Demand for recycled paper and cardboard

According to Mr Huysman, the most important competitors for waste cardboard and paper are of course virgin fibres. However, in the case of packaging, different types of packaging compete with each other. For instance, the Belgian retailer Colruyt has replaced its cardboard packaging by washable plastic containers. Other retailers have made a move in the opposite direction because they think the washing process is too complex. It is not clear what the determining factors behind these different approaches are.

According to European procurement rules, public authorities can require a minimum amount of recycling in their tenders. The Flemish cooperation agreement with the municipalities covers the purchases of recycled paper (OVAM 2008b, p.92).

OVAM reckons that for paper, there are no real marketing problems (OVAM 2008b, p.92). According to FETRA[334], all collected waste paper is indeed recycled.

All consulted stakeholders agreed that the bottleneck is not on the demand side.

7.10.5. Drink carton

Drink cartons are produced mainly by Tetra Pack. Elopak and Combibloc have lower market shares.

According to FOST Plus, drinks cartons are a complex type of packaging, composed of several layers of what seems to be at first incompatible materials in terms of recycling. The recycling of drinks cartons therefore requires special paper-mill technologies.

Drinks cartons contain 75% of top-quality cellulose fibres at the most. Once separated from low-density aluminium and polyethylene layers in special pulpers, paper fibres can be integrated into classic paper-mill channels. Contracts have been concluded with paper mills in Germany, France and Spain to recycle drinks cartons.

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[332] Information provided by Mr Huysman (VAL-I-PAC) during interview on 18 April 2008.

[333] Information provided by Mr Huysman.

[334] FETRA is the Belgian Federation of Paper and Cardboard Processing Industries. The information was provided by Ilse Vervloet, Environmental Advisor, in a telephone interview on 16 May 2008.

In spite of the quality of fibres extracted from drinks cartons, market value remains rather low. According to Mr Van Gaever, this is due to the low quantities of drinks cartons available on the world market as a result of selective collections[335] and to the fact that there is only a limited number of paper mills equipped with the appropriate recycling technologies. Consequently, there is no real international competitive market and prices are rather a matter of "opportunity". However, ACE explains the negative price paid for beverage cartons in Belgium by the fact that the mills have to get the cartons at the sorting centre; this negative price is partly a contribution for the transportation cost. Indeed, in Belgium, beverage cartons are collected together with the PMD fraction. Paper waste, however, is brought to the mills. The logistics of the 2 systems are thus different.

The following graph gives the trends concerning the average 'ex-sorting centre price" for drinks cartons in EUR/ton from 1997 to 2008:

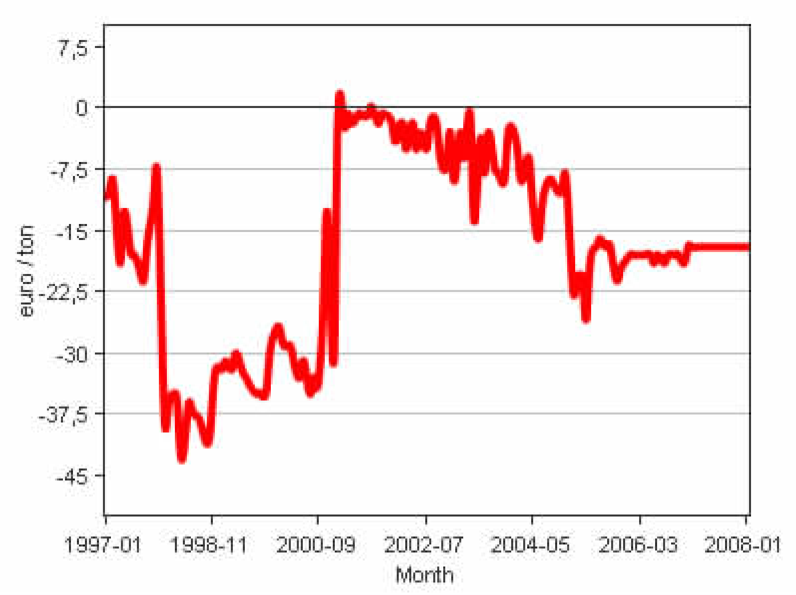

Figure 33: Ex-sorting centre price for drinks cartons

Within the PMD waste flow, drinks cartons have remained stable with an 11% rate.

According to Mr Van Gaever, the specific recycling targets for drink cartons are uniquely due to the Belgian ecotax legislation. FOST+ thinks that the limit has been reached of what is economically feasible.

Because 95% of the collected drink cartons are recycled in Düren and the remaining in a French mill just across the border, transport costs are not excessive.

According to Mr Van Gaever, mixing drink cartons with cardboard would contaminate the cardboard (for instance, with drink remains) and would thus lead to less efficient recycling. ACE disputes this. They claim that, where these collection systems exist, it was agreed between all parties that this was not an issue.

335 Selective collection is not significant except in Belgium and in Germany (where there is a take-back duty for all packaging). There is no selective collection at all in the Netherlands, and scarcely any in France. Information provided by Mr Van Gaever.

7.11. SOME PROVISIONAL CONCLUSIONS

7.11.1. Issues of market organisation

Bracke and De Clercq (2005, p. 9) have pointed to problems that arise with the free of charge take-back principle when some end-of-life products have a positive value (for instance, ELV and some WEEE fractions) As a result a dual collection and recovery networks arises: on the one hand, the network managed by the PROs, which is subject to stringent environmental standards; on the other hand, the informal network that usually existed before the introduction of the take-black obligation. This informal network was usually paid for dumping waste or got its revenues from selling spare parts or recovered metals.

As argued by Bracke and De Clercq (and as illustrated by the more up-to-date examples we have provided above), the networks organised by the PROs are subject to independent auditing and reporting. This reduces the burden linked to control and enforcement for the authorities, but increases the burdens for the waste collectors and processors. In order to limit the control and enforcement costs, the PRO also reportedly try to reduce the number of waste collectors and processors they have to work with. Moreover, the stricter standards for treating end-of-live products require important capital outlays. Finally, with sometimes small amount of waste to be collected per separate waste streams, the size of the market is limited.

Bracke and De Clercq argue that the combination of these factors has led to an increase in market concentration in the collection and recovery sector.

Bracke and De Clercq have also argued that, due to the collective financial responsibility in a PRO, there is no direct link between the producer and the real waste management cost.

The waste recovery federation COBEREC has pointed out that, due to overly stringent requirements for transportation and exploitation, the cost of these activities can become higher than the market value of the waste product, and that this can lead to a collapse of market driven collection. However, COBEREC reminds that a selective collection system is easier to enforce when it is driven by a positive value of the waste product. COBEREC has requested that, when a PRO is created, the tendering of the markets for collection and recycling respects at least the principles of public procurement in order to maintain fair competition. It also insists on a strict enforcement, including of recycling activities abroad[336].

The position of the waste management federation FEBEM is that the competitive effects of the PRO depend on how the market is organised[337]. In some cases (such as Recupel), there is one collective body that contracts the market. In this case, there is effectively a monopsony situation. However, in other cases (VAL-I-PAC for instance), the system does not distort the market but provides incentives for working with specific collectors. BEBAT also holds a monopsony position, but one has to take into account that it has created a completely new market. In the case of WEEE, however, selective collection systems already existed before the obligation of acceptance was introduced. Moreover, in the case of BEBAT, the quantities concerned are very small and the system requires very specific investments, which leaves very little room for competition anyway. According to FEBEM, the Fost+ system is more balanced than the Recupel system, but it has led to unfair competition between intermunicipal associations and private sector companies. Finally, FEBEM thinks that the Valorfrit system could have a positive impact on

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[336] See COBEREC website: www.coberec.be

[337] Telephone interview of Mr Annaert (FEBEM) on 22 May 2008.

the level of professionalism in that specific subsector. However, in this stage, the focus is rather on reaching the recycling targets than on selecting professional partners to work with.

Finally, a cost accounting model for the collection of household waste through container parks was developed on behalf of INTERAFVAL, a joint venture of the VVSG and the Flemish intermunicipal associations. The Ministry of the Environment has recognized this model, and it will be used as a basis for the reimbursement of municipalities when the next round of voluntary agreements will be signed[338].

7.11.2. Position of OVAM on improving recycling markets

As explained in OVAM (2008b, p.47) the focus in Flemish policy is separation at the source and the promotion of green purchases by consumers. With respect to Green Public Procurement, Flanders has a very low score according to a European research project. In order to protect the consumer, there exists a Flemish regulation on the use of following secondary materials: construction materials, soil improving and fertiliser, animal food and soil. However, public authorities do not provide any further information to help reduce transaction costs.

Although Flemish policy has traditionally focused on the role of and the impact on the consumer, OVAM (2008, p.49) reckons that for some waste streams, a more integrated approach is being developed: C&D waste, organic waste, wood waste…. Green waste is the only waste stream where research is undertaken with respect to the markets for the recycled product (compost). For other streams, OVAM acknowledges that the public authorities lack knowledge with respect to the legal and economic aspects, even if they do understand the technological issues.

OVAM (2008b, p.172) concludes that quality standards and assurance is the key element to a higher demand for recycled products.

The study concludes (OVAM 2008b, p. 173) that the following measures could be taken by OVAM in order to stimulate a cradle-to-grave approach for waste products:

- Stimulate design for recycling. OVAM refers here specifically to COTREP in France.
- Conduct public information campaigns in order to obtain a high quality of the collected fractions.
- The collection of recyclable materials needs to take into account the characteristics of the demand.
- Provide a stable and coherent regulatory framework
- Maintain a strict enforcement of the environmental characteristics of recycled materials
- Stimulate innovative treatment technologies. For instance, part of the budget of the PRO could be earmarked for R&D.
- Create a level regulatory playing field between primary and recycled materials.
- Create encounters between the recyclers and the end users of the recycled product.
- Reduce the VAT on recycled products.

[338] E-mail by Lieselot Decalf of VVSG of 18 June.

- Use "green" public procurement to create markets

7.11.3. FEBEM position

Mr Annaert would recommend the following policy changes as having the highest priority[339]:

- Change the climate surrounding the use of recycled material: allow lower VAT rates for recycled products, change the image of the product (starting with education at school) ...

- Improve the quality of the collected material. For instance, in the case of glass collection, heat-resistant glass dishes get mixed up with other glass waste, while their melting point lies much higher. This can have a significant negative impact on the quality of recycled glass. These dishes should not be mixed with other glass waste, but one should not count on the individual citizens to cope with this: producer should take these issues into account in the design phase

- One should aim at better tailored policies, for instance for collecting waste originating from SMEs[340].

- There is need for more and better support for R&D.

- At the European level, waste policy should be transformed into a resource policy (thinks for instance of the restrictions of transfrontier shipment of waste).

- Waste policy should be better integrated with other policies (such as public works).

- REACH creates a lot of uncertainty for the recycling sector; policy makers should accept that waste is not a primary resource; if this is not accepted, this could lead to a collapse of all recycling activity.

- End-of-waste criteria are important but should not discriminate against recycled products (for instance, the heavy metals content restrictions are stricter for sludges than for primary products, although primary products can also be heavily contaminated)

[339] Telephone interview of Mr Annaert (FEBEM) on 22 May 2008.

[340] Note that OVAM (2006a, p. 22) intends to develop a specific policy for waste from schools and SMEs that is comparable to household waste.

8. CASE STUDY: UNITED KINGDOM

8.1. BATTERY RECYCLING MARKET IN THE UK

8.1.1. Production and Consumption

There is no national data on the volume and type of portable, industrial or automotive batteries that are placed on the market in the UK in any particular year. This is almost certainly because it has been perceived that there was no specific need for this data to be collected in the past. One of the aims of the Directive is to collect such data across Member States to obtain a clearer picture of the operations of the internal market.

There are, however, a number of estimates of the size and composition of the UK battery market. These are discussed in the sections that follow.

8.1.1.1. Portable Batteries

It is estimated that more than 90% by weight of portable batteries consumed in the UK are imported, principally from North America, Europe and Japan.[341] There are no UK manufacturers of 'general use' portable batteries, though there are some UK manufacturers of button cell batteries.

WRAP estimates that there are somewhere in the region of 2,000 'producers' in the UK, as defined in the Batteries Directive.

The market for portable consumer batteries has shown continued and marked growth in recent years. The European Commission's Extended Impact Assessment (COM(2003)723 final), (EIA)) which supported the proposal to introduce the new Batteries Directive, estimated that the consumer battery market in the EU-15 had grown by some 70%, in terms of units sold, between 1985 and 1995.

More specifically, the UK market for portable rechargeable batteries is estimated to have grown by 70% (in terms of sales by weight) between 1995 and 1999.[342] This is explained by the rapid growth of widely available, low cost consumer electrical goods now incorporating rechargeable batteries, such as mobile phones, lap top computers and MP3 players.

In 2006, Defra commissioned the consultants ERM to produce a life-cycle assessment for separately collecting and recycling portable batteries in the UK according to the requirements of the new Batteries Directive. This report estimated that 24,850 tonnes of portable batteries were placed on the UK market in 2003. This compares to a figure of 24,010 tonnes in 1999, also estimated by ERM, suggesting a 3.5% increase in sales by weight from 1999 to 2003. It should be noted that the 2006 ERM report states that:

> *"predicting battery sales, and subsequently future waste arisings, can not be carried out with absolute precision because of uncertainty in the sources of data. Hence the absolute results are open to debate."*

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[341] DTI (2002) *Batteries Factsheet*, August 2002. http://www.berr.gov.uk/files/file31761.pdf

[342] Ibid

More recently an estimate from industry suggests that in 2006, UK sales of portable primary batteries amounted to 24,000 tonnes, and sales of portable secondary batteries were of the order 6,000 tonnes.[343] These figures thus imply that in the UK in 2006 the total sales of portable batteries amounted to 30,000 tonnes. This suggests a 20% increase relative to the 2003 ERM total figure, or around 6% per annum.

In calculating the 30,000 tonne figure, the main source of sales data for batteries was the British Battery Manufacturer's Association (BBMA). The BBMA had predicted that the mainstream brands which it represents have a combined share of the portable battery market of around 80%, and this was used to extrapolate sales figures.

Some recent brand analysis carried out by G&P Batteries Limited on behalf of WRAP has thrown this 80% figure into question. This analysis looked at 2.5 tonnes of portable batteries collected across three WRAP trial areas and identified 695 different brands of batteries. This staggering quantity, within a relatively small sample size which was randomly chosen, surprised most people within the industry and suggests that there could be over a thousand brands in circulation across the UK.

As a result it is believed that the BBMA estimation that its members represent 80% of the market is over-inflated, with the real figure more likely to be somewhere between 50% and 60%. Thus, there are some within the industry who believe that the annual figure of 30,000 tonnes estimated by BBMA, based upon major brands having a market share of 80%, is likely to be a low end estimate, with the actual figure potentially being considerably higher.

Given the wide range of portable batteries types on the market it is also useful to understand the relative proportions of portable battery sales. These are shown by battery type in Table 63.

Table 63: Portable Battery Sales by Battery Type in 2003

Battery Type	2003 Weight (tonnes)	2003 % by Weight
Silver Oxide (AgO)	**5**	**0.02%**
Zinc Air (ZnO)	12	**0.05%**
Lithium Manganese (LiMn)	11	**0.04%**
Lithium (Li)	107	**0.43%**
Zinc Carbon (ZnC)	4,628	**18.62%**
Alkaline Manganese (AlMn)	14,899	**59.95%**
Lithium Ion (Li-ion)	**1,064**	**4.28%**
Nickel Cadmium (NiCd)	2,285	**9.19%**
Nickel Metal Hydride (NiMH)	1,300	**5.23%**
Lead Acid (PbA)	538	**2.17%**

[343] BERR (2007) *Consultation Document on the Implementation of the Batteries and Accumulators and Waste Batteries Directive*, December 2007, pp87.

Total	**24,850**	

Source: ERM (2006). Battery Waste Management Life Cycle Assessment, Final Report for Defra, October 2006.

The battery chemistries in Table 63 show that around 80% of batteries sold in the UK are either alkaline manganese batteries or zinc carbon batteries. In terms of market trends, for primary batteries, alkaline manganese has been increasingly replacing zinc carbon as the main chemistry. For secondary batteries, recent years have seen strong growth in lithium-ion and nickel metal hydride technologies, generally at the expense of nickel cadmium technology. This trend is set to continue as those batteries containing hazardous substances, such at cadmium, are targeted by legislation.

ERM also carried out estimates on the amount of annual portable battery waste arisings on the basis of sales, taking into consideration typical battery lifetimes. These are shown in Table 64. For general purpose consumer primary batteries lifetimes are typically less than three years, though this will be substantially longer for rechargeable batteries. Whilst this is useful in providing a snapshot of waste arisings in a particular year, future arising forecasts become increasingly problematic due to market growth rates, battery weights and battery composition. As explained in section 8.1.1 it is the batteries placed on the market that is used to calculate collection rates.

Table 64: UK Portable Battery Consumption for 1999 and Estimated Arisings for 2000

Battery Type	**1999 Sales (tonnes)**	**2000 Waste Arisings (tonnes)**	**Percentage Difference (arisings relative to sales)**
General Purpose	20,300	16,500	-19%
Button Cells	70	60	-14%
Other non-rechargeable	130	70	-46%
NiCd, NiMH, Li ion (Secondary)	3,260	1,990	-40%
Lead Acid	250	300	+20%
Total	**24,010**	**18,900**	**-21%**

DTI (2002) Batteries Factsheet, August 2002. http://www.berr.gov.uk/files/file31761.pdf

Looking at Table 64 it is interesting to see the variability between battery sales and waste arisings, as depicted in the percentage difference column. Lead acid batteries stand out because more batteries arose than were placed on the market, though the overall quantities are relatively small. This can be explained by the physical nature of this type of battery, as it is generally substantially greater in size and weight which make it less easy to dispose of (there may also be a greater perceived environmental externality due to it's liquid content). This can lead to 'hoarding' by consumers after the battery becomes waste, usually until an appropriate route of disposal can be found (Civic Amenity sites in the UK have been accepting lead acid batteries in the UK for some time now). This is explained by the relative long-life of this chemistry and hence the higher weights of old batteries lead to the mass of discarded (old) batteries being greater than the mass of new ones.

In contrast secondary batteries and the longer life primary batteries (other non-rechargeable) show a much greater difference between sales and arisings. This is attributable to their longer life span against a backdrop of rapid growth in sales in recent years. General purpose and button cell batteries have a much shorter life span and so are more likely to be disposed of near to the year of purchase.

8.1.1.2. Automotive Batteries

Until relatively recently the bulk of UK automotive batteries were produced within the UK, with approximately 20 domestic manufacturers. This picture has now changed radically as companies have moved overseas to take advantage of lower production costs.

ERM estimated that in 1999, UK sales for automotive batteries were around 108,500 tonnes.[344] More recent estimates, also from ERM, suggest that in the region of 131,000 tonnes were put on the market in 2006 (a market growth of 21%, equating to around 3% per annum).[345]

H J Enthoven & Sons, as the only lead acid battery reprocessor in the UK at present, handles almost all of the lead acid battery arisings in the UK, with the remainder being exported. They were able to broadly verify these figures (and the industrial figures below) from the known collection volumes of scrap, though they noted that improvements in battery technology continue to lead to reduced battery weights, and so this can be expected to have an impact on the growth rate expressed in tonnage terms.

In terms of waste arisings the picture is similar for the lead acid battery fraction of portable consumer batteries, as might be expected. ERM estimated that there were 112,600 tonnes of waste automotive batteries in 2000, 4% more than the predicted sales in 1999.

8.1.1.3. Industrial Batteries

In contrast industrial lead acid battery production in the UK is still active, with approximately 40,000 tonnes being produced in the UK each year by a small number of companies.[346] This is because of a different pricing structure to automotive batteries, brought about by this being a largely replacement market. The relatively small proportion of nickel cadmium batteries used by industry are predominantly manufactured abroad.

Table 65 shows the estimated amount of industrial batteries placed on the market in 1999 and subsequent waste arisings. Some recent estimates from ERM suggest that around 69,000 tonnes of industrial batteries were sold in the UK in 2006.[347] This indicates 5% annual growth between 1999 and 2006.

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[344] DTI (2002) *Batteries Factsheet*, August 2002. http://www.berr.gov.uk/files/file31761.pdf

[345] BERR (2007) *Consultation Document on the Implementation of the Batteries and Accumulators and Waste Batteries Directive*, December 2007, pp88.

[346] Personal communication with H J Enthoven & Sons.

[347] BERR (2007) *Consultation Document on the Implementation of the Batteries and Accumulators and Waste Batteries Directive*, December 2007, pp88.

Table 65: UK Industrial Battery Consumption for 1999 and Estimated Arisings for 2000

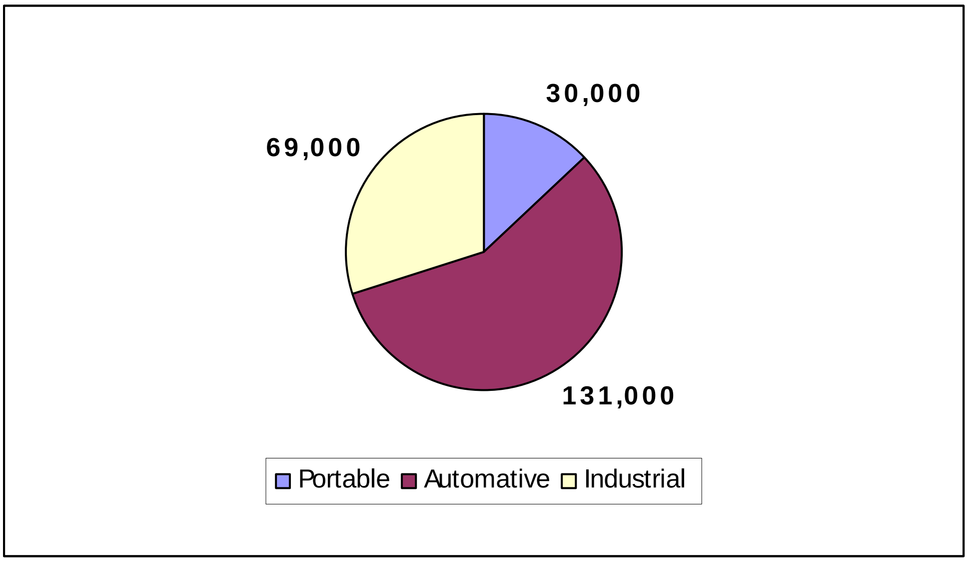
Battery Type	1999 Sales (tonnes)	2000 Waste Arisings (tonnes)	Percentage Difference (arisings relative to sales)
Lead Acid Standby	20,500	18,000	-12%
Lead Acid Traction	29,200	22,400	-23%
Nickel Cadmium	910	910	0%
Total	**50,600**	**41,300**	**-18%**

DTI (2002) Batteries Factsheet, August 2002. http://www.berr.gov.uk/files/file31761.pdf

8.1.2. Summary of Sales by Battery Type

Figure 34 summarises the sales of the three battery types discussed in the above Sections. Automotive batteries is the largest market in tonnage terms, being almost twice the size of the industrial market and over four times the size of the portable market.

Figure 34: Approximate Battery Tonnages Placed on the Market in 2006



8.1.3. Policy and Legislation

8.1.3.1. Producer Responsibility

Producer responsibility in the UK is a policy tool that is an extension of the "polluter pays" principle, and is aimed at ensuring that businesses that place products on the market take responsibility for those products once they have reached the end of their life. Producers are required to finance the cost of collection, recycling and treatment of batteries collected under the Batteries Directive. The UK Government is proposing that producers should have the responsibility for developing schemes for collection, recycling and treatment of waste batteries themselves as they will be able to influence the way schemes achieve the Directive requirements so as to ensure that this is done as effectively and efficiently as possible.

Producer responsibility directives impose an obligation on producers which they can either discharge themselves or through a collective scheme of some sort, generally known as "compliance schemes". This framework can be delivered by either a single scheme or a number of schemes (multiple-schemes). The extent of producers' obligation depends on the amount they put on the market. Compliance of these schemes would then be monitored by regulators.

A "producer responsibility" policy underlies the approach taken in implementing the EC Directive on Packaging and Packaging Waste in the UK and is the approach taken in both the EC Directive on Waste Electrical and Electronic Equipment (WEEE) and End of Life Vehicles (ELV) Directives.

The recent WEEE Directive has led to the creation of around 40 compliance schemes in the UK and this has involved some complications, particularly in terms of reconciling data between the schemes and the Environment Agency.

There has been a suggestion from Defra that there is no overall majority of stakeholders in favour of either a single compliance scheme or a multiple compliance option for the collection of batteries. Stakeholders are, however, seeking competition from the system, which is possible via the single compliance scheme if a suitable tendering process is used.

8.1.3.2. UK Adoption of the EU Battery Directive

The UK and all other Member States are required to transpose the Directive into national law by 26 September 2008. Responsibility for leading the implementation of the Batteries Directive is being shared between the Department for Environment, Food and Rural Affairs (Defra) and the Department for Business, Enterprise and Regulatory Reform (BERR).

Defra is leading on portable/household battery provisions (including portable batteries form business and industry) and on treatment provisions for all batteries, while BERR is leading on automotive/industrial batteries and single market provisions.

Responses to a stakeholder consultation on options for implementing the Directive are currently being considered by Government, and a six week consultation on draft regulations is expected to open over the summer of 2008. There is some scepticism in the industry that the September deadline will be met.

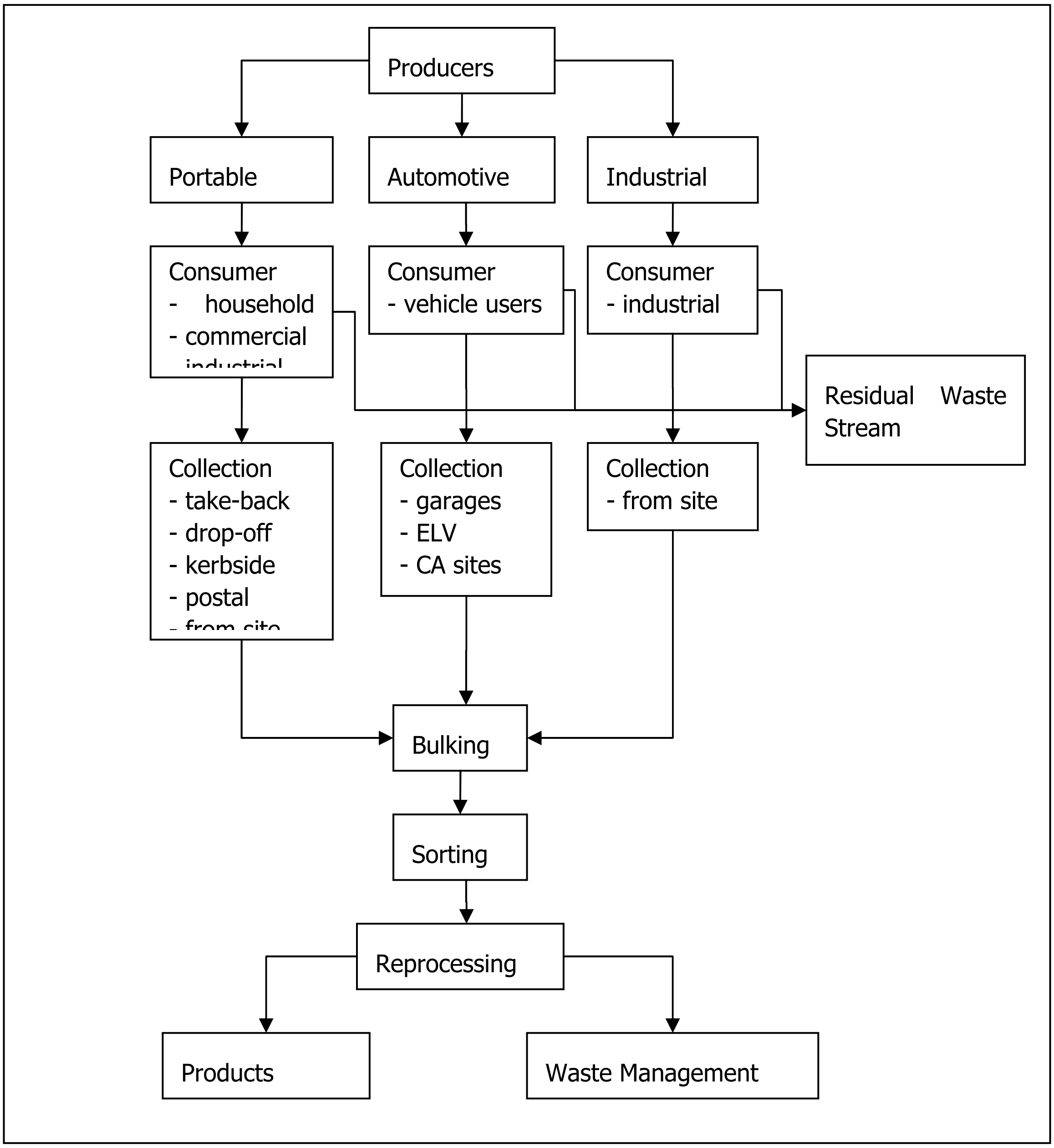
8.1.4. Current UK Battery Collection

This section outlines the current collection tonnages and infrastructure for the three battery types. The life-cycle of the three battery types is similar (see Figure 35), with the principal variation coming at the collection stage.

8.1.4.1. Portable Batteries

The collection of portable batteries is a recent phenomenon in the UK and the infrastructure is still very underdeveloped. The primary barrier to battery collection has been the cost of reprocessing the batteries once collected (particularly when set against cheap landfill costs), however, this situation is about to change as the Battery Directive demands a significant increase in the collection of portable batteries recycled, and the battery producers may be required to pay these previously prohibitive reprocessing costs.

Figure 35: The Battery Life-cycle



8.1.4.1.1. Collection Rate

Estimates suggest that 600-750 tonnes of portable batteries were separately collected in 2007/08.[348] The collection rate, one of the key targets of the Directive, is a function of the total weight of batteries collected (not necessarily recycled) in that calendar year, divided by a rolling three year average of the total batteries placed on the market. The calculated collection rate will clearly depend on the figure used for the quantity of batteries placed on the market, though if we are to use 30,000 tonnes per annum as discussed in Section 8.1.1.1, this produces a collection rate of 2-3%. This suggests enormous potential for increases.

Even if we assume that there is no portable battery growth to 2012, then in order to meet the Directive target of a 25% collection rate by 2012, 7,500 tonnes would need to be collected in the target year, a ten fold increase relative to current performance. The 2016 target of a 45% collection rate will require a further doubling of tonnage. The above discussion suggests, however, that this market is one where tonnages placed on the market are increasing, so in absolute terms, the increase in the tonnage collected is likely to have to be still greater than this.

8.1.4.1.2. Collection Systems

There has been development in portable battery collections in recent years, albeit from a very low level, and these are discussed below.

Civic Amenity (CA) Sites

Many local authorities now accept portable batteries at CA sites as a consequence of pressure from residents and from the need/desire to separately collect as many different materials as possible. The actual collection costs are negligible as the householder brings the batteries to the site, and all that is required is a suitable collection container, additional signage and a small degree of training for site operatives so that they can instruct the public appropriately. Due to the relatively low volumes of batteries delivered to the site, the onward reprocessing costs are manageable. Estimates from WRAP suggest that around 140 tonnes of portable batteries were collected in this way in 2007/08.[349] A comprehensive study of CA sites in the UK in 2004[350] estimated that 16% of CA sites were then collecting portable batteries, though a more recent study has shown that 30% of local authorities have plans for separate banks for the collection of batteries.[351]

Ealing Community Transport (ECT)

ECT is a community based recycling organisation in the UK that has contracts with 10 local authorities to carry out kerbside recycling collections. The company uses compartmentalised (stillage) vehicles to collect the recycling and sorts the material into compartments at the kerbside. This flexible system allows small amounts of additional materials (such as portable and automotive batteries) to be added to the collection at a negligible marginal cost.

ECT currently collects portable batteries in this way from 6 of the 10 authorities it services. The reason ECT is almost unique in offering such a service is that it has a much more progressive attitude towards waste management than other players in the market and is keen to divert hazardous waste from landfill. Due to the relatively small amounts of portable batteries being collected, this system is more or less cost neutral to ECT as it receives some income from the automotive batteries collected.

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[349] Personal communication with WRAP.

[350] Network Recycling (2004) *The National Assessment of Civic Amenity Sites*, 2004, http://www.networkrecycling.co.uk/downloadable-reports.htm#national

[351] Materials Recycling Week (2008) *State of the Nation report 2008,* 2008.

Bristol was the first place where this service was introduced in 2002 and the service is available to all 150,000 of the city's households. Data provided by Bristol City Council shows that in the 12 months from June 2007 to May 2008 11.21 tonnes of portable batteries were collected from the kerbside. In addition 109 tonnes of automotive batteries were collected over the same period via kerbside vehicles.

It is also interesting to note the relative proportions of batteries collected from kerbside collections versus CA sites – just over twice as many automotive batteries and nearly five times more portable batteries were collected from the kerbside compared to CA site deposits. This highlights the value of the convenience of kerbside collections for batteries relative to bring-type schemes. Hence, as long as costs are relatively low (and on this type of scheme, they are unlikely to be high), then kerbside schemes may have an important role to play if collection targets are to be met (as they may prove difficult to meet through bring-type and take-back schemes alone).

WRAP COLLECTION TRIALS

WRAP is currently carrying out work to determine the most cost-effective way of collecting batteries to meet the targets under the forthcoming Directive. The trials involve assessing several different collection methods which are described below. It is worth mentioning that while these schemes are principally set up for portable batteries from the public, it is expected that there will be some use by businesses that generate small amounts of portable battery waste.

The WRAP trial costs and tonnages should be treated with caution. By the very nature of these schemes being trials, the coverage in many places has only been a few thousand households, and as a result, wider schemes would be expected to benefit from economies of scale. WRAP was also keen to be able to monitor individual scheme performance closely to allow a thorough evaluation. This meant that a premium was paid for collection and reprocessing. The collections have also taken place in a near vacuum of publicity, and so tonnages collected are likely to be considerably higher with appropriate promotion.

Kerbside Schemes

13 kerbside collection trials are running across the UK, servicing approximately 350,000 households in a mixture of high-rise, urban and rural areas. Householders in the trial areas receive a dedicated collection container for their batteries (either sealable bags or a small cardboard box). This is set out with other kerbside materials on the appropriate day of collection (frequency of collection varies from weekly to quarterly).

The trials began in April 2006 and by November 2007 a combined total, across all areas, of 75 tonnes of batteries had been collected.[352]

While all the original kerbside trials were operated in conjunction with kerbside sort or single material collections, a new trial was launched in August 2007 in association with a commingled dry recyclable scheme (St Edmundsbury Borough Council). Hooks were fitted to the handles of the recycling wheeled-bin and householders were provided with special battery bags to hang onto the hooks. The crew then remove the bags from the hooks to be emptied in a small container on the collection vehicle. In the first eight months of this trial to 44,000 households, over 9 tonnes of portable batteries have been collected. This innovative approach is significant as commingled collections account for around 30% of all collections in the UK.

[352] Bennett, L (2008) Batteries on trial, *Resource Journal*, No. 39, pp11-12.

St Edmundsbury will shortly be conducting a further trial, also in partnership with WRAP, to 20,000 households whereby residents are able to put out small WEEE items at the kerbside from which batteries will be removed for recycling.

This new trial highlights the potential cross-over between the Batteries Directive and the WEEE Directive. WEEE legislation requires batteries to be removed from the electrical items but does not specify how and when. As a result it is not currently common practice to remove batteries at the pre-shredding stage. Battery producers are only required to finance the treatment and recycling of waste portable batteries collected under the collection obligations in Article 8 of the Batteries Directive.

The Government is considering whether or not to impose an obligation on portable battery producers to finance the collection, treatment and recycling of batteries collected under schemes set up in accordance with the WEEE Directive, or whether to make this an option for battery collection schemes such as in the St Edmundsbury trial.

On the back of information gathered by the kerbside trials, WRAP believes that kerbside schemes will be able to collect in the region of 3,500 tonnes per annum at best.[353] This is clearly some way short of the amount required to meet the Directive targets, suggesting that a range of collection schemes will be necessary.

Take-back Schemes

Retailer take-back trials began in October 2006 and have involved 33 major retail stores across three council areas. WRAP is working with a consortium of retailers including the Home Retailer Group (Argos and Homebase), B&Q plc, DSC International (Currys and PC World) and Tesco plc. Battery containers have been installed in participating stores and shoppers can drop-off all their used portable batteries. By the end of November 2007 these retailer take-back schemes had collected about 6.5 tonnes of portable batteries.

Drop-off Schemes

In this scheme householders can deposit portable batteries in containers located across the authority. Three councils in the UK are involved with this trial. A London borough had 46 collection points (all on-street) and a more rural district had 24 (in a mixture of locations such as council buildings, libraries, sport centres and large and small retailers). These schemes started in spring 2007 and had collected just over 2 tonnes by the end of November 2007.

Postal Schemes

The latest scheme, starting in June 2007, makes available special pre-paid envelopes from public places such as offices, schools, post offices and shops. These can be placed in the UK postal system and are delivered direct to a battery sorting depot. Two rural UK authorities are trialling this system where it is believed that this method is most likely to be cost effective.

SUMMARY OF WRAP TRIALS

As explained above, the actual costs of the trials are not likely to be representative of what the real full-scale costs are likely to be. The trials have also taken place in a near vacuum of publicity, so participation and capture is likely to be lower than what might be achievable with a coordinated media campaign. It is, however, interesting to look at the schemes relative to each other. This shows that kerbside collections

[353] http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=323&listitemid=9907

are roughly twice as expensive as bring schemes, though the captures (in terms of grams per household) are around four times higher in the better performing trial areas.

On the basis of the portable battery collection trials WRAP believes that all four collection methods have a role to play in meeting future targets. There is no 'silver bullet' which will ensure that these targets are met and it is believed that a variety of compliance systems will need to be offered in order to engage the public.

All of the portable batteries collected via the schemes discussed in this section are ultimately destined for G&P Batteries Ltd (UK's leading portable battery collector) for sorting. All collected batteries are taken to the company's headquarters in the West Midlands where batteries are correctly identified, sorted by hand and stored until an economical load is accumulated. They are then sent to the appropriate reprocessing company according to battery chemistry.

8.1.4.1.3. Business Collections

It is also important to consider that G&P Batteries has launched a nationwide service aimed at capturing portable batteries from businesses. The "Battbox" scheme is a scheme which involves the charging of a pre-paid one-off fee of £25, and has been running since the end of last year. A small box (approximately 20cm x 10cm x 10cm) is provided to businesses and once full of any assortment of portable batteries will be collected by G&P. Whilst in its infancy this scheme has at least started raising awareness amongst businesses about the issue of battery disposal, and is likely to make a significant contribution towards collection targets come 2012.

8.1.4.2. Automotive Batteries

Automotive battery recycling has been taking place in the UK over many years due to the inherent value of lead which is used in the batteries. In the last few years metal prices have been extremely buoyant, with lead no exception (see Figure 36). As a consequence the economics have pushed collection rates to around 97%. The price of lead is currently so high that there have even been instances of waste lead acid battery thefts from CA sites.

Figure 36: Lead Price Graph 2003-2008 (US$ per tonne)[354]

[354] London Metal Exchange http://www.lme.co.uk/lead_graphs.asp

Old automotive batteries are usually returned to garages, or suppliers of new batteries, or taken to CA sites, where they are widely accepted. The ELV Directive has also brought about a significant quantity of waste automotive batteries arising at ELV Authorised Treatment Facilities[355] (around 1,400 in the UK[356]) in the form of 'after market material' since its inception in the UK in 2003.

Collection from these locations is done via a well established, if slightly fragmented, network of small merchants. The batteries then gradually pass down the line to the larger scrap metal merchants who then sell them to lead smelters.

The Directive requires that producers of automotive batteries must register, provide accessible free take-back from privately owned vehicles, and must finance the net costs of collection, treatment and recycling. BERR believes that it is best left to the market to determine when there is a net cost (i.e. where an independent battery collector is acting commercially it may be assumed that there is no net cost) and that given the high collection rates for automotive batteries in the UK, driven by economics,

> *"the Government does not favour introducing a system which would disrupt existing successful collection and recycling activity, or significantly distort the current market arrangements".*[357]

8.1.4.3. Industrial Batteries

Given that around 98% of industrial batteries consist of lead-acid batteries, the situation is almost identical to automotive batteries, with collection rates of over 95%. Again the Government does not favour introducing a system which would disrupt existing successful collections.

8.1.5. Reprocessing

This section looks at how the various battery types are reprocessed after collection and sorting into the separate battery chemistries.

8.1.5.1. Portable Batteries

Reprocessing facilities do exist in the UK for some of the more specialist battery chemistries. Button cells are treated by Odin Research and Development and Mercury Recycling, silver oxide batteries are reprocessed by Engelhard Ltd and lithium ion recycling facilities are being developed by H J Enthoven & Son.

Alkaline manganese and zinc batteries make up around 80% of the total weight of portable batteries placed on the market, and although G&P batteries has, since late 2006, begun the mechanical processing of these chemistries through its sister company H J Enthoven, nowhere in the UK offers a full recycling process as yet for these chemistries. These are, therefore, typically sent to other Member States, principally France, for recycling (see Table 41).

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[355] Authorised Treatment Facilities are those establishments carrying out treatment operations which hold a site licence that meets the requirements of Part VII and Schedule 5 of the ELV Regulations.

[356] BERR (2007) *Consultation Document on the Implementation of the Batteries and Accumulators and Waste Batteries Directive*, December 2007, pp50.

[357] Ibid

The gate fees for the reprocessing of portable batteries vary according to chemistry. Primary lithium batteries are extremely expensive to recycle due to their explosive properties (approximately £2,500 per tonne). Button cell batteries are also relatively costly to recycle (around £800 per tonne) as mercury distillation is an expensive process. Most other portable batteries, including zinc and alkaline chemistries which make up the bulk of the market, cost in the region of £400 per tonne to reprocess. Lower costs apply to the reprocessing of lead acid batteries and secondary lithium batteries, which have an inherent value. It is, however, expected that all costs will come down considerably as the collected quantities grow (as the first collection target year approaches). One collector estimates that by 2012, reprocessing costs may well be as low as 50% of current levels.

8.1.5.2. Automotive and Industrial Batteries

As all automotive and 98% of all industrial batteries consist of lead acid batteries these are all reprocessed in the same way. H J Enthoven reprocesses practically all of the lead acid batteries in the UK at its plant in Derbyshire. Firstly the sulphuric acid is removed which is put through a purification process to produce gypsum. The batteries then pass through a battery breaker where the polypropylene is removed to be recycled. The reclaimed lead is then fed into a rotary furnace before passing through a refining kettle. The recycled lead is then cast into ingots for sale to the metals industry.

The small proportion of industrial Nickel Cadmium batteries are exported for reprocessing as already described for portable batteries.

8.1.5.3. Collection & Reprocessing Summary

The above Sections provide evidence that the UK automotive and industrial battery collection and reprocessing systems are working effectively and efficiently. By contrast, the collection rate of portable batteries is still extremely low and will require significant change to meet the Directive collection targets. As a result the following section on identifying market failures will focus on portable batteries. The UK Government's desire to leave the market for automotive and industrial batteries to 'sort itself out' reflects a view that these markets are functioning in an acceptable manner.

8.1.6. Market Failures in the Batteries Market

As the UK is on the verge of transposing the Batteries Directive into national law, there is a need to be mindful that the market conditions up until now are likely to be very different to those which may exist following implementation of legislation to meet Directive targets. This section will therefore attempt to consider market barriers as they exist *at present*, though we also comment on how the Directive is likely to change this picture.

8.1.6.1. Transaction and Search Costs

As a result of the WRAP-led battery trials there is now considerably more information on portable battery collection available to local authorities, although this is against a backdrop of significant search costs prior to the trials.

Whilst this has undoubtedly reduced price discovery and search costs for collection (reprocessing search costs are not really an issue because both local authorities and businesses are only really concerned to the point of collection), there are still few suppliers in the market. As described in section 8.1.4.1.2, ECT is virtually alone in coming forward to offer a kerbside collection service to the market, and local authorities in the UK are typically tied into recycling collection contracts of 7 years' duration or longer. It is not possible to change service provider easily, though it may be possible to adapt existing services, albeit usually at a cost to the local authority.

There are an increasing amount of companies offering collections from specific locations (businesses and bring sites) as the opportunities offered by the Directive begin to be realised. G&P still dominate the market, however, collecting around 75% of all portable batteries either via their own fleet of through subcontractors. G&P also have a sales team who contact SMEs regarding their new Battbox service (see section 8.1.4.1.3) which is increasing the interface between businesses and collection routes and hence removing transaction and search costs. It is anticipated that there will be considerably more competition in the market once the Directive becomes active in the UK. From the collectors perspective there are markets available for all battery chemistries in Europe, and these are well known within the industry.

As regards reprocessors, transaction and search costs are likely to be low insofar as sale of secondary materials are concerned. Many of the principal metals produced are traded on the global market and as such are listed on the London Metal Exchange (iron, steel, lead, zinc and aluminium alloy). There are well established markets for varying grades of secondary metals, with widely published indicative prices for these various grades (a price is quoted specifically for lead batteries). The slag by-product can be used in asphalt road construction.

8.1.6.2. Information Failures

The metals market sources materials from a huge variety of industrial processes that create secondary metals. Clearly certain standards need to be met according to the nature of what the metal is to be used for, though reprocessors will routinely deal with metal merchants they have an established relationship with based on the output specification of the secondary metals. A number of British Standards exist for secondary metals, for example lead and lead alloys (BS EN 12659:1999) and zinc and zinc alloys (BS EN 14290:2004). Other countries will have similar standards and the reprocessors will need to meet these specific purity targets.

Any perceptions of battery reprocessing producing inferior products have been largely dispelled over time as metal merchants have seen the relatively high quality outputs.

One of the biggest information challenges in the UK will be getting the right message to the public and businesses about the need for collection and how to participate. As with the experience for other recyclables already widely collected in the UK, large urban areas will present a significant challenge due to their high levels of transiency and low income groups for whom recycling is not a priority. This is likely to depress captures of batteries, potentially increasing the unit costs of the service provision.

8.1.6.3. Consumption Externalities and Risk Aversion

The fact that there are a small number of portable battery collectors and reprocessors in the market is likely to make local authorities slightly risk averse to kerbside collections due to the possibility of having to retract a service that the public have become accustomed to due to the collection or reprocessing company folding. This occurred in 2003 when Britannia Zinc, based near Bristol, was forced to close, threatening the continuation of the Bristol kerbside scheme. Fortunately the scheme was saved by G&P Batteries, although additional sorting and transport did push up costs. As mentioned previously there are more players now entering the market, and competition is likely to intensify further from September 2008.

Another area of concern emerging in the UK is the kerbside collection of batteries from commingled services.[358] This type of collection, which accounts for around 30% of all collections in the UK, presents

[358] 'Commingled' refers to those kerbside services that collect mixed dry recyclables, with sorting taking place at a later stage at a Materials Recovery Facility (MRF).

several issues. Whilst WRAP is trialling collections in one authority using hooks on wheeled bins for plastic bags (see section 8.1.4.1.2), there has been a warning from the Campaign for Real Recycling that the practice of combining the two collections could lead to batteries not being properly separated by members of the public, and therefore contaminating other recyclate streams. These concerns are shared by the Local Government Association.[359] The vehicles used for this type of collection have powerful compaction units that could split batteries and cause contamination of other materials, particularly paper. In addition any batteries reaching the Material Recovery Facilities (MRF) would not be well received.

One of the most technically advanced MRFs in the UK was contacted and they commented that with the large throughput of material there is no way that the manual pre-sorting stage could hope to separate out household batteries reliably. If the batteries were to pass through the system those containing steel would be pulled out by the overband magnet, while any batteries containing alloys would be separated by the eddy current separator. This would lead to contamination of the metal streams, reducing the level of purity and the price which might be obtained for these materials.

8.1.6.4. Enforcement of Legislation

8.1.6.4.1. Licensing

There are a number of licensing issues around the collection of portable batteries that have come to light as a result of the WRAP trials. The Directive seeks the unpermitted and unregulated collection of portable batteries, but unfortunately this provision does not mesh well with current UK legislation. The situation is further complicated by the variances in legislation in England, Wales, Scotland and Northern Ireland, and having to deal with the different environmental protection agencies that enforce them.

There are two conflicting pieces of legislation for the kerbside collection of mixed portable batteries, the Hazardous Waste Regulations 2005 and the Carriage of Dangerous Goods Regulations 2007. Paragraph 14 of the Hazardous Waste Regulations allows the separate collection of household batteries and it is this legislation that WRAP has adhered to. The difficulty with applying the Dangerous Goods Regulations is that there is no precedent for hazardous waste being collected in this way, though aerosols (a hazardous substance) have been overlooked in the past. These regulations would require that each battery be placed in an individual tray, and so common sense has led to the Hazardous Waste Regulations being the legislation that is being followed.

For the take-back and drop-off schemes, all collection points have had to be registered with the Environment Agency (EA) as producer of hazardous waste at a cost of £18 per site. This was essentially the minimum requirement and WRAP had to work closely with the Producer Responsibility Team at the Agency so that portable batteries could be classified as a 'low-risk waste'. The EA waived the requirement of consignment notes (a cost of £5 per pick up) that should strictly have been required, though documentation of the movements was required.

The law in Scotland would have required that all collection sites have a Waste Management License. This would have prohibited the trials due to the significant cost and time needed to obtain the licenses. After discussions with WRAP the Scottish Executive agreed to change the law on 1 December 2006, allowing collections of portable batteries up to 5m^3 to be exempt. Consignment notes were required in Scotland, however, at the cost of £24 per collection round.

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[359] http://www.lga.gov.uk/lga/aio/351365

The WRAP trials have therefore highlighted a number of licensing issues that present significant barriers to portable battery collections, though these have now been recognised and highlighted to Government so these should be addressed in the forthcoming legislation.

An area that WRAP sees as playing an important role in portable battery collections is through reverse logistics from supermarkets. As supermarkets place a considerable proportion of portable batteries on the market, it is logical that they should act as popular collection points for consumers. The barrier to this is that all drivers of haulage vehicles supplying supermarkets would need to receive dangerous goods training as required by the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). The initial cost of this training is around £300 per driver, with ongoing costs thereafter to keep the training up to date. It is not known how interested the supermarkets would be in diversifying into the collection and transport of hazardous waste given these cost and legislative burdens.

A company on the collection side (Loddon Recycling Ltd) who were contacted believe that with batteries being relatively low risk, it would be helpful to consider revising their classification under ADR, perhaps through an exemption providing certain driver awareness criteria could be met.

Another licensing collection barrier is the Transfrontier Shipment (TFS) of Waste Regulations 1994. This is currently an important piece of legislation as with very limited current UK portable battery reprocessing facilities, all battery waste that is shipped abroad must adhere to TFS regulations. An annual permit for TFS costs approximately £1,500, with each shipment requiring a further cost of around £100. As well as the cost there is a significant administrative burden as each shipment has to be applied for a month in advance. A potential solution, as put forward by Loddon Recycling, might be to place the export of waste batteries under the 'green list', whereby lower risk materials are subject to less stringent regulations.

Loddon Recycling did, however, believe that the revisions that the Environment Agency are bringing in as a result of environmental permitting changes will assist in reducing the regulatory burden on businesses.

8.1.6.5. Enforcement

8.1.6.5.1. Illegal Activity

There is concern within the industry of illegal practice around the collection and disposal of batteries, and this practice is likely to intensify as more players enter the market post Directive. If illegal practices are not squeezed out of the system, not only will there be significant environmental risks, but the legitimate businesses will suffer as those operating illegally will be able to undercut their prices. Illegal practice is also likely to feedback to risk aversion from the market.

Policing by the Environment Agency is therefore crucial to the long-term viability of the industry, though it is recognised that the Agency only has limited resources to carry out this work.

8.1.6.5.2. Mercury and Cadmium Limits

The Directive will prohibit the placing on the market of any batteries that contain more than 0.0005% (5 ppm) of mercury by weight; and of portable batteries that contain more than 0.002% of cadmium by weight. There are some exemptions to the prohibition for button cells containing mercury and for batteries containing cadmium, namely those used in emergency/alarm systems, medical equipment and cordless power tools.

G&P recently carried out some research into the mercury content of alkaline batteries found on the UK domestic market. This analysis showed that a kilogram of European branded batteries fell well within the proposed legal limits, though astonishingly a kilogram of batteries from the far-east revealed mercury levels of 255 ppm, as well as elevated levels of cadmium and benzene. These findings clearly show that for the Directive targets to be met a much higher level of international policing will be required.

8.1.6.6. Recycling Efficiency

There is still a lack of clarity on the subject of recycling efficiency as required by the Battery Directive. This relates to the question of what is a battery. Some in the industry (i.e. those reprocessors that might struggle to meet the efficiency criteria) are trying to claim that certain elements of the battery should be excluded from the recycling efficiency calculation (i.e. the gross weight). For example, some batteries contain water and there are those that believe that the water content should be deducted from the gross weight of the battery. Similarly some batteries are housed within a plastic casing and it is being questioned as whether this fraction would be included in the total battery weight.

A more tenuous claim is that the carbon content should be subtracted from the gross weight of the battery in the pyrometallurgical process because carbon would otherwise have to be added as a reducing agent during the process. There is also debate as to whether metal slag from battery reprocessing can be considered as recycling.

Having held consultation with industry it will be for Defra to draft the regulations on recycling efficiency in the coming months.

8.1.6.7. Technological Externalities

Primary lithium batteries are very volatile and appropriate measures need to be taken to ensure their safe transport and storage. This can include dissolving the batteries in saline solution to discharge them or bagging the batteries individually and storing them in sand. These safety requirements mean that there is additional cost involved in their recycling.

There has been suggestion that the steel industry might play a part in the recycling of alkaline batteries, though this would only be possible if mercury levels are below 0.0005%. It may be difficult to ensure that this is the case given the analysis carried out by G&P Batteries, as discussed in Section 8.1.6.5.2, unless batteries with higher mercury content than the Directive allows are prevented from entering the UK market in future. The producers are certainly keen on this idea as it would be a relatively cheap process. There are, however, doubts that the steel industry would be able to meet the Directive recycling efficiency targets as the process is not designed as a recycling route for batteries as a whole, and as such, it is only really the steel element that would be recovered.

The high levels of mercury in portable batteries from the far-east mean that reprocessors have to design processes that take account of mercury at these levels. If the level of mercury were reduced to the levels required by the Directive then new plants could be built that would not need to cater for such high levels of mercury, and hence reduce the overall cost of the process.

8.1.6.8. Market Power

As previously noted there are only a limited number of collectors in the UK market and reprocessors across Europe. Market power is not a particular issue at present because the market is still growing and the barriers to entry are not such as to prevent new entrants collecting material (the regulatory barriers are common to all collectors). As an example G&P suggests that it has priced its Battbox scheme in a very competitive way to try to attract a wider customer base, and even under this offer to the market, the company states that it is struggling to get businesses to take up the offer as they know that they can legally continue to put portable batteries in the residual waste at negligible cost. It is very difficult to assess how this picture will change until the details of the regulations are revealed. It is certainly likely that kerbside collections from households will increase through the waste management companies that collect dry recyclables, and there will be more collection sites for the public to use. This will create more demand for collection services from consolidated points and will probably lead to an increase in competition. Sorting, currently carried out by only a handful of companies in the UK, may also see new market entrants, though this is more of a specialist area and requires a Hazardous Waste Treatment Licence.

Despite there being, in Europe, a limited number of suppliers on the reprocessing side, there is over capacity in Europe at the moment and so it is not clear that the small number of reprocessors necessarily leads one to conclude that market power is an issue. On the other hand, we are not aware of any analysis which demonstrates an absence of the exercise of such power. Post consumer responsibility will again raise competition and in the longer-term may see the development of recycling capacity within the UK. Several companies are certainly considering the possibility of establishing UK portable battery recycling, but are waiting to see the outcome of the regulations as this will have a significant bearing on viability. At present, however, notwithstanding the small number of reprocessors, it is not clear that market power is a major issue, partly because of the over-capacity situation.

8.1.6.9. Network Externalities

At present the number of customers receiving a portable battery collection service is low. G&P Batteries and Loddon Recycling provide a national pricing structure to try and attract wider business so as more customers are attracted to the service the more efficient the process will become. Other things being equal, this is likely to lead to a reduced price for customers, which may in turn attract further customers.

On the other hand, ironically, as more collectors enter the market, the density of the logistics for any one collector may fall. Consequently, because the economics of the collection service will be driven by the density of pick ups (and the quantity per pick-up), in any given area, the more widely the market is distributed, the higher the unit costs are likely to be. As in other collection systems, therefore, the logic of competition has its downsides. It ought to be difficult for a collector to compete on price with one that has a near monopoly over the collection service, and it may make sense to draw the distinction between competition *in* the market (on a day to day basis) and competition *for* the market (on a periodic basis, with the winning tenderer being granted a time-limited monopoly). The latter situation ought to be more efficient and should lead to lower costs, at least in principle. In practice, the diversity of commerce and industry may imply that a diversity of service offerings is desirable. Quantities available for collection per pick-up are likely to vary much more significantly in absolute (tonnage) terms in the commercial and industrial sector than at the household level.

8.1.6.10. Adoption of New Recycling Technologies

The technology for automated sorting and identification does exist but is not being used in the UK at present as the capital costs for this equipment are high and the volumes currently being sorted in the UK do not currently warrant the investment (it has been suggested that an annual throughput of 5,000 tonnes would be needed to make this investment worthwhile). As with a MRF there will always be a certain level of hand sorting required as there will be contamination, as well as batteries contained within plastic packs and casings.

Industry has commented that improvements can be made to existing technologies, and these will be driven by further research and development on the back of the Directive efficiency targets, the greater volumes of batteries requiring recycling and increased competition. The high price of metals will also encourage a greater separation of materials and higher levels of purity.

A number of Mechanical Biological Treatment (MBT) plants now exist in the UK and this number is expecting to grow considerably in the future as Landfill Directive targets become increasingly challenging.

Some of these are being designed with pre-treatment specification (x-ray) that would allow the batteries to be separated from the residual waste at an early stage.

8.1.7. Conclusions

Collection rates for automotive and industrial batteries are already high as a result of the inherent value of lead acid batteries. As a result the UK Government is proposing limited intervention in this area, though a ban on the landfill of these batteries will act as an additional driver for higher collection rates.

In stark contrast the proportion of portable batteries currently being collected are very low (around 3%) due to the high reprocessing costs associated with these battery types. Although the objectives of the Directive are known, until the UK draft regulations are published, it is difficult to say with any precision how the system will operate in practice. The UK adoption of the Directive will undoubtedly change the way waste portable barriers are managed by addressing many of the barriers currently preventing the collection of portable batteries, particularly the cost issue via producer responsibility.

The lack of UK reprocessing facilities is not a barrier, though it is believed that once the regulations become clear and the volumes of portable batteries begin to grow, a UK reprocessing industry could develop. In the short-term the Directive will require significant development of the portable battery collection infrastructure. The tonnage of portable batteries placed on the market is still largely unknown, and could be significantly higher than the current estimation of 30,000 tonnes per year. It is therefore believed that a diverse range of collection methods will be needed in order to meet the targets; trying to calculate collection provision in order to just meet the targets will be very risky. This will of course need to be done in conjunction with the battery producers who will want to protect their profit margins.

As well as a making it as convenient as possible for consumers to recycle their batteries it will also be important to widely publicise the reasons why battery recycling is important and the various ways in which it can be done.

8.2. FOOD WASTE RECYCLING MARKET IN THE UK

The food waste recycling market in the UK is an emerging and developing market. Although the potential growth in the market is enormous, there are a number of impediments that limit the market.

As well as reducing greenhouse emissions, food waste recycling can be highly beneficial to some producers as a method of saving money and achieving recycling targets. Figure 37 outlines an overview of the food waste market including the actors involved.

8.2.1. Food Waste Types

Within the UK, the main food waste streams requiring treatment can be broken down in to three distinct categories;[360]

- Household;
- Commercial; and
- Industrial

[360] Agricultural Wastes are not included in the analysis.

This analysis does not use the term Municipal Solid Wastes (MSW). For ease of comprehension we have chosen to use the 'household' and 'commercial' categories, as many of the issues explored require a distinction between the two categories, which is not easily extrapolated from the term MSW.

8.2.1.1. Household food waste arisings

In the UK there are an estimated 24.9 million households each producing food waste every week. Waste composition analyses repeatedly show that food waste is, if not *the* largest then, one of the largest single fractions of the household waste stream.[361] Typically food waste from households would consist of unwanted food. The causality of this can be attributed to a number of reasons, whether it is from being past its 'best before' date, past its 'sell by' date, overcooked, undercooked or simply no longer wanted.

In most cases, a quantity of food waste is expected to arise due to the whole product not able to be completely consumed (bones, tea bags, fish heads etc), this would be considered unavoidable food waste. A recent WRAP report[362] highlights that UK households waste 6.7million tonnes of food waste per annum, of which, only 1.3 million tonnes is deemed to be clearly unavoidable. Avoidable, or possibly avoidable, food wastes make up the other 5.4 million tonnes of food waste generated by UK householders. Table 66 shows the total arisings of food waste from the household sector by country.

Table 66: Food Waste Arisings from Household Sources

Country	Food Waste Arisings (tpa)
England	5,602,000
Scotland	587,000
Wales	333,000
Northern Ireland	178,000
United Kingdom	**6,700,000**

Source: adapted from Exodus Market Research (2008) The Food We Waste, Report for WRAP, April 2008

There are an array of socio-economical factors in action contributing to the causality and magnitude of this waste stream. Some analysts see the main cause of food waste production at the home being caused by consumers not knowing how much food is required, and simply buying too much food through excessive shopping. An increase in unplanned shopping trips has also led to an escalation in food waste production as the ability to plan meals ahead is reduced.

Analysts also see a poor level of food education driving the increase in food waste at the home. Poor storage practices within many homes accounts for wastes being generated, as food is not cared for properly. A misunderstanding of food labelling is also seen a problem, with terms like 'best before' being misconstrued by consumers and resulting in food being needlessly discarded.

[361] Recent estimates suggest that food waste constitutes around 23.6% of household waste.

[362] Exodus Market Research (2008) *The Food We Waste,* Final Report for WRAP, April 2008

Table 67 : Avoidable Household Food Wastes by Type

Food Type	Weight (tonnes per annum)	% of total avoidable food waste
Potatoes	359,000	9.70%
Bread slices	328,000	8.80%
Apples	190,000	5.10%
Meat or fish mixed meals	161,000	4.20%
World breads (e.g. naan, tortilla)	102,000	2.70%
Vegetable mixed meals	96,000	2.60%
Pasta mixed meals	87,000	2.30%
Bread rolls/baguettes	86,000	2.30%
Rice mixed meals	85,000	2.30%
Mixed meals	85,000	2.30%

Source: adapted from Exodus Market Research (2008) The Food We Waste, Final Report for WRAP, April 2008

Table 67 outlines the top ten types of avoidable food waste arising from household sources. There are wide variations in the types of waste within the table with no single stream of food dominating the list.

There are other reasons for the generation of food waste explained by some other analysts which concentrate on general trends in societal behaviour and are seen as more 'deep rooted'. The adage of 'you don't value what you pay little for' is often associated with views on food waste. Many see the low prices paid for food as a key driver in the creation of food waste, which can be especially exasperated with the 'buy one-get-one-free' offers (BOGOF's) common place in many of the major food retailers.

Some columnists see the upbringing of the latest generation of children as a determining deep rooted factor that is a driver of food waste generation. Lack of food education in schools and homes are seen as key drivers in the creation of food waste as younger generations are not taught how to manage food or their budgets. This is set alongside the concept that older generations still adhere to 'war time' values and do not waste as much food as younger generations. However, in contrast to popular perceptions, research has shown that older people waste as much food as younger people (on average, 1.2 kg of food waste per week). [363]

Retailers have highlighted that spending habits on food have changed radically in the last 25 years or so. The removal of preservatives from foods, coinciding with a movement away from tinned produce and towards fresh produce, is certainly one factor that has caused the shelf life of food to be reduced, thus increasing the likelihood of waste arisings.

[363] Exodus Market Research (2008) *The Food We Waste,* Report for WRAP, April 2008.

8.2.1.2. Commercial Food Waste Arisings

Commercially generated food waste is considered to be food waste arising from commercial, non-manufacturing businesses such as offices, shops or restaurants. The commercial sector has had much less detailed research into arisings carried out in the UK when compared to the household sector. Consequently, very little detailed information is known about the sector and in particular, food waste arising from it.

The main sources of food waste are characterised by premises that are entrusted to handle food and sell it to consumers, though most businesses generate some food waste associated with the activities of employees (tea, coffee, fruit peelings, wastes from lunches, etc.). In the UK, this market is dominated by the catering sector (comprised mainly of restaurants, hotels and pubs) involved with secondary processing of food, and therefore likely to generate waste. Similarly to householders, these businesses do not tend to generate very large quantities of food waste at a single location, although they will generate more than most households. This may generate issues for food waste collection which shall be discussed later in the report.

Unlike the household sector there are no firm societal issues explaining the generation of food wastes in the commercial sector. Undoubtedly, some of the drivers are similar, especially so in localities where food waste is consumed. However, Eunomia research shows that within the catering sector in particular, far more food waste arises during the processing stage than during consumption.[364]

In 2002 the Environment Agency [365] estimated that 2.2 million tonnes of waste was generated from the commercial sector consisting of animal and plant material in England and 60,000tpa arose in Wales. The animal and plant material can be assumed to be mostly consisting of food waste. Within the Agency survey, there is a further category referred to as 'Mixed' wastes, of which, almost certainly, a significant proportion is food wastes. It is unknown exactly how much how food waste contributes to the 'Mixed' category. However, 'mixed wastes' account for more than 15.5 million tonnes in England, and 0.5 million tonnes in Wales. If 20% was food waste, one might estimate that around 3.2 million tonnes of mixed wastes could be food waste in England and Wales. If one considers the whole of the UK, then adding this to the animal and plant material, one could estimate that around 6 million tonnes of food waste arisings may exist in the commercial waste stream.

8.2.1.3. Industrial Food Waste Arisings

As in the case of the commercial sector, industrial food waste arisings are poorly known. Food wastes arising from this sector would mostly consist of wastes from food processing and food and drinks manufacturing. This is a broad category and can include a multitude of sub sectors, each producing differing types and mixtures of food waste. Unlike the commercial and household sectors, the industrial sector is comprised of a smaller number of producers each producing a larger quantity of waste.

The causality of food waste generation within this sector is unlikely to have the same drivers as the commercial sector, and certainly not the same as the household sector. Wastes from the manufacturing and processing sector are generally unavoidable as they are a by-product of the process. Consequently, the quantity and consistency of the wastes can be predicted by a given business.

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[364] Eunomia (2008) *Regional Biowastes Management Study,* May 200*8, available at:*
http://www.eera.gov.uk/Text.asp?id=SX7EF6-A77FDF90&cat=587

[365] Environment Agency Commercial and Industrial Waste Survey 02/03 available at: http://www.environment-agency.gov.uk/subjects/waste/1031954/315439/923299/1071046/?version=1&lang=_e

Environment Agency data suggests that 4.75 million tonnes of animal and plant material arose in the commercial sector in England and Wales. In addition, there were 7 million tonnes of mixed waste. [366] Following a similar logic to that used for commercial wastes above, we would estimate that around 6.5 million tonnes of food waste is produced by the industrial sector each year. As one of the main drivers in the industrial food waste market is considered to be the economics of treatment, the trend in waste growth in this sector is uncertain. In most cases companies are able to adapt their manufacturing processes to become more efficient by reducing waste and therefore saving money.

8.2.2. Food Waste Collection and Recycling

The food waste recycling market is an emerging market in the UK. Since 2004, there has been an increased trend in the collection and recycling of food waste, especially in the household sector. This has primarily been driven by the introduction of legislation and policies directed at household waste.

8.2.2.1. Capture and collection of food wastes

8.2.2.1.1. Household food waste capture

In the majority of UK authorities, food waste is still being collected as part of refuse and not being recycled. However, there is an increasing trend for authorities to offer a recycling service for food waste. Within the country there are considered to be two main approaches to food waste collection employed;

- Co-collection systems

  Implementation involves all food waste collected alongside a free garden waste collection service. The service involves householders segregating both food and garden wastes into a single 240 litre bin for collection. Some Local Authorities are also likely to provide 'kitchen caddies' to increase capture of food wastes within the home, the contents of which will be set out in the same single wheeled bin at the kerbside.

  Variations in this system do arise as some authorities will also include card alongside the collection of food and garden wastes. The frequency of collection is usually fortnightly. There are two reasons for this. The first is that the collection service in many authorities alternates between collecting residual waste one week and biowastes the other. The second reason is cost. Collection of biowastes in wheeled bins using compaction vehicles is not a low-cost service.

- Separate food waste collection systems

  This approach is slightly less common in the UK, although it is growing in popularity. The system usually involves the use of kitchen 'caddies' along with small food waste 'bins' (usually around 30 litres) at the kerbside. Again, variations in these systems are apparent. These include the use of different containers, the use of different liners to contain the waste, and the use of bokashi powder to reduce unwanted odours. There are also variations in the vehicles used in collection. As food waste collected on its own has a high bulk density, there is little need for compaction vehicles. Consequently, a variety of new vehicle designs have been (and are being) developed. Unlike the co-collection system, the lower cost of each pick-up, and the targeted collection of food waste usually means that the frequency of collection tends to be weekly.

[366] Environment Agency Commercial and Industrial Waste Survey 02/03 available at: http://www.environment-agency.gov.uk/subjects/waste/1031954/315439/923299/1071046/?version=1&lang=_e

The choice of co-collection of food and garden waste, or separate collection of food waste, can have a key impact upon the tonnage of food wastes captured by authorities. Waste Data Flow[367] provides information on 'green recycling', which includes both green and food wastes. Therefore actual tonnages of food waste capture cannot be quantified on this basis. Information gathered by Eunomia relating to individual local authorities suggests that in practice, across all households within a given area, separate (weekly) collection services can yield on average between 75-100kg/hhd/annum of food wastes, whilst co-collection on an alternate weekly basis is far less effective, yielding on average only 25-45kg/hhd/annum.[368]

Separate, (weekly) collection of food wastes is now effectively promoted as 'best practice' by Defra and WRAP (Waste & Resources Action Programme). As a result of backing separate food collections, Defra is funding WRAP to trial household food waste collection systems. In England, WRAP is supporting 19 local councils with collection duties to conduct weekly food waste collection trials, in order to develop good practice guidance in the design and operation of food waste collection schemes[369].

Participation in food waste recycling can vary widely from authority to authority within the household sector. Defra[370] explain that there are complex factors shaping the enthusiasm and effectiveness of householders when it comes to food recycling. These include the type of collection scheme in operation, householder age, socio-demographic profile and local authority communications strategy. However, when a weekly food waste collection service is offered with a fortnightly residual collection, household participation tends to be high.[371]

Due to the relatively poor performance of co-collection schemes, a number of authorities are now considering increasing collection frequency to a weekly service. It seems likely that, in the long term, this will become increasingly common as higher recycling and composting targets are sought. The early indications are that these weekly co-collected systems still generally fail to reach the yields achieved by separate collection, but will perform significantly better than fortnightly services.

Latest figures indicate that just over 100 authorities in the UK have set up a food waste collection service (Table 68 below) with many new authorities introducing new services month by month. The figures show that there is no particular preference to one collection system over another. Many of these services are in their infancy so are likely to change characteristics in the future as the systems become more developed. Although a high number of authorities are now collecting food waste, it is estimated by WRAP that less than 5% of all food wastes were captured in 2006/07.

Table 68 : Number of authorities offering food waste collections

Country	Authorities offering co-collection	Authorities offering separate collection	Total Authorities
England	40	42	82

[367] http://www.wastedataflow.org/

[368] This is largely data from WRAP-funded ROTATE projects

[369] http://www.wrap.org.uk/local_authorities/biowaste/separate_food_waste.html consulted April 2008

[370] http://www.defra.gov.uk/news/2008/080327c.htm consulted April 2008

[371] Brook Lyndhurst (2008) *Enhancing participation in kitchen waste collection schemes – household behaviour and motivations,* Final Report for Defra

Scotland	6	4	10
Wales	3	7	10
Northern Ireland	7	1	8
United Kingdom	**56**	**54**	**110**

8.2.2.1.2. Commercial food waste capture

The commercial waste recycling market in the UK for food waste is poorly developed. Although there is an increasing interest in recycling, there are no large scale operational food waste schemes in current operation. In London, the East London Community Recycling Partnership (ELCRP) does offer a food waste collection and treatment service for a limited number of commercial premises.

The development of enterprises, such as the ELCRP, demonstrates that commercial food recycling is possible and there is not a complete market failure. In the past WRAP have funded small scale SME food waste trials in order to ascertain the market barriers.[372]

A report by YouGov investigated the current state of recycling within the work place. In comparing SMEs and larger corporate companies, it was found that whilst 90% of corporates were currently recycling paper, only 25% were recycling food waste (see Table 69). The figures are even lower for SMEs. However, our impression is that this survey over-states the prevalence of commercial food waste recycling in the UK, which is very much in its infancy.

Table 69: Businesses Recycling Different Non-hazardous Products

Material	SMEs	Corporates
Food	12%	25%
Wood	18%	32%
Paper	71%	90%
Metal	20%	44%
Glass	37%	54%
Plastic	39%	52%
Cardboard	60%	75%
Cans	39%	61%
Scrap metal	15%	41%
TetraPak cartons	12%	19%
None	15%	6%

Source: YouGov (2007) Recycling in the UK Plc: A State of the Workplace Report, Commissioned by Taylor Intelligence, October 2007.

[372] http://www.wrap.org.uk/wrap_corporate/news/wrap_launches_24.html consulted April 2008

8.2.2.1.3. Industrial Food Waste Capture

In contrast with the household and commercial sectors, the industrial sector has the majority of its food wastes generated in homogeneous, single waste streams. This ought to imply that the collection of segregated food wastes for recycling is unproblematic and widespread. In truth, the UK market has very limited capture of industrial food wastes for recycling. This is due to a variety of factors.

8.2.2.2. Recycling Technologies

The UK market, similar to the European Market has developed two distinct technologies for treating and processing food waste; aerobic composting and anaerobic digestion (AD). In the UK, the implementation of the Animal By-products Regulation (ABPR) is such that wherever food waste is collected, it has to be treated in an enclosed facility (referred to henceforth as in-vessel composting, or IVC). As such, open-air windrow composting is not a treatment which is allowed for any material containing any food wastes, whether from households or businesses.

In the last 5 years there has been a 20% growth in composting in the UK.[373] This is, in part, due to the growth in the treatment of segregated garden wastes and the roll-out of free garden waste collection schemes by many local authorities. However, the majority of the growth can be attributed to the development of ABPR compliant sites built in order to treat food wastes.

8.2.2.2.1. In-Vessel Composting

IVC systems come in various forms. One is a 'housed windrow', which is similar to the open-air version, but in which the opportunities for control of odours and emissions can be improved. Other forms of IVC include static clamps, tunnels, agitated bays, vertical silos and rotating drums.

In the UK there has been significant growth in IVC capacity, albeit from a low base. Between 2003/04 and 2005/06 the IVC capacity doubled in size to over 500,000 tpa.[374] Since then, there have been significant further developments.

Typically IVC technologies are chosen on the basis of cost, which has implications in terms of quality and performance:

- Low quality, simple IVC (SIVCs)– cheap, usually static clamp systems with 'temporary' polymer textile-type roofs. These systems have a relatively high propensity to generate odours where significant quantities of food waste are in the feedstock; and

- High quality, complex IVC (CIVCs) - more expensive, housed or tunnel systems with more dynamic approaches to mixing / aeration / turning, with generally lower likelihood of problematic odours.

The aim of composting processes ought to be to produce a quality compost suitable for use in a wide variety of applications, although in practice, in the UK, much emphasis has so far been placed on the need for 'landfill diversion' and this has led to an often supply-driven market whose largest component is landfill restoration. As the need to pursue markets for outputs increases, it seems likely that the aim will be to focus increasingly on marketing quality outputs.

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[373] WRAP (2008) *Realising the value of organic waste, April 2008.*

[374] Ibid

The degree to which specific end-use markets can be satisfied depends critically on the nature of the input material, but also, to some extent, how the material is refined and blended. It is more difficult for compost producers to meet requirements of high value horticultural markets (without blending) where the waste being composted includes a high proportion of food waste. This affects the salinity of the compost, which in turn, makes it unsuitable for young plants. On the other hand, higher food waste content generally implies a better nutrient content. Farmers may prefer 'fresher' as opposed to more mature compost, but equally, farmers will not tolerate poorly sanitised products, or impurities (plastics, glass, stones) in the compost.

The Department for Communities and Local Government[375] lay out all of the National Indicator's for waste. They define composting as;

> *'Composting' means, the controlled biological decomposition and stabilisation of organic substrates, under conditions that are permanently aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat.*
>
> *It results in a final product that has been sanitised and stabilised, is high in humic substances and can be used as a soil improver, as an ingredient in growing media, or blended to produce a top soil that will meet British Standard BS 3882.*

Composting (particularly IVC) is a process which uses energy, but generates no energy in return. The role of soils in sequestering carbon, however, is being increasingly widely recognised,[376] whilst (depending upon end use markets) compost can also substitute for one or more of peat, fertiliser, lime, irrigation water or pesticides.[377] Consequently, there are likely to be many benefits to compost use which are as yet relatively poorly understood.

8.2.2.2.2. Anaerobic Digestion

There are currently only four AD sites treating food waste in the UK. However, this is likely to change in the future as there are a number of developers and technology providers keen to introduce the technology in the UK market, particularly following Government views regarding the eligibility of AD for 2 Renewables Obligation Certificates (ROCs) per MWh of power generated.

8.2.3. Legislation and Policy

Within the last 10 years, the UK market has seen a whole raft of policy and legislative measures introduced which influence the quantity of food being recycled in the UK. In some cases, some of the legislation has impeded food waste recycling.

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[375] http://www.communities.gov.uk/localgovernment/performanceframeworkpartnerships/nationalindicators/ consulted April 2008

[376] Carbon sequestration by soils is gaining in recognition although significant research still needs to be undertaken to verify potential quantifications of the benefits of compost applications. See, for example, Favoino and Hogg (2008) The potential role of compost in reducing greenhouse gases, *Waste Management & Research 2008; Vol 26; 61*

[377] Eunomia (2007) Managing Biowastes from Households in the UK: Applying Life-cycle Thinking in the Framework of Cost-benefit Anaylsis, Final report for WRAP, May 2007, http://www.wrap.org.uk/downloads/Biowaste_CBA_Final_Report_May_2007.522f9261.pdf

8.2.3.1. Landfill Allowances Trading Scheme

To meet the targets set under Article 5(2) of the EU Landfill Directive, the Landfill Allowance Schemes (LASs) allocate allowances to local authorities restricting the amount of biodegradable municipal waste (BMW) they can consign to landfill in any given year. In UK legislation, the Waste and Emissions Trading Act 2003 hosts the framework for the LASs.

The roll out of the scheme has not been applied homogonously across the UK and the devolved administrations. Within all countries, all waste disposal authorities have been allocated a quota of allowances for landfilling BMW in any given year, this quota reducing over time in line with the EU targets. In England and Scotland, these allowances are tradable, and the system allows for banking of allowances and some borrowing from future years to increase flexibility in the system. However, these flexibilities are reduced in and around target years (2010, 2013 and 2020).

From 2008, the Scottish scheme allows trading of allowances whilst the Welsh and Northern Irish schemes do not allow trading of allowances. Throughout all schemes sanctions are applied to authorities who fail to comply with their obligations. In England, Scotland and Northern Ireland, a penalty of £150 applies to each tonne of landfilled BMW which is not covered by allowances held by the authority, whilst in Wales the penalty is £200 per tonne BMW.

These incentives act to increase the cost of landfilling BMW under certain conditions, therefore encouraging the development of alternative means (other than landfill) of managing BMW. The policy has the secondary effect of establishing a planned approach to waste management of biowastes with clear strategies for dealing with wastes in the long term more likely. This includes both the capture (collection) and treatment of the food wastes.

At the time of writing, allowances in England are trading some distance below the level of £150. The currently low value of allowances reflects the surplus of supply over demand, attributable to the volume of banked allowances available for sale. These banked allowances are retired in the year before each target years, so the market for allowances will be forced into a new equilibrium in the first target year, 2009/10.[378] It is likely that allowance prices will rise in the years between 2009/10 and the 2012/13 target, which will function as an increasing driver for diversion of food wastes from landfill.

8.2.3.2. Landfill Tax ‘Escalator’

For each tonne of ‘active’ waste landfilled, a tax is charged. In April 2008, the Landfill Tax for ‘active’ wastes rose from £24 to £32 per tonne, and will increase annually at a rate of £8 per tonne, rising to a rate of ‘at least’ £48 by 2010/11, when the Tax will be reviewed once more.

While the effectiveness of the tax escalator in promoting alternatives to landfill, with regard to wastes for which local authorities are responsible for, has been in some part subsumed by the effects of LAS as the primary driver for change, generators of commercial and industrial wastes increasingly have a greater incentive to consider non-landfill treatments such as composting and AD.

8.2.3.3. Pre-treatment Requirements (as part of the EU Landfill Directive)

Regulation 10(1) of the EU Landfill Directive came into force in the UK on 30th October 2007. This requirement specifies that all non-hazardous wastes must be ‘pre-treated’ prior to landfill, and that this ‘pre-treatment’ must fulfil three criteria:

[378] Trade prices range from £5 to £40 / unit (tonne of BMW)

1. Be a physical, thermal, chemical or biological process - which can include sorting;
2. Change the characteristics of the waste;
3. And do so in order to:
   a) Reduce its volume; or
   b) Reduce its hazardous nature; or
   c) Facilitate its handling; or
   d) Enhance recovery.

Whilst this is already happening for MSW under the Household Waste Recycling Act 2003, and as a result of the LASs, it is a relatively new requirement for commercial and industrial wastes.

The requirement applies to each site owned by a company and each separate waste stream on that site. For example, a shop or small industrial unit that mixes all its waste as a single stream has to meet the requirements applied to that single stream, but a factory that has different waste containers with different types of waste on a site must apply the treatment criteria to each of these streams. Organisations are not, however, obligated to treat their own wastes on site, and thus can choose to 'buy' a pre-treatment service from a waste contractor, which can meet the requirements at another site.

With regard to functioning as a driver for separate collection of food wastes, this largely depends upon the services offered by the contractor. For organisations generating large volumes of biowastes from food processing, it may often be financially advantageous to ensure that these are source-separated, and that they are not landfilled.

8.2.3.4. Animal By-Products Regulation (ABPR)

Under the UK ABPR (see Section 3.5.3 for the European context), catering waste must not be fed to livestock but may continue to be disposed of to landfill, whilst raw meat and fish can be used as a raw material in an approved pet food plant, but should not be sent directly to landfill. The ABPR also lay down processing requirements for feedstock containing catering waste. These are as set out in Part II of the ABPR, reproduced below.

PART II - TREATMENT SYSTEMS AND PARAMETERS FOR CATERING WASTE

1. Unless an approval specifically permits a different system, catering waste shall be treated by one of the systems specified in the table below. The system shall ensure that the material is treated to the following parameters:

Composting

System	Composting in a closed reactor	Composting in a closed reactor	Composting in housed windrows
Maximum particle size	40cm	6cm	40cm
Minimum temperature	60°C	70°C	60°C
Minimum time spent at the minimum temperature	2 days	1 hour	8 days (during which the windrow shall be turned at least 3 times at no less than 2 days intervals)

The time temperature requirements shall be achieved as part of the composting process.

Biogas

System	Biogas in a closed reactor	Biogas in a closed reactor
Maximum particle size	5cm	6cm
Minimum temperature	57°C	70°C
Minimum time spent at the minimum temperature	5 hours	1 hour

2. The approval shall normally specify one of the methods in the table, but the Secretary of State may approve a different system if she is satisfied that it achieves the same reduction in pathogens as those methods (including any additional conditions imposed on those methods) in which case the approval shall fully describe the whole system.

Composting plants

3. If the approval for a composting plant specifies one of the methods in the table, it shall specify which one and, in addition, shall have as a condition either that -

a. measures shall be taken at source to ensure that meat was not included in the catering waste and that following treatment the material is stored for at least 18 days; or
b. following the first treatment, the material shall be treated again using one of the methods in the table and specified in the approval (not necessarily the same method as was used for the first treatment) except that, if the treatment is in a windrow, the second treatment need not be in a housed windrow.

Biogas plants

4. The approval for a biogas plant shall specify one of the methods in the table and in addition require that either -

a. measures were taken at source to ensure that meat was not included in the catering waste; or
b. following treatment the material is stored for an average of 18 days after treatment (storage need not be in an enclosed system).

8.2.3.5. Waste Management Licensing Regulations

The Waste Management Licensing Regulations (WMLR) provide for exemptions for the spreading to land of source-separated biowastes.[379] In addition to agricultural land, the WMLR state that such materials may be spread under an exemption to any of the following land types;

- Forest;
- Woodland;
- Park;
- Gardens;
- Verges;
- Landscaped areas;

[379] Waste Management Licensing Regulations (England and Wales) (Amendment and Related Provisions) (No 3) 2005 Regulations

- Sports grounds;
- Recreation grounds;
- Churchyards; and
- Cemeteries.

A possible (though usually, minor) barrier to gaining exemption from the WMLR is the requirement to prove to the Environment Agency (EA) that the activity will result in "ecological improvement". Guidance on this criterion is vague, with decisions down to the discretion of the local EA Officer. Under an exemption, however, it should be noted that there are a number of usage conditions including:

- Maximum spreading depth of 2 metres; and
- A limit of 20,000 cubic metres of waste per hectare.

8.2.3.6. Standards for Compost and Digestate Quality

Included within Defra's 2007 Waste Strategy was an action for the Environment Agency (EA) and WRAP to develop a standard and protocol for digestate produced at AD facilities.[380] Previously, digestate produced from anaerobic digestion plants has been seen as a waste and a barrier for its entry in to the market. The protocol allows producers to create compost which is no longer classified as a waste, making it a more marketable product, as it can be spread to land without the need to register for an exemption from licensing (see above).

The Waste Protocols Project has the objective of developing an AD quality protocol and a new PAS 110 standard, with the aim to open up the market and further confidence in the product. The quality protocol is currently under consultation with industry, whilst the PAS 110 standard is due to be consulted upon in autumn 2008.

A similar system already exists for compost in the UK. The quality protocol sets out a standard which, if met, implies use of compost is not required to obtain an exemption from WMLR.

8.2.3.7. Renewables Obligation Order

The Renewables Obligation Order, which came into force in 2002, is the Government's main policy measure for supporting the development of renewable electricity in England and Wales. Generators of eligible sources of renewable energy receive Renewables Obligation Certificates (ROCs) for each MWh of electricity generated. These certificates can then be sold to electricity suppliers who, under the Order, have to fulfil obligations to supply a specified proportion of their electricity from renewable resources in any given year. This obligation started at 3% in 2003, and will rise gradually to 10.4% by 2010, and 20% by 2020.

The cost to consumers is limited by a 'buyout' ceiling (presently £34.30/MWh). The buyout price is the fixed penalty that energy suppliers pay for each MWh that it falls short of its obligation. The suppliers pay this money into an account administered by Ofgem (the Buy-out Fund) and each year the accumulated Fund is shared among those suppliers who have presented RO Certificates (ROCs). The combination of the buy-out price and the extent to which suppliers have fallen short of their obligations determines the nominal value of a ROC and the total support available for each MWh of renewable electricity under the

[380] Defra (2007) *Waste Strategy for England 2007*, May 2007, available at: http://www.defra.gov.uk/environment/waste/strategy/index.htm

RO. There are also ROs in Scottish and Northern Ireland; all three Obligations are closely linked, creating a larger market for ROCs[381].

The value of a ROC will remain above the buyout value so long as there is a shortage in the supply of eligible power relative to the target to be achieved. This shortfall was about 24% in 2005/6, leading to a return for suppliers for each ROC submitted of £10.40/MWh. The value of ROCs to suppliers was £42.56 in 2005/6, reflecting the previous year's shortfall. There has been a shortage of supply of ROCs since the RO's inception in 2002. The value of ROCs to suppliers was previously £45.05 in 2004/5, £53.43 in 2003/4 and £45.94 in 2002/3. This does not, however, guarantee future revenues and in the event of over-supply, ROCs might even trade below buyout levels. It might be argued however that the RO was designed to rely on the buyout mechanism as the mechanism allows generators to receive higher values than paid by consumers whilst allowing the setting of ambitious targets.

Of some significance for AD is the Government's proposal (in a May 2007 consultation) for banding of technologies for the purposes of ROCs.[382] In January 2008, BERR announced its intention to go ahead with the proposed banding, though with some amendments from the situation in the consultation paper.[383] The situation regarding banding is shown in Table 70. Under the banding, AD is classed as an 'emerging' technology, and as a result, will attract 2 ROCs for every MWh of electrical energy delivered. Clearly this incentive provides AD with a significant financial boost assuming the buy-out price remains at current levels.

Table 70: Banding of Technologies in Terms of Eligibility for ROCs

Band	**Technologies**	**Level of support ROCs/MWh**
Established 1	Landfill gas	0.25
Established 2	Sewage gas, co-firing on non-energy crop (regular) biomass	0.5
Reference	Onshore wind; hydro-electric; co-firing of energy crops; EfW with combined heat and power; geopressure; other not specified	1.0
Post-Demonstration	Offshore wind; dedicated regular biomass	1.5
Emerging	Wave; tidal stream; fuels created using an advanced conversion technologies (anaerobic digestion; gasification and pyrolysis); dedicated biomass burning energy crops (with or without CHP); dedicated regular biomass with CHP; solar photovoltaic; geothermal, tidal Impoundment (e.g. tidal lagoons and tidal barrages (<1GW)); Microgeneration	2.0

381 http://www.berr.gov.uk/files/file39569.pdf consulted April 2008

382 See DTI (2007) *Reform of the Renewables Obligation*, May 2007.

383 BERR (2008) *Renewables Obligation Consultation: Government Response*, BERR, January 2008.

8.2.3.8. Climate Change Levy

In operation since 2001, the Climate Change Levy (CCL) is effectively a Government charge on fuel or power usage aimed at promoting energy efficiency. It is applied by suppliers to non-domestic consumers of 'non-exempt' electricity at a rate of £4.30/MWh, whilst for coal usage, these charges were set in 2001 at £11.70 / tonne (equivalent to around 0.15p/kWh).

To achieve an 80% reduction on these charges, under 'umbrella' Climate Change Agreement (CCAs), industries can agree to reach certain efficiency standards with DEFRA. One such CCA is in operation for the food and drink industry, negotiated by the Food and Drink Federation.[384] The efficiency standards within this agreement are determined by the fossil-energy 'intensity' of production processes, which would be reduced by provision of energy from renewable sources, such as AD.

Renewably generated power is eligible for Levy Exemption Certificates (LECs). Generators that are accredited by Ofgem receive LECs which they can sell, via suppliers, to customers who are exposed to the CCL. The value to the generator is therefore a negotiated percentage of the £4.30/MWh that the customer will save through purchasing renewable output. It has been reported that typically, 80% of this value is built into a long term power purchase agreement.

Thus far, however, the CCL has not driven widespread development of AD facilities within the sector, but it remains an instrument which contributes to a wider set of incentives, such as the RO.

8.2.3.9. Local Authority Recycling and Composting Targets

The different administrations of the UK have different recycling targets. They also apply to different streams (household or municipal). In every administration, recycling targets have been raised over time. It is our view that this trend should be expected to continue, though with the rate of increase slowing down over time.

The national targets are as follows:

- England:
  - The targets in Waste Strategy for England 2007 are:[385]
    - 40% recycling and composting of household waste by 2010;
    - 45% recycling and composting of household waste by 2015; and
    - 50% recycling and composting of household waste by 2020.
- Wales:
  - The previous waste strategy, Wise About Waste, set the following non-statutory targets for municipal waste:[386]

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[384] Umbrella Climate Change Agreement for the Food And Drink Sector, 30th March 2001. Available at: http://www.defra.gov.uk/environment/climatechange/uk/business/ccl/pdf/202fdf.pdf

[385] Defra (2007) *Waste Strategy for England 2007*, May 2007, available at http://www.defra.gov.uk/environment/waste/strategy/index.htm

- by 2003/04 achieve at least 15% recycling/composting of municipal waste with a minimum of 5% composting (with only compost derived from source segregated materials counting) and 5% recycling;
- by 2006/07 achieve at least 25% recycling/composting of municipal waste with a minimum of 10% composting (with only compost derived from source segregated materials counting) and 10% recycling;
- by 2009/10 and beyond achieve at least 40% recycling/ composting with a minimum of 15% composting (with only compost derived from source segregated materials counting) and 15% recycling.

Wise About Waste hinted at the fact that targets could be extended to 60% in the longer-term. The strategy is being revised as we speak. The Environment Minister has made clear her intention to pursue a recycling rate not of 60%, but of 70% in the longer-term;

- Scotland:
  - The Scottish Waste Strategy set the following targets:[387]
    - 25% recycling/composting target by 2006 (not statutory).
    - 30% recycling and composting by 2008.
  - The National Waste Plan, on the basis of the Waste Strategy, suggests that if the Plan is on track, the following targets will be met:[388]
    - 38% recycling and composting of household waste by 2010.
    - 55% recycling and composting of household waste by 2020.

  Recently, the Scottish Executive made it known to local authorities that according to its own calculations, it would not meet its Landfill Directive obligations unless recycling rates reached 40% across the country.[389]
- Northern Ireland:
  - Targets for household waste set out in the Northern Ireland Waste Management Strategy are as follows:[390]
    - 35% recycling and composting of household waste by 2010;
    - 40% recycling and composting of household waste by 2015; and
    - 45% recycling and composting of household waste by 2020.

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[386] Welsh Assembly Government (2002) *Wise About Waste: The National Waste Strategy for Wales*, available at: http://new.wales.gov.uk/about/strategy/strategypublications/strategypubs/2096132/?lang=en

[387] SEPA (1999) *The National Waste Strategy, Scotland*, Stirling: SEPA.

[388] SEPA and Scottish Executive (2003) *The National Waste Plan 2003*, Stirling: SEPA.

[389] See, for example, SEPA (2007) *North Region Board Meeting: National Waste Strategy*, 6 July 2007.

[390] DOENI (2006) *Towards Resource Management: The Northern Ireland Waste Management Strategy 2006-2020*, available at: www.doeni.gov.uk

> It should be noted that this Strategy was very much 'written under Whitehall', with limited political input from politicians in Northern Ireland.

For most countries, these targets are 'aspirational' in the sense that there are no direct sanctions applied. However, in the different countries, failure to perform well in terms of recycling may have financial implications for the authorities, either in terms of grant funding, or financial awards from central government.

8.2.3.10. WRAP Capital Grants Funding

In order to facilitate the commissioning of food waste processing plants, WRAP are willing to contribute up to 30% of the capital to the cost of ABPR approved plants in order to develop more food treatment infrastructure. The Organics Capital Programme VI invites applicants for projects in England and Northern Ireland with the deadline for the current round of funding in late June 2008. Separate schemes are in operation in Scotland and Wales.

Capital funding support from WRAP is undertaken via a competitive process, and where a project proposal meets specific criteria and objectives, a financial award is offered (subject to contract) towards the cost of plant, equipment, land and infrastructure relating to the project costs (though subject to the details of agreements with the European Commission in respect of State Aid). Uniquely, the Organics Capital Programme is not solely focused on food waste from households. The programme has prioritised plants that can treat source separated food waste from household, commercial and industrial sectors.

8.2.4. Market Failures in the Market for Food Waste Recycling

Throughout the study, many of the key actors in the market have been contacted so as to ascertain their views and opinions on the current market. As shown in Figure 37, there are a wide range of actors involved in the market for the recycling of food waste. It is important to clarify that barriers and impediments in the market are not just found at the reprocessing stage, but throughout the whole market, from production, to collection and finally to reprocessing and application.

The food waste market has similarities apparent in the household, commercial and industrial sectors. These occur at during the collection (most likely between household and commercial) and the processing of the waste (all sectors).

8.2.4.1. Household Sector

The key obstacles to the development of food waste recycling from households have been:

1. The nature of the choice of collection authorities regarding biowastes;
2. The effect of the ABPR on the pace of development of food waste treatment facilities; and
3. The low cost (until very recently) of alternatives ways of dealing with food waste.

Some of the associated market failure issues are discussed below.

8.2.4.1.1. Information failures

In the household sector, there are some information failures regarding the costs of collection and reprocessing (gate fee) of food wastes. WRAP is working with Local Authorities to try and understand costs and give a more informed representation of these issues. However, at present, the perception is that costs are high. This perception is reinforced, to some extent, by the separation, in much of England, of responsibilities for waste collection and waste disposal. Although the costs of collection may increase (though there are ways of ensuring this is constrained), the benefits of food waste collection, both in environmental terms, and in terms of avoided marginal costs of disposal, are not always well appreciated.

Due to the undeveloped nature of food waste treatment systems, there are likely to be problems of asymmetric information in the context of local authority procurement. Few local authorities have experience of procuring such facilities, and where AD is concerned, only one UK authority has been responsible for the procurement of a facility. Knowledge about gate fees for such facilities is therefore limited, though again, WRAP has recently carried out an investigation of this nature.

Finally, the match of biowaste and biowaste processing technology is important. If a local authority seeks to process food waste in a facility more suitable for garden waste (or material with relatively low moisture content), then problems can arise with the process. Similarly, the opposite problem can occur. Again, this problem may be exacerbated in England where collection and disposal responsibilities are separate. It is questionable whether this is an 'information failure' or a 'technological externality'. It seems that the *cause* of the problem is the information failure.

For households, disposal cost increases (in the form of the landfill tax escalator) are likely to be ineffective as there is no system of differential charging in the UK market. This is an example of an information signal not being received by households as a result of the absence of marginal cost pricing (or anything resembling this) for the waste management service.

8.2.4.1.2. Technological Externalities

To the extent that one seeks to understand if the nature of food waste sometimes inhibits recycling, then there are probably two matters of concern. The first relates to the packaged nature of a significant minority of the food which is wasted. This effectively contaminates food waste. The second relates to the nature of bags and containment used to collect biowaste in the kitchen. Whereas households should use either paper liners of starch based biobags, some use conventional plastic bags for containment, again introducing contamination. Both of these could be addressed through education of residents.

8.2.4.1.3. Market Power

Locally, some processors of food waste may be able to determine their gate fees as landfill tax increases, and as long as the availability of treatment capacity is limited in a given area. Some food waste processors may, for some of their capacity, be able to operate as a local monopoly, with gate fees for in-vessel facilities reaching levels as high as £70 per tonne, 70% or so higher than the median price.

8.2.4.2. Commercial Sector

In the commercial sector, there is only a limited amount of food waste collection. The key issue has been, in the past, the cost of the combined collection and treatment of separately collected biowaste. However, this is beginning to change as landfill tax increases.

The key constraints in the commercial sector relate to the establishment of an integrated collection and treatment service. Many commercial waste collectors will have little or no experience with biowaste collection and treatment. The market for treating separately collected biowastes has been established, mostly, on the back of contracts to deal with household waste. Relatively few 'merchant' facilities exist.

8.2.4.2.1. Search Costs

For commercial enterprises seeking providers of a food waste collection service, and there are many, the search can be a fairly fruitless one. This is partly an issue of 'search', and partly one of arriving at the conclusion that there is an absence of provision (as there will be in many parts of the country).

Due to the nature of the sector, many businesses are too small and their waste stream too insignificant, to warrant establishing 'their own' food waste recycling process. As a consequence, it falls upon the waste management companies to offer the service. Whether they do so or not depends upon:

- Their access to ABPR-compliant processing technology; and
- The degree to which they feel able to offer a service for food waste collection and treatment which is competitive in the market place.

The former issue is not aided by the high transaction costs incurred in the planning process.

The latter issue is one which is affected by the former, and which is also affected by the lack of certainty that a new service configuration will be taken up by what may be price sensitive consumers.

Within the commercial sector, there is an unwillingness to pay additional costs for waste services. Currently, many businesses within the sector pay for a 'black-bag' collection service only, which is usually charged 'by pick-up' or 'per container', rather than by weight as is more common for larger generators of such wastes. To be cost-competitive, new food waste collection services for smaller businesses must therefore:

- Be introduced as part of a wider service which encompasses collection of 'residual' wastes; and
- Reward customers for reducing the 'residual' stream by charging for residual waste according to the amount actually generated, thus encouraging segregation of food and other recyclable wastes.

Our contact with waste collection companies indicates an awareness of these issues, although the service is only offered in exceptional circumstances. The issue is explored further at 8.2.4.2.4 below.

8.2.4.2.2. Information Failures

One of the information failures which affects the degree to which commercial waste generators seek alternatives to landfill is the way in which companies charge for waste collection services. The landfill tax is charged on waste when it crosses the boundary of the landfill, though some exemptions apply. It is charged by the landfill operator.

The tax is generally passed back to consumers, as far as possible, by those handling the waste (waste management companies). However, the pattern of charging for waste still takes the form, in many cases, of a 'per lift', or 'per container' charge. There is, therefore, little incentive for many operators to reduce, at the margin, the amount of waste they generate, or reduce the amount the landfill, or to segregate wastes as landfill tax increases.

The costs of food waste collection are clearly affected by the ABPR in the UK, which is the measure used to implement Regulation (EC) 1774/2002. It might be argued that the Regulation is overly precautionary where many materials are concerned. Food waste is still landfilled in the UK, and the potential for material to enter the livestock food chain through transfer by vermin or other vectors is arguably much larger where landfill is concerned than where composting and AD are concerned. Elsewhere, we have assessed the UK Risk Assessment in this regard, and have suggested it is extremely precautionary in nature.

8.2.4.2.3. Technological Externalities

In some instances, certain business sectors may not provide food waste in the most desired format. Food waste arising from the retail sector may still be contained within plastic packaging which must be removed before the waste can be processed. This can occur in the industrial sector as well. This is an impediment to recycling as it can be costly for reprocessors to remove packaging either manually or mechanically. Food waste presented to reprocessors in this way is usually accepted at a higher gate fee than materials which are not, suggesting that the market internalises this effect to some degree.

8.2.4.2.4. Network Externalities

There appear to be a range of pre-conditions which need to be met if commercial food waste collections are to be developed in future. Some of these fall under the heading of network externalities, since the effects of the absence of one or other element of the network has consequences for the supply of the service, as well as its cost.

As regards to collection, some waste producers would like to know who will collect their food waste separately. Collectors, on the other hand would like to have some feel for the level of take up of a service so that they can price the service sensibly. The more companies who take up the offer, the lower the costs can fall (as the logistics will be improved). In collection, there are efficiencies to be gained from the existence of high densities of collection points. In the UK, commercial waste collectors compete for customers on a day by day basis. This has the effect of reducing the density of collection points for any one collector, so increasing the cost of all services, and in particular the cost of new collection services for which the uptake is uncertain.

All of this assumes a facility will be available to treat the food waste. Food waste processing capacity for commercial food waste is likely to be developed either through merchant plants, or through additional capacity being specified in municipal waste contracts. Merchant capacity relies, to some extent, upon a guaranteed flow of material into the plant, at least for a period of some years. However, most food waste producers are not used to concluding contracts for waste services for more than a year, or exceptionally, three years.

In consultation, one of the UK's largest grocers commented that in the past and possibly still currently, authorities have procured treatment sites for food waste based solely on their needs and not those of other sectors. They argued that this has the effect of locking out both the industrial and commercial sectors from food waste recycling in that locality as the availability of capacity is limited. This does suggest, however, a lack of appreciation on the part of waste generators of the position which is faced by developers of facilities.

The above highlights that there are some drawbacks to the level of competition in the commercial waste sector, and to its price responsiveness. This might have been an attractive feature of the market when the principle approach was based upon collecting material for transfer to landfill. It looks less attractive in a situation where capital needs to be invested at a developer's risk in order to unlock the existing log-jam. This could be unlocked through regulation requiring the segregation of food wastes.

8.2.4.3. Industrial Sector

Within the Industrial sector, the key issues affecting the recycling of food wastes relate to the nature of outlets for food waste, and (arguably) the definition of what constitutes recycling.

8.2.4.3.1. Search Costs

Looking forward, as landfill tax increases, then those industries generating food waste who are currently consigning material to landfill would be expected to seek alternative ways of treating the waste to avoid the costs of landfilling. The issue for the waste generator, or the waste collector, is likely to be one of identifying an appropriate provider of treatment capacity.

In essence, the problem for developers of treatment capacity is the opposite one. If a developer could identify producers of waste, and could secure the supply of waste into his / her plant for several years, this would, most likely, unlock investments in treatment capacity. Currently, therefore, the constraint on treatment of food wastes lies around marrying up suitable waste producers with would-be developers, and ensuring producers are prepared to guarantee the supply of their material for a period of several years.

8.2.4.3.2. Information Failures

As discussed in Section 8.2.2.2, the ABPR regulations can have a large bearing on treatment routes and ultimately treatment costs. Interpretation and understanding of these regulations by industry is critical for successful and cost effective waste management. We have found that some industrial producers that generate one or more of Category 1, 2 and 3 waste types have been found to mix the waste streams and send the whole waste stream to renderers, and then on to thermal treatment. This practice implies higher costs, and reduced potential for recycling, since Category 1 and 2 processing requirements effectively rule out recycling technologies.

8.2.4.3.3. Contractual Issue

Contractual issues occur where industrial waste producers only conclude contracts for a few years unless they process the waste on-site themselves.

8.2.4.3.4. Technological Externalities

Similarly to Section 8.2.4.2.3, food waste arising from the industrial sector may not be provided in the desired format. Post production food waste may be contained within plastic packaging which is an impediment to recycling as it can be costly for reprocessors to remove packaging either manually or mechanically. Food waste presented to reprocessors in this way is usually accepted at a higher gate fee than materials which are not, suggesting that the market internalises this effect to some degree. Some new processes are emerging (e.g. Inertec) where the packaged food waste is converted to a dry powder which is to be gasified. This process is in construction at present.

8.2.4.3.5. Market Power

The relative absence of processing plant for food waste means that in some areas, facility operators are in a relatively strong position. As landfill tax increases, the economics for development of new processing plants is likely to become more favourable. This is likely to result in an increased number of developments, thus increasing competition in the market and reducing the power of current facility operators.

At this moment in time, however, as mentioned in 8.2.4.1.3, some treatment providers are likely to be able to demand high gate fees due to lack of capacity in treating food wastes.

8.2.4.4. Collectors

For collectors, the key issues relate to the securing of customers for their service. In most cases, where household waste is concerned, the mechanism for achieving this is competing for local authority contracts. Household services tend to have high density but low pick-up rates. Outside of this area, the market is much more open, and collectors compete in a relatively free market. They are not obliged to offer collections of food waste so competition occurs on an open playing field, with price being an important variable. Consequently, services to commercial premises have lower densities than those of households, but with the advantage of higher quantities of material per pickup. In the industrial sector, densities of collection are not so important as arisings are likely to be large enough to justify dedicated journeys to serve individual companies.

As well as securing customers, the collector needs to secure an outlet for the material. This outlet needs to be competitive in terms of price, and appropriate for the nature of the material being collected.

Finally, securing customers is one thing. Ensuring that the waste delivered by customers is in the desired form is another. It will be important for collectors to ensure, for the purposes of subsequent treatment, that there is minimal contamination of the material. Failure to ensure this is likely to lead to higher gate fees, or worse still, rejection of the most heavily contaminated loads.

8.2.4.5. Reprocessors

For reprocessors, the key issues relate to the securing of supply of material into their plant. In most cases, where household waste is concerned, the mechanism for achieving this is competing for local authority contracts. Outside of this area, the market is much more open. Securing supplies of material are less straightforward. This is especially because of the fact that waste producers are not used to concluding long term contracts either with collectors or treatment companies.

8.2.4.5.1. Transaction Costs

WRAP have provided information that indicates that some technology providers are declined to build capacity due to a number of transaction costs incurred when first building a new plant. The planning process is seen as too complex for some newcomers, who have not had the experience of building facilities. As a consequence, experience is sought from outside the organisation, thus incurring cost. There are also issues around local authority procurement rules which again can incur a transaction cost to some providers.

8.2.4.5.2. Consumption Externalities

One other potential failure relates to the lack of emphasis given to the quality of the product produced from biowaste treatment. The food waste processing market in the UK is still motivated by a logic of 'not landfilling' as opposed to seeking to manufacture a quality product for use by different end-users. This probably results in lower end-product prices being obtained than might otherwise be achieved. This reflects, in part, the costs of the marketing effort which would be required to sell such products to potential end-users. In a fledgling market, in the absence of a guarantee of benefits, producers of compost are probably reluctant to invest effort in improving product quality, and marketing the product generated.

8.2.4.5.3. Information Failures

Currently one barrier to the AD market is the lack of market for the digestate produced. Digestate is seen by many land owners as an inferior product and is currently competing with other (sometimes free) materials. As discussed in Section 8.2.2.2, the adoption of a protocol and quality assurance standard will hope to improve this situation. With respect to the use of digestate (and in some instances compost) on land, in some parts of Scotland, a moratorium on use of compost derived from ABPR sources by farmers was in existence, though this has now been relaxed for composts derived from garden waste. There are currently (mis)perceptions that materials containing food waste are unsuitable for application to farm land. It is hoped that the development of quality protocols for compost and digestion residuals, in conjunction with end-users, can ameliorate this situation.

8.2.4.5.4. Market Power

The food waste recycling market is not dominated by a single monopoly. There is an abundant quantity of technology providers in both the IVC and AD markets. Incumbents find it very difficult to tie users in to long term contracts or loyalty programmes, and as a result, treatment capacity is under-developed.

In most situations this is seen as a hindrance for reprocessors for obtaining capital expenditure from financial institutions as no long term security is guaranteed, this despite there being a need for additional facilities across the UK.

8.2.4.5.5. Risk Aversion

Risk aversion effects all of the different types of technology providers, be that AD or IVC providers due to the young age of the market. Research has shown that reprocessors, especially in AD technologies, are faced with a whole host of impediments offered other interested partners.

The finance sector is an example of an area where one would expect a high level of risk aversion, especially in the current climate. There appears to be a lack of confidence by potential funders of AD in treating the food waste stream, most likely due to there being few operational plants in the UK. However, this is counterbalanced by the government’s willingness to offer capital (provided criteria are met) for the technology, as well as to support AD through the ROC system. Equally, since the value of ROCs is determined in the market place, finance institutions tend to be risk averse in respect of building this into project finance models (leading many to argue in favour of fixed feed-in tariffs for electricity from renewables).

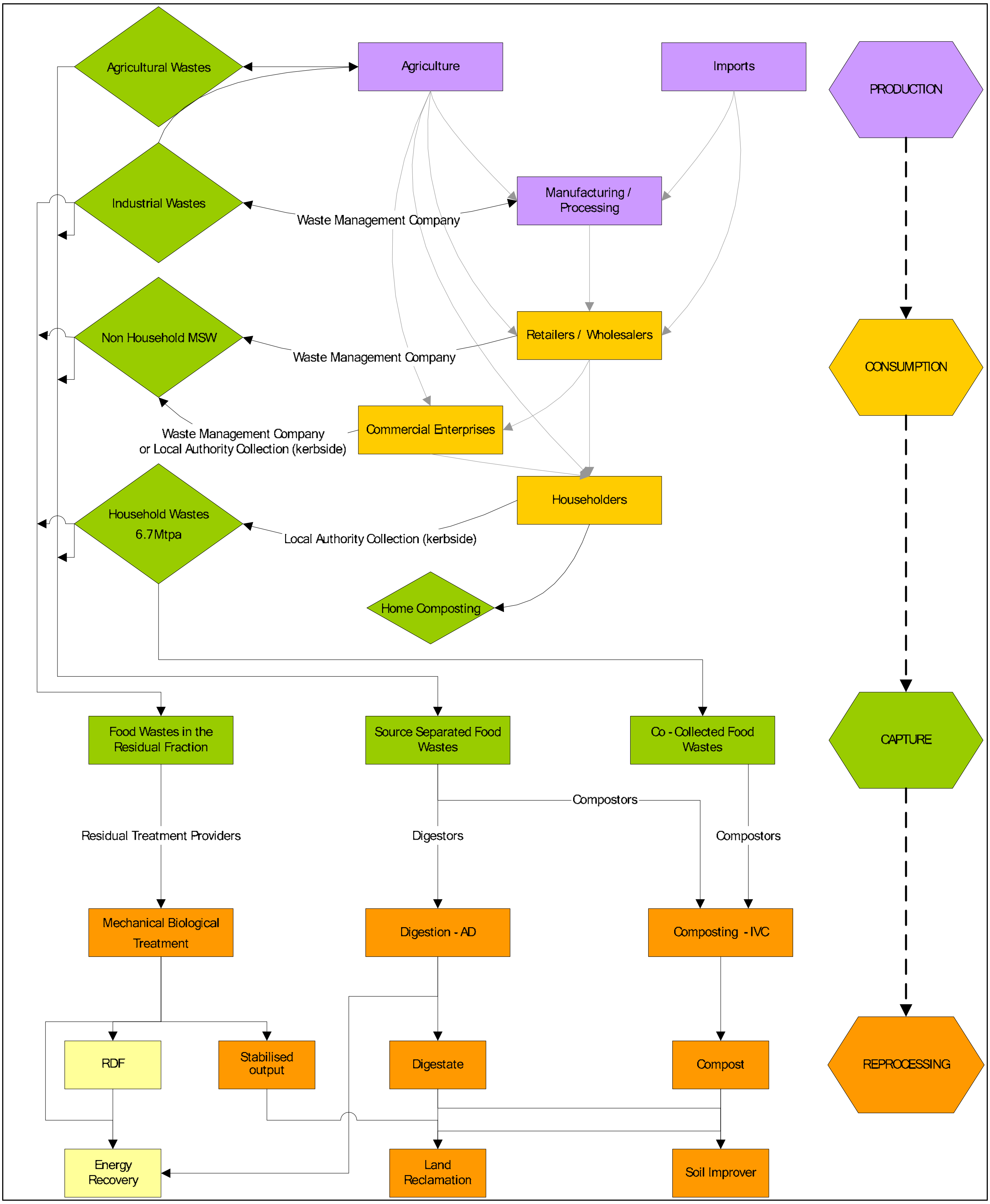


Figure 37: Food market overview

8.3. PVC RECYCLING MARKET IN THE UK

8.3.1. Production and Consumption

PVC is a relatively widely used polymer, particularly in the construction sector and makes up 16% of the total plastics used in the UK.[391]

Estimates show that PVC consumption in the UK in 2000 was around 1.07ktpa, 14% of that consumed in the whole EU and equivalent to 18kgpa per capita.[392] Data on PVC waste arisings, however, is difficult to obtain due to the longevity of the polymer, resulting in a time lag between the consumption of the material and its arisings in the waste stream (this is discussed in detail in section 8.3.7.2).

The main uses of PVC in the UK are outlined in Table 71. There is very little data on PVC consumption in terms of consumer items and healthcare equipment. PVC is commonly used in medical devices, although it is being phased out or restricted (i.e. for infants) in some countries.

The largest sector in terms of PVC consumption is in construction. PVC is extremely durable and resistant to water and so is often used in piping, guttering and profiles. Flexible PVC is widely used in flooring and as vinyl wallpaper. Due to its flexible nature and insulating properties it is also used in coverings for electrical cable. The main uses of PVC in relation to other polymers in the construction sector are shown in Figure 38.

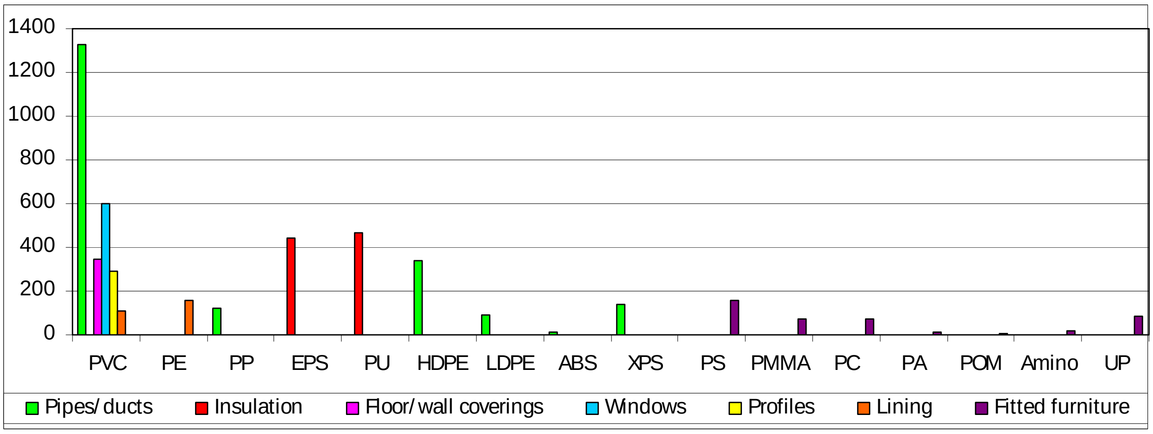
Table 71: PVC Uses

Stream	Product Examples
Packaging	Bottles, food trays, food wrapping, blister packs
Consumer Items	Vinyl records, toys, credit cards, shower curtains, plastic coated fabrics (bags, raincoats etc)
Healthcare	Blood transfusion sets, artificial skin for burns treatment, heart and bypass sets, surgical gloves, overshoes, bedding covers
Construction	Pipes, door and window profiles, flooring, vinyl wallpaper, tarpaulin

[391] *Ibid*

[392] Commission of the European Communities (2000) *Environmental Issues of PVC* (Green Paper) http://ec.europa.eu/environment/waste/pvc/en.pdf

Figure 38: Plastics Consumption in the C&D sector in Western Europe in 1995 ('000s per year)



Source: Adapted from: Assessing the Potential of Plastics Recycling in the C&D Activities. APPRICOD

8.3.2. Current Levels of UK PVC Collection and Recycling

There are around 45,000 tpa of *post-industrial* (i.e. wastes resulting from manufacturing products) PVC waste which are collected and recycled each year. By contrast, 100-200,000 tonnes of collectable *post-consumer* PVC waste are produced in the UK each year, but currently very little of this is collected for recycling.[393]

The main sources of PVC consumption, with the amounts of recyclable arisings and figures for tonnages actually recycled are summarised in Table 72. The major sources of recyclable PVC are discussed in detail in the following sections.

Table 72: PVC use, Arisings of Recyclable Waste and Quantity Recycled

Material Type	Product	Quantity Used Tonnes/year		Quantity of Recyclable Arisings Tonnes/Year	Quantity Recycled Tonnes/year
Rigid PVC	Windows	250,000	Post-Industrial	30,000	30,000
			Post-Consumer	6,000[394]	
Rigid PVC	Pipes	170,000	Post-Industrial		8,000
			Post-Consumer	8-12,000	
Flexible PVC	Flooring	220,000	Post-Industrial		7,000

[393] P. D. Coates, A.L Kelly, R.M. Rose, S. Weston & R. Morton (2004) *Materials and Products from UK-Sourced PVC-rich Waste.* Final Report for WRAP, May 2004 www.wrap.org.uk/downloads/MatProdPVCRichWaste.7ab903f6.pdf

[394] Estimated to increase to 89,000 within 10 years

			Post-Consumer	65,000	
PVC coated Textiles[395]	Tarpaulins, Awnings, Inflatable Castles	25,000 (of which 17,000 imported)	Post-Industrial	Very little	See left
			Post-Consumer	2,500	None
Flexible PVC	Wallpaper	100,000	Post-Industrial	15,000	1,500[396]
			Post-Consumer	None[397]	None
PVC Packaging	Bottles, blister packs, food tubs, trays	83,000	Post-Industrial	Not known	Not known
			Post-Consumer		8,000[398]
Flexible PVC	Cables	67,000	Post-Consumer	6,500	Mainly exported to China
Various	End of Life Vehicles	15,000	Post-Industrial	Unknown	Unknown
			Post-Consumer	5-10,000	Mainly landfilled

Source: Materials and Products from UK Sourced PVC-rich Waste. WRAP

Although recycling levels in some cases are relatively low, incentives have been introduced to reverse this. Apart from the legislation and agreements as discussed in Section 8.3.7.6 there are organisations such as Recovinyl, EPFloor and EPRoof – see Section 3.3.

8.3.2.1. *Construction and Demolition Wastes*

8.3.2.1.1. Arisings

The majority of PVC arisings are within the construction and demolition sector – either as post-industrial wastes (created during the manufacturing of the product, as off-cuts during fittings etc) or post-consumer waste (usually resulting from demolition, refurnishing etc.). The former is usually a relatively clean material and easily collected in a segregated form, whereas the latter is more difficult to collect and may be contaminated with other materials or colours.

The main streams of waste which are currently recycled are profiles, pipes and cables. Various organisations collect rigid PVC from profiles and piping, both post-industrial and post-consumer. Due to its longevity and the relatively short time that for which it has been widely used, PVC arisings are likely to increase in the next few years as the stock of materials is increasing, and a growing proportion of this stock comes to the end of its useful life. This is highlighted in Table 72 which shows current arisings of

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395 PVC coated fabrics have a short life, but are very difficult to recycle due to the mixture of materials

396 100% liquid waste is recycled in-house. The trimmings are sent to landfill

397 Post consumer waste is hard to recover and there are no separate collections in the UK

398 The amount of PVC in the mixed plastic which is exported to China/India

PVC window frame waste at around 6,000tpa, with this set to increase to around 89,000tpa in the next 10 years[399].

Piping, however, is often a difficult stream to capture due to the fact that during demolition or refurbishment, old sub-surface pipes are often left in place rather than extracted for disposal or recycling.

The recycling of PVC cable insulation is an interesting sector as a different market driver exists. Cables are primarily collected for valuable metals such as copper and the PVC is a secondary recyclate. Previously, much of the cable waste was recycled within the UK, but this is changing due to the low export costs to countries such as China.

Vinyl wallpaper is made up of around 50% PVC and 50% paper; although very little post-consumer waste is recycled. Much of the post-industrial waste, however, is recycled internally, where the colours are source segregated where possible, or mixed to produce a dark base.

8.3.2.1.2. Collection Routes

Supplier Take-Back schemes or Reverse Logistics are becoming increasingly popular in the UK. This involves the manufacturer of the product (who is often involved in the delivery), collecting waste on-site, which can then be taken back to the manufacturing site for recycling. This is often extremely efficient as the delivery vehicle can collect this waste on its return trip and the materials collected are often of a high quality (such as off-cuts).

PVC waste from home improvements and DIY tends to be taken to CA sites and is usually landfilled, although there have been trials in London to assess the potential of installing skips at CA sites to target vinyl flooring specifically.

At present, there are very few separate collections of pipes and guttering as these arisings tend not to be as high as the window/door profile stream. Much of the waste pipe material is left in the ground and guttering tends to be coloured and so is often not collected with white PVC.

8.3.2.2. Packaging

8.3.2.2.1. Arisings

Although several companies are phasing out the use of PVC packaging, the use of plastics in the packaging industry is increasing by more than 2% per year. This is linked to the cost of disposal, as plastics are lightweight and so cheaper to dispose of when compared to other materials.[400]

There are currently 13,000tpa of PVC bottles consumed, although this is only around 5% of the total plastics waste composition in the MSW stream.[401] Many companies were previously using PVC for large,

[399] P. D. Coates, A.L Kelly, R.M. Rose, S. Weston & R. Morton (2004) *Materials and Products from UK-Sourced PVC-rich Waste.* Final Report for WRAP, May 2004 www.wrap.org.uk/downloads/MatProdPVCRichWaste.7ab903f6.pdf

[400] It is worth pointing out in this regard that the UK's system for implementing the Packaging Directive does not visit the costs of collection and treatment of packaging directly on producers. The incentive to recycle plastics is also limited by the relatively low targets set in the Directive and transposed into UK legislation.

[401] RECOUP

handled, bottles, but this has started to change recently. Many manufacturers are switching to bottles with 'grips' rather than handles which can be made from polymers which are more easily recycled.

It is difficult to get accurate figures on PVC packaging arisings as so little of it is collected at present. It has to be assumed that most is sent for disposal, either to landfill, or other residual waste treatments such as incineration or mechanical biological treatment (MBT).

8.3.2.2.2. Collection Routes

As Local Authorities continue to decrease tonnages landfilled, plastics recycling has become more of a focus. PVC was previously not a widely collected polymer, although an organisation called "Reprise" began recycling household bottles collected by Local Authorities in 1993. They found that the separation of plastics (PVC, PET and HDPE) and their subsequent reprocessing was extremely successful, although the PVC stream was discontinued due to the decline in the use of PVC in bottles (PET is cheaper and provides a better gas barrier to carbonated drinks).[402]

Several Local Authorities collect PVC both through bring banks and at the kerbside. 80 Authorities collect plastic bottles of all types, 51 collect food tubs and trays and 17 collect packaging films.[403] Local Authorities often specify the collection of "bottles" or "trays" which can include PVC, although this is often not actually separated during the recycling stage and is treated as a contaminant. Due to the low proportion of PVC packaging and the ease of communication (stating "bottles" rather than bottles of specific polymer types) PVC is collected alongside the polymers targeted for recycling; this is then usually landfilled.

There is also some collection of "Back of Shop" PVC packaging, particularly of trays which hold food items such as yoghurt pots, and PRN credits can be obtained from this (see Section 8.4.5). In recent years, however, much of this material has been shipped to China or India, although this is likely to become less viable in the future due to China's economic development. Some mixed packaging waste is currently collected at the back of shops and reprocessed into plastic pallets or livestock partitions, although as with bottles in local authority collections, PVC is often seen more as a contaminant that a recyclate in this system.

8.3.2.3. End of Life Vehicles

The focus in terms of recyclable materials is usually on the metals which make up a larger, heavier fraction of the vehicle. The remaining materials are put through a shredding process, of which around 20% is plastics. PVC makes up around 5-10% of this, or around 5-10,000tpa.[404] Virtually none of this is currently recycled and some automotive companies (including General Motors, Toyota and Honda) are phasing out the use of PVC in response to various pressure campaigns.

8.3.2.4. Healthcare

Although PVC is widely used in healthcare equipment, very little is recycled. This is likely due to health and safely implications, although there is very little available information relating to this.

[402] Pers. Comm. EVC Compounds

[403] RECOUP (2007) *Annual Local Authorities Plastics Collection Survey* . Final Report for WRAP, June 2007

[404] P. D. Coates, A.L Kelly, R.M. Rose, S. Weston & R. Morton (2004) *Materials and Products from UK-Sourced PVC-rich Waste.* Final Report for WRAP, May 2004 www.wrap.org.uk/downloads/MatProdPVCRichWaste.7ab903f6.pdf

8.3.3. Recycling/Reprocessing

PVC is a relatively easy polymer to reprocess due to the fact that it is a thermoplastic and so retains its original properties once cooled down after melting. There are two main recycling techniques: mechanical and chemical.

8.3.3.1. Chemical Recycling

Chemical recycling, or feedstock recycling, involves the breakdown of composite materials with the use of chemicals so that the basic compounds can then be reused in the production of new polymers.

A Polymer Cracking technology was developed in the UK and has been utilised at BPs Grangemouth facility. This involves an input of mixed plastic waste which is then broken down and can be used as an input to make more plastics of a high grade in a closed loop system. The facility was set up as a trial, but has since been discontinued and the process has not been re-established in the UK. It was found that the technology was not economically viable as the technology used was so complex and the costs of processing so high.

Currently, the only chemical recycling of PVC takes place in other European countries (Germany and Denmark) and so the only possible use of this technology at present would be through the export of the waste to these countries.

8.3.3.2. Mechanical Recycling

Mechanical recycling of PVC is the most widely used technology in the UK and is a relatively simple process, particularly for post-industrial, rigid PVC waste. The collected material is shredded, sorted, and regranulated or melted and pelletized (post-consumer PVC will undergo more sorting and cleaning steps). For mixed plastics, sorting through hand, laser or in a flotation tank to separate densities is required and the process is longer and more complex.

Due to the fact that PVC is usually found in compound form, with added additional materials, contamination is often an issue. For low grade PVC, with a large amount of contaminants, recycling into new PVC products may be impossible. In order to avoid this, it is preferable to collect one type of PVC only (i.e. window frames alone) to be recycled back into the same product. Some PVC wastes are less easy to segregate and so other applications have been found, such as substitution for wood or concrete.

Much collected flexible PVC is ground into a powder and mixed with other plastics (or PVC) in an open loop system. This process is widely used in the production of traffic cones and speed bumps.

It is worth mentioning the Vinyloop process – see Section 5.2.3.1.

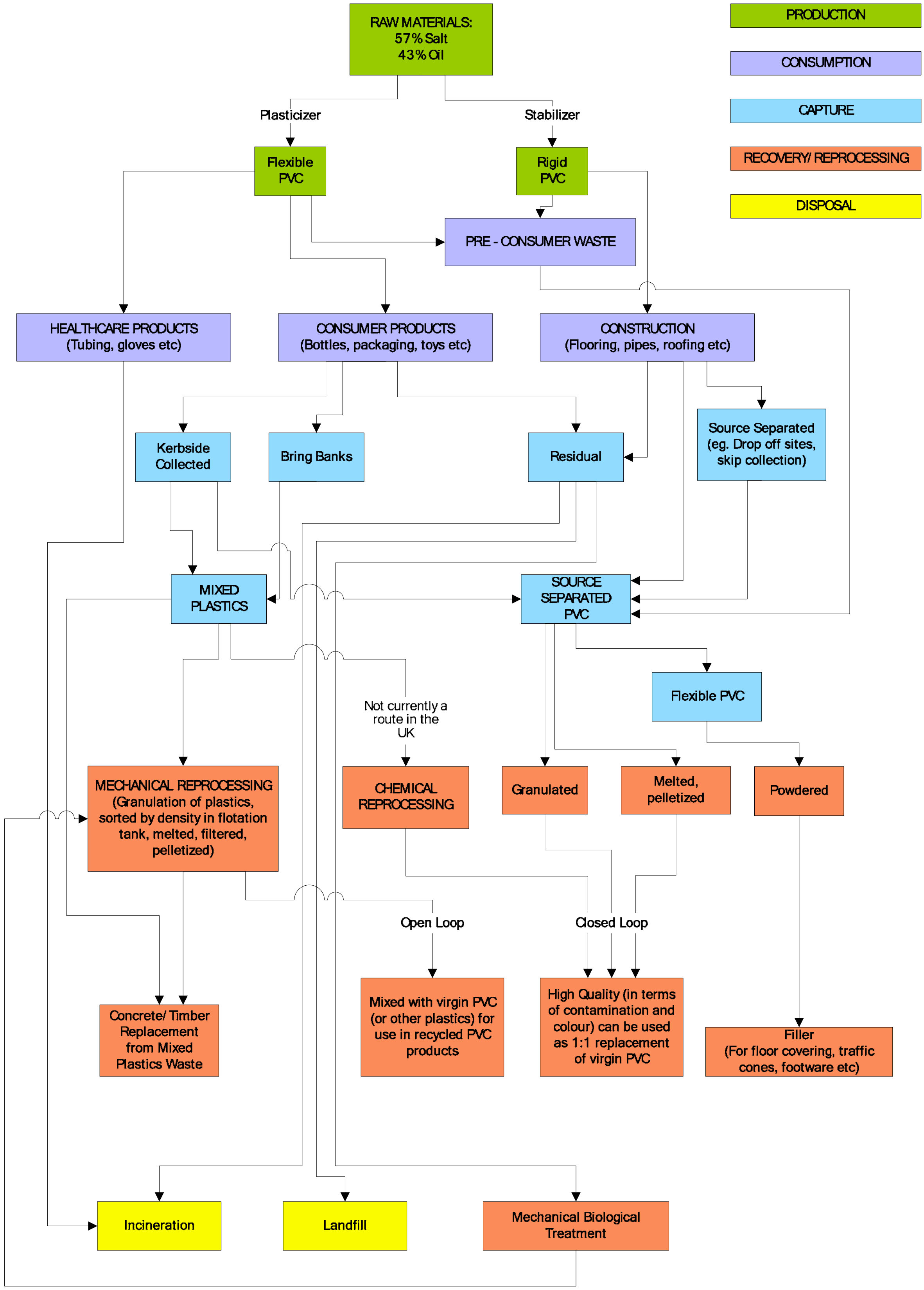
8.3.4. Disposal

In the UK, most PVC is currently landfilled after use, although disposal through incineration is widely used in other parts of Europe.

8.3.5. The Lifecycle of PVC

The entire cycle of PVC from production through to recycling or disposal is illustrated in Figure 39.

Figure 39: Illustration of the lifecycle of PVC material in the UK



8.3.6. Policy and Legislation

8.3.6.1. Regulatory

The EU regulatory context was discussed in Section 3.3. It should be noted that the UK has a somewhat lax interpretation of the Landfill Directive in regard of the requirement of pre-treatment but some collectors are seeking to capitalise on the requirements to push more businesses to recycle. This has pushed more plastics waste into the recycling stream, although due to the fact that the Landfill Tax is applied by weight, plastics are often not considered for recycling before heavier materials.

8.3.6.2. Site Waste Management Plans

In the UK, legislation in this respect came into force on 6th April 2008. These Plans are required for any construction work which will cost over £300,000 and the process involves the preparation of a report forecasting waste arisings and their subsequent management (i.e. recycled, reused, disposed). During the construction/demolition process, detailed records must be kept of waste movement to ensure that the targets in the plan are met.

8.3.6.3. Voluntary

This Vinyl 2010 commitment sets out targets for the PVC industry in order to increase sustainability in the sector – see Section 3.3.

8.3.7. Market Failures in the Market for PVC Recycling

The only recycling which takes place under "free market conditions" is that of pre-consumer waste (clean and easy to recycle, so cost effective) and post consumer cabling (although this has its own specific market conditions, as outlined in 8.3.2.1).

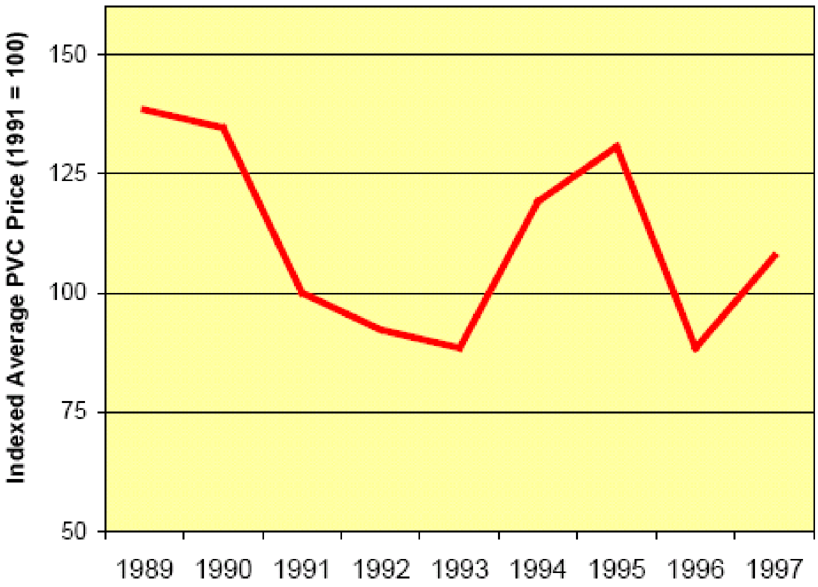
8.3.7.1. Pricing

8.3.7.1.1. Virgin PVC

The price of virgin PVC will greatly affect the market of the recycled product and so the viability of recycling. If virgin materials are cheaper than recycled alternatives, there will be a switch to obtain the cheapest. This will, in turn, affect the prices obtained from reprocessors for collected PVC materials.

The price of virgin PVC is relatively volatile due to its reliance on crude oil, as seen in Figure 40, although this is likely to be less connected with the price of oil than other polymers due to the larger salt to oil ratio.

Figure 40: Price Fluctuations of Virgin PVC



Source: Mechanical Recycling of PVC Wastes. 2000. European Commission

8.3.7.1.2. Recycled PVC

The price of recycled PVC is not transparent and is often closely related to production costs and transportation. This may lead to costs in terms of bargaining and negotiation.

One reported problem was related to buyers who were not willing to pay a price as high as that of the virgin material. A common view was that recycled material should be cheaper than its virgin counterpart. One organisation interviewed pointed out that there was little incentive for buyers to purchase recycled goods in terms of the environmental benefits associated with them, particularly if the price was comparable with that of the virgin material (as it often is, due to the high costs associated with collection and recycling).

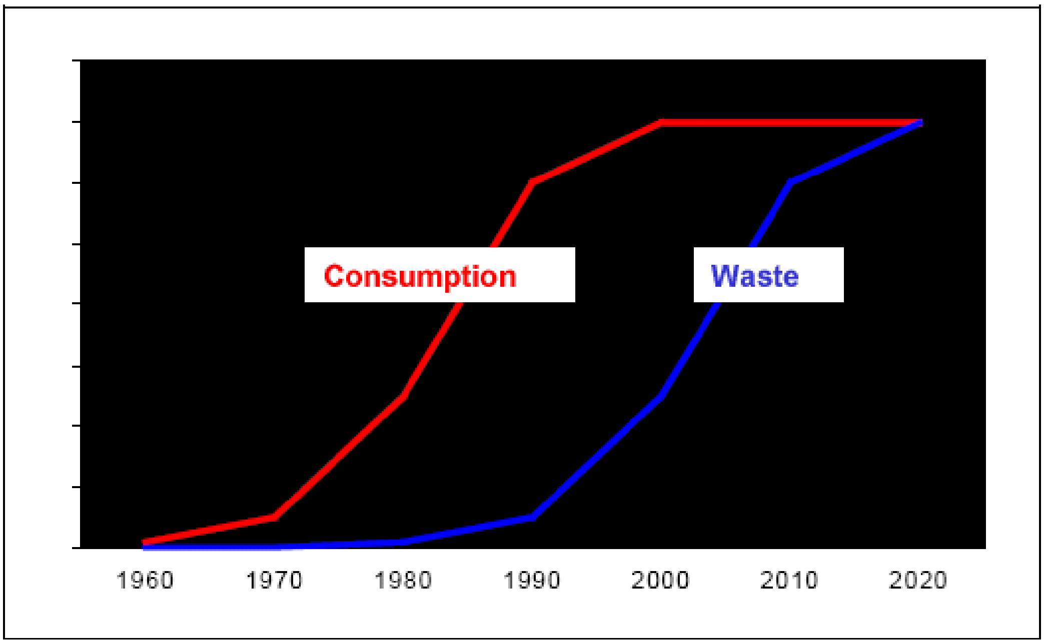
There are, however, no obvious market failures in relation to PVC pricing due to the low market concentration on the part of the buyers and sellers.

8.3.7.2. Time Lag Effects

PVC is a long-lived polymer which has only been utilised widely since the 1970's and its use in window profiles became popular in the 1980's. If we assume an average lifespan of 30 years, we would expect a large increase in PVC arisings from 2010 onwards. It is likely, therefore, that as arisings increase, the development of the post construction PVC recycling market will correspondingly increase.

Currently, arisings of PVC are too low in many cases to make separate collection of this polymer economically viable. This is likely to change as the waste stream 'catches up' with the levels of consumption. This is shown graphically in Figure 41.

Figure 41: Time Lag between PVC Consumption and Arisings (Schematic)



Source: Environmental Issues of PVC (Green Paper) 2000. Commission of the European Communities

8.3.7.3. Transaction and Search Costs

There were previously high costs associated with search and transaction, particularly in the C&D sector, as the easiest approach to dealing with C&D waste was to dispose of all the material in one skip. Metals have usually been separated as there is a source of income related to this, but the industry was less familiar with PVC recycling and there would have been little or no (known) financial incentive to separate PVC.

There are also associated costs with the effort to actually source segregate the waste on-site. This is currently changing due to new legislation such as the increasing Landfill Tax and the requirement for Site Waste Management Plans. Waste producers are now looking for ways to increase their recycling on site and also at Waste Transfer Stations. Communication with several recycling companies revealed that there is now better communication between producers and collectors and this is likely to further improve, particularly with the escalation of the Landfill Tax.

Transaction and search costs are being overcome in some cases in the profile industry with the introduction of 'reverse logistics' (explained fully in section 8.3.2.1.2). This is becoming an increasingly efficient and popular mode of recycling in terms of rigid PVC profiles.

In less developed sectors, such as with vinyl flooring, it has been found that the producers of the waste are eager to recycle it, but that the infrastructure is not there for them to do so. It is possible that as Site Waste Management Plans are implemented, this potential recycling stream will increase and collection will become more feasible. It is likely that the reverse logistics approach will be a useful tool in this sector.

8.3.7.4. Information Failures

There have been several large publicity campaigns by recycling companies in order to reduce search costs for waste producers. This is particularly applicable to recyclers of rigid PVC profiles as there tend to be a few, large companies, and so the resources are available for such campaigns. For smaller waste streams, the related search and transaction costs are greater, particularly as there tends to be a greater number of smaller companies.

One company which collects and recycles PVC, however, indicated that they did not recycle post-consumer PVC waste because there seems to be no supply of it. They concentrate on the stream of post-industrial waste which is easier to collect and recycle and they find that they have a steady supply of this. This would indicate some degree of information failure between producers and recyclers and also between different recyclers.

In terms of the well established profile recycling industry, a few large players tend to dominate. The recycling process is also relatively easy, with high quality products achievable and so, in principle, one would expect few, if any, information failures related to this sector. It would not be in the interest of large, established players to withhold information from buyers as this may undermine their position in the current market.

In terms of rigid PVC, particularly profiles, it appears that there are few misperceptions about the quality of the recycled product. Due to the fact that this industry tends to generate high quality products this is not a problem, particularly as recycled PVC is often coated with virgin material or higher quality recyclates in order to maintain a white colour. In some cases, it was found that the seller may actually withhold information about the fact that recycled materials are used, in order to avoid any misconception that the recycled products might be inferior.

Campaign groups are having a large impact on the PVC market, although it is debatable whether this may be classed as an information 'failure'. The previous use of additives such as lead, cadmium and PCB, which may still be found in PVC, means that there are associated health concerns. Pthalates, which are used in flexible PVC, also have associated health risks (although this is, arguably, not conclusively demonstrated). Pressure from campaign groups has resulted in many large organisations phasing out the use of PVC packaging[405] or discontinuing the use of flexible PVC in children's toys. It is, therefore, likely that PVC packaging will remain a stream which is not commercially viable for collection and recycling.

The contentious health issues surrounding the use of PVC have resulted in further information failures. There appears to be a general understanding that PVC is prohibited from use as packaging which has direct contact with foodstuffs unless an additional film of another polymer is used (this was even conveyed by a company which recycles PVC food packaging). In reality, it is permitted to use PVC with foodstuffs as long as the levels of certain additives fall under a specified level (see legislation in Section 3.3).

An information failure was found in connection with British Trading Standards of PVC. Previous standards required a layer of virgin PVC in window and door profiles to avoid discolouration and one company indicated that they believed this standard was still in place. Further conversations, however, revealed that this criterion is no longer in place, but several Local Authorities have not updated this and still use the old standard.

8.3.7.5. Technological Barriers

The technological externalities related to the design of plastic products are probably one of the biggest prohibitors of recycling of household products. There is very little incentive for a manufacturer to design

[405] A response from a large supermarket, Waitrose, indicated that due to health and environmental concerns, they no longer use PVC in own-brand products. In terms of other suppliers, they require documentation to show that the PVC has been produced in accordance with current environmental best practice.

a highly recyclable plastic product, particularly as plastic is currently not a commonly recycled material by Local Authorities in the UK (although this is changing, albeit slowly due to the low EU and UK targets for recycling plastic packaging waste). Many plastic products are, therefore, badly labelled in terms of the polymer type and are often made using several combined polymers (either mixed, in films, or as separate components such as bottle tops). This is being specifically highlighted by RECOUP, who are in the process of redesigning plastics labelling relating to recyclability. One can argue that these problems are only made worse by the relatively weak implementation of producer responsibility legislation in the UK, for example, with respect to packaging, where the financial responsibility for recycling household packaging does not rest on the packaging companies themselves.

The widespread use of PET in packaging, particularly bottles, has resulted in PVC being seen as more of a contaminant than a resource. The combination of PET and PVC in terms of separation technologies is very undesirable. Both these plastics have very similar densities (both sink as they are >1g/cm³) and so separation through flotation is difficult. RECOUP are currently promoting better design in packaging to overcome these problems in recycling.[406]

A further barrier is in the extruding technology which is required to coat recycled PVC profiles with a virgin PVC layer. This is often required when profile waste is being recycled for use as new profiles, as a layer of virgin PVC will prevent discoloration. This process requires additional machinery and in some circumstances this technology, or the capital to invest in it, is not in place.[407] Some recyclers, therefore, only have the capacity to produce lower quality recycled PVC products.

Flexible PVC in vinyl flooring is potentially a large source of recyclable material, although there is no commercial technology which produces recycled vinyl flooring. This is currently being investigated and initial results from trials show that there is potential to do this in a commercially viable way. There are issues relating to safely flooring (often used in hospitals, kitchens, office areas etc) which contains a 'grit' and can be damaging to recycling machinery.

Chemical recycling of PVC has been trialled in the UK and in other European countries, but is often found not to be financially viable due to the high associated costs. This may change in the future, as disposal costs increase and as the price of chemical feedstocks increase, particularly in the case of cruse oil.

8.3.7.6. Legislation

Numerous public policy interventions have had an impact on the PVC recycling market. In terms of rigid PVC, the Landfill Tax gives some incentive to recycle. However, for lighter PVC materials such as packaging, this is less of an incentive as the tax relates to weight and so the effect on low density materials tends to be much weaker.

A previous draft of the ELV Directive encompassed a ban on PVC in order to prevent the release of toxins during the recycling of the vehicle. This was withdrawn in the final implemented version.

Previously, legislation made it difficult to export rigid PVC chips as this material was classed as a waste, without regards to its quality. To be declassified as a waste, the material had to be separated, melted and pelletized. This has recently been changed and it is now easier to export rigid PVC recyclate.

Recovinyl was set up to provide support and incentives to recycle PVC and focuses on non-regulated streams which are not covered by the legislation mentioned above. In 2005 they aided the collection and

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[406] RECOUP (2006) *Designing PVC Packaging for Recyclability.* www.recoup.org/design/docs/Recyclability_PVC.pdf

[407] Pers. Comm. Axiom Recycling

recycling of 8,000 tonnes of PVC and this rose to 16,836 tonnes in 2006.[408] It is likely to increase further and is an important facilitator to the recycling industry, as it aims to provide a steady stream of materials. As the industry become more established it is likely that these streams will remain in place without the extra financial incentives.

There has been recent talk of setting 'Carbon Targets' rather than the weight-based targets currently in place. If this occurs, plastics are likely to become a major focus of recycling. It is estimated that 1 tonne of plastic recycled saves 1 tonne or more of carbon dioxide equivalent.[409]

8.4. CARDBOARD RECYCLING MARKET IN THE UK

Corrugated board and carton board are related but have varying market situations within the UK so both have been individually investigated.

In the trade, board is regarded as a sub-category of paper. This review of current literature has found some information specific to board but the majority discusses paper and board as one. From these references, data relating specifically to cardboard has been extrapolated where possible. In general, information relating to corrugated board has been more widely available, with limited publicly available information specifically relating to carton board.

In the UK, the lack of differentiated data is not helpful. Many local authorities, for example, collect newsprint and magazines for recycling, but not cardboard. Without clear information about the relative size of the 'paper' and 'card' streams, the magnitude of the opportunity foregone in not seeking to recycling card is difficult to estimate. The relative paucity of more differentiated data is also surprising given that specific materials tend to be used in specific applications by reprocessors.

8.4.1. Production and Consumption

8.4.1.1. Corrugated Board Production

Latest figures from the Confederation of Paper Industries (CPI) show that in 2006 the UK produced 2.0 Mt of corrugated board. This was an 8.7% reduction from the 2005 figure. More than half of the material used in the production process is sourced from the UK (Figure 42). On average, corrugated board contains 76% recovered fibres but this can be as high as 100%. As the fibres are recycled over and over they become weaker and shorter and after approximately 6 cycles they are removed, usually being used as a soil improver. Virgin fibre is added for strength and in the case of most fruit and vegetable boxes 100% virgin fibres are used in order to make the box more resistant to high moisture levels whilst retaining strength.

The reduction seen in UK corrugated production could in part be explained by the closure of several UK paper and board mills over the last few years. This trend is expected to be seen in 2007 data, when published, because a further 2 paper and board mills ceased production in 2007.

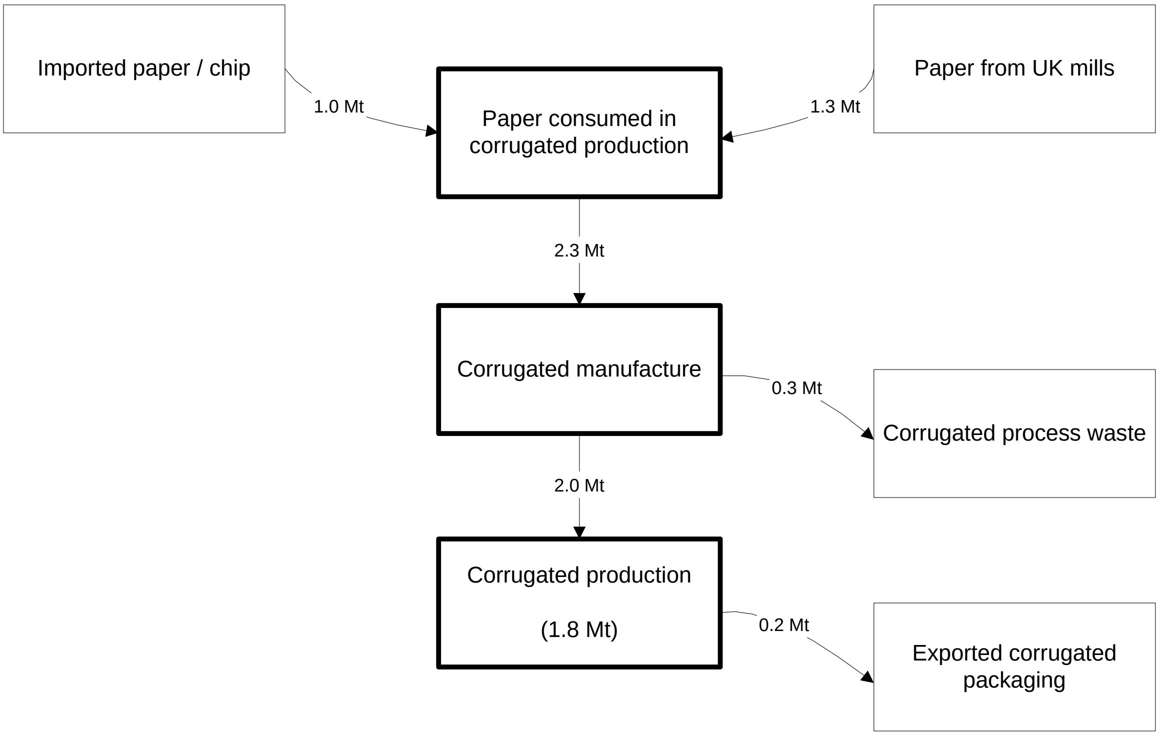
The CPI explained that the UK and Western Europe are expecting to capture the market, therefore retain or increase current production rates, through the development of Retail Ready Packaging (RRP) in a move to become more competitive with Eastern Europe and China. RRP is packaging which is not only

[408] Recovinyl

[409] RECOUP

used for transportation of the product but actually goes onto the retailer's shelves. This increases the scope for corrugated packaging to include visual impact as well as quality and strength.

Figure 42: Corrugated Production Material Flow[410]



8.4.1.2. Carton Board Production

UK carton board production has dramatically declined over the last fifteen years as the UK has seen the closure of the last recycled carton board mill a decade ago. The only carton board production in the UK which currently takes place is at the Iggesund Paperboard mill in Workington. Here, only carton board made from virgin fibre is produced. It is estimated that in 2007 approximately 100,000 tonnes[411] of virgin board was produced for UK consumption and it is unknown exactly how much would have been produced for export.

An industry expert estimated the average recycled content of carton board to be approximately 70%. Board can be classified as recycled if the product contains 50% or more recycled fibres. Any carton board being produced for direct contact with food must be 100% virgin fibre.

The board manufacturing process is extremely energy intensive and the decline in UK production for both corrugated and carton board has been driven in part by increasing energy prices resulting in relocation to less developed economies, such as China and Eastern Europe. Relocation to these areas is likely to ensure a more cost effective process with provision of low cost skilled labour readily available. Preceding the trend for mills to relocate was a general decline in UK manufacturing. As large manufacturers move

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[410] Confederation of Paper Industries (2007) *Annual Report*, Adapted from 'Figure 7: Summary of Material Flows in 2006'.

[411] Data provided by industry contact from confidential source

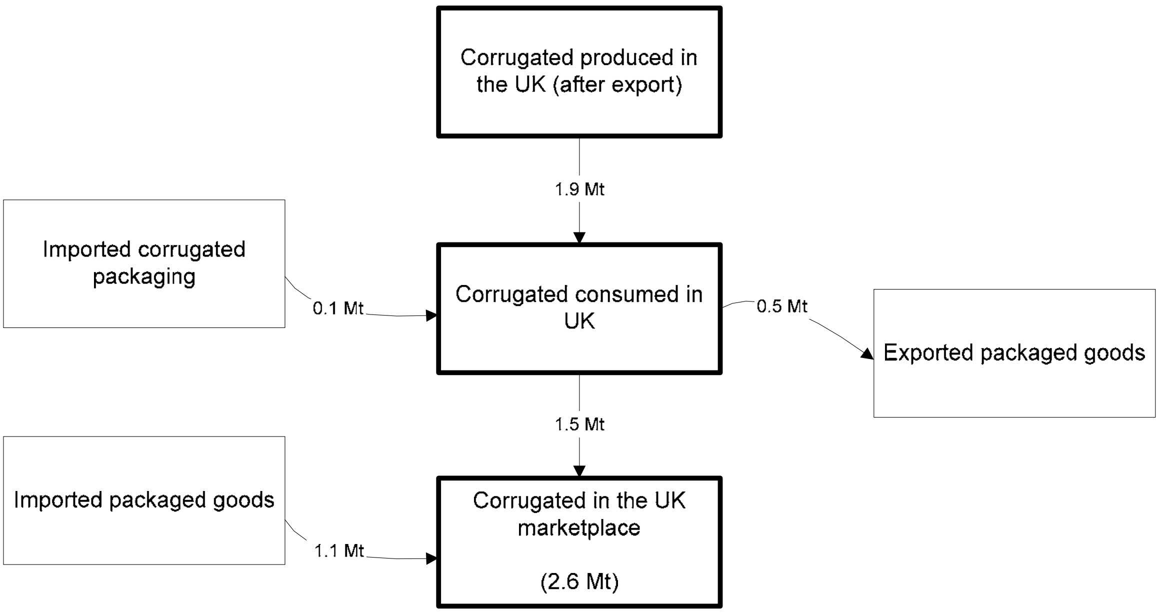
away from the UK, those supplying packaging for these products generally have either to follow, or find new products within the UK to package. The continuing decline means that this is becoming harder, constituting another driver for relocating the mills.

In light of this, the current global economic situation, and the fact that industry estimates that setting up a board mill requires a minimum outlay of between £200 - £300 million, it is seen as highly unlikely that the UK will have any board mill development in the near future.

8.4.1.3. Board Consumption

Since the 1990's consumption of paper and board has stabilised. Over the last few years there have been decreases in production and capacity meaning that the UK now has the capacity to produce 45% of the paper and board it consumes.[412] Detailed consumption of corrugated board in the UK marketplace, accounting for both imported and exported packaging and packaged goods, is shown in Figure 43.

Figure 43: Corrugated Consumption Material Flow[413]



In accounting for the net trade imbalance of board, CPI data from 2005 and 2006 shows that there was a 7.4% reduction in the amount of corrugated in the UK market place over this time period. Imported corrugated materials were mainly as packaged goods, rather than as simply packaging.

Carton board consumption for 2007 in the UK is far lower than corrugated and estimated to be around 700,000 tonnes. Approximately half of this is recycled board and 600,000 tonnes of both recycled and virgin board are imported.[414] Although consumption in 2007 was slightly higher than 2006, 2006's consumption was lower than 2005. Generally it is thought the market for carton board in the UK is stable and likely to maintain a similar level of consumption for the foreseeable future.

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[412] WRAP (2007) *Assessment of the UK export market for recovered paper, UK exports of recovered paper, a risk analysis,* April 2007, http://www.wrap.org.uk/downloads/International_Markets_Paper.191c2aef.pdf

[413] Confederation of Paper Industries (2007) *Annual Report*, Adapted from 'Figure 7: Summary of Material Flows in 2006'.

[414] Data provided by industry contact from confidential source

8.4.2. Market Conditions

For corrugated board the recycling market is dominated by 5 main companies, of whom 3 have amalgamated. They collect, reprocess and distribute the corrugated board:

- SCA Recycling
- Smurfit Kappa
- DS Smith / Severnside / St Regis

The UK capacity for domestic production of recycled corrugated board enables companies that are recycling the board to become integrated with the collection and sorting processes. This integrated system, and the fact that the majority of corrugated board does not enter the domestic waste stream, results in a highly efficient, closed-loop recycling system.

The carton board situation varies slightly due to the complete lack of UK capacity for recycled carton board production. There are more than 20 mills seeking to supply the UK market. The UK market is currently dominated by 5 large European companies who are responsible for supplying the UK market with carton board:

- MM Karton
- Cascades
- WEIG Karton
- Smurfitt-Kappa
- Fiskeby Board

However, they are not usually involved with the collection of recovered board from the UK. This fragmentation and the greater likelihood for carton board to end up in the domestic waste stream act to reduce the potential for closed loop recycling of clean board.

8.4.3. Sources of Waste Board

A source of information which divides waste board arisings between household sources and commercial and industrial (C&I) sources was not identified.[415] There are, however, several sources from which approximations can be made.

PackFlow 2008 (2005), which reports on packaging waste only, identifies 3 sources of data which have attempted to estimate the split between the household and C&I waste components in the national flow of packaging. Cardboard is not specified as a single material, but is amalgamated with paper. Results are also inconclusive due to the huge variation shown (Table 73). However, the PackFlow report continues with the 25%:75% ratio for paper and board packaging in the household and C&I waste streams.

[415] It should be noted that in the UK, it is still common to differentiate between household waste, and waste from commercial and industrial sources. This is slightly at odds with the method of reporting under the Waste Statistics Regulation.

Table 73: PackFlow Data[416]

Report	Household paper waste	C&I paper waste
ACP Task Force (2001)	41.5%	58.5%
Waste Strategy (2000)	12.6%	87.4%
Valpak's Project PRIME (1998)	25.5%	74.5%
PackFlow assumptions (2004)	25%	75%

With reference to corrugated board specifically the CPI have calculated that 60% goes to large retailers, a very small percentage goes to households and the rest falls within the remaining C&I sector going to SMEs, but there is no exact data on this.

8.4.4. Board Recycling Rates / Collection

8.4.4.1. Board Recycling Rates

The Confederation of Paper Industry's recent analysis of paper and board recovery in the UK estimates that 8.6 million tonnes of recovered paper and board was collected from the UK waste stream in 2007.[417] This was an increase from 2006, which showed poor growth in collection. However, looking back a very positive trend can be seen in recovered fibre collection.

Data from the National Packaging Waste Database (NPWD) held by the Environment Agency shows a 78% UK recovery rate for UK paper and board packaging waste exceeding the EU Directive target by 18%.

The corrugated sector has consistently reached a recycling rate of 84% for the last decade and more which is the highest recycling rate for any form of packaging in the UK. This is largely due to the highly efficient closed loop recycling found within the retail sector where the majority (60%) of corrugated packaging is used. It can be assumed that 100% of the corrugated board packaging with the retail sector gets recycled by a company as listed in Section 8.4.2. The material is simply collected from back of store, and is usually a clean, non-contaminated stream (so a very good raw material for reprocessors).

8.4.4.2. Board Collection

In 2007 a survey showed 39% of local authorities were collecting cardboard from the kerbside, whilst 61% were collecting paper from the kerbside.[418] The reason for far fewer authorities opting to collect board is two-fold:

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[416] David Davies Associates (2005) *PackFlow 2008: UK compliance with the 2008 targets of the European Packaging and Packaging Waste Directive*, Report for Valpak, http://www.valpak.co.uk/docs/packaging/packflow_2008_vol_1.pdf

[417] CPI (2008) *UK Paper and Board Recovery: 2007 State of Trade* , Press Release for CPI on 10 March 2008 http://www.paper.org.uk/news/2008/pr1003paperboardstateofmarket2007.htm

[418] Valpak data from email correspondence

- First, the bulkiness of the material means that collection logistics can prove to be more expensive. This is especially true for systems where materials are sorted on the vehicle, and where no compaction occurs; and

- Second, as a relatively low bulk density material, a large volume has to be collected to produce the same weight that other materials, such as paper and glass, produce from smaller volumes. Given that in the UK, recycling targets are weight-based, local authorities have not generally prioritised board.

Collection from households is carried out by local authorities through a variety of schemes. Some collect from a bag or box or bin, sometimes with other dry recyclables, and others accept cardboard in the bin used to collect garden waste (so the material collected is composted). Alongside the kerbside collections, local authorities usually accept cardboard at local household waste recycling centres.

In 2003/04 WRAP's statistics[419] showed 32% of UK local authorities co-collecting cardboard with organic waste. Assuming this has remained at a similar level this leaves a remaining 7% of UK authorities collecting cardboard in kerbside sorted and commingled collections. WRAP (2007)[420] find commingled collections currently unpopular but foresee a trend towards them in the near future. This is potentially threatening to the recovered paper and board market because commingled collections will probably affect quality in a negative way as more mixed grade streams are obtained which are valued lower than pre-sorted streams by the reprocessors.

WRAP (2007)[421] estimate that 5.5 million tonnes (64%) of recovered paper and board is collected from the commercial and industrial sector and 2.5 million tonnes (29%) is derived from household sources. This data is not specific to board and nor is it specific to packaging. However, composition studies of household waste suggest that there is as much paper as board in the household waste stream. Given that paper is currently captured far more effectively than cardboard by local authorities, then probably only some 0.5 million tonnes (at most) of cardboard is collected by local authorities. Most household composition studies show a broadly even split between paper and cardboard. The suggestion is that collection of cardboard from households is particularly prone to market failures. It should also be noted that anecdotal evidence suggests a rising proportion of cardboard in the household waste stream, possibly owing to the increase in on-line purchases, which tend to be packaged in cardboard to an even greater extent than where materials are purchased direct from stores.

Recycling collections from the commercial and industrial sector are either through a private waste management company, or the local authority. Table 74, which shows results from a YouGov Report using a sample of 610 SMEs and 201 larger companies, gives the proportions of surveyed SMEs and Corporates using private contractors or local authorities as their recycling contractor. The Table shows a clear preference for SMEs to use a local authority as their recycling collection, with 61% of the corporate companies choosing a private contractor. The pattern of collection may change.

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[419] WRAP (2002) *UK Paper Mills: Review of current recycled paper usage*, Prepared by AF-QPS and NLK Associates for WRAP in March 2002, http://www.wrap.org.uk/downloads/Secondary_fibre_study.c420a0d7.pdf

[420] David Davies Associates (2005) *PackFlow 2008: UK compliance with the 2008 targets of the European Packaging and Packaging Waste Directive*, Report for Valpak, http://www.valpak.co.uk/docs/packaging/packflow_2008_vol_1.pdf

[421] WRAP (2007) *Market Situation Report – July 2007: Realising the value of recovered paper*, http://www.wrap.org.uk/downloads/Paper_report.ee2f2503.pdf

Table 74: The Types of Recycling Contractor Used by Companies

	SMEs (%)	Corporates (%)
Private Contractor	13	61
Local Authority	38	22
Do not use a recycling contractor	47	9
Don't know	2	7

Source: YouGov (2007) Recycling in the UK Plc: A State of the Workplace Report, Commissioned by Taylor Intelligence, October 2007.

The YouGov (2007) report investigated the current state of recycling within the work place. In comparing SMEs and larger corporate companies it was found that whilst 75% of corporates were currently recycling cardboard, a considerably lower 60% of SMEs were doing the same. However, interestingly cardboard, second to paper, was found to have the highest recycling rate for both SMEs and corporates (see Table 69).

YouGov (2007) identified a market opportunity for commercial recycling collections for SMEs as one of their major report findings illustrated by the 47% of SMEs that currently do not use a recycling contractor (Table 74).

Table 75: Businesses Recycling Different Non-hazardous Products

Material	SMEs	Corporates
Food	12%	25%
Wood	18%	32%
Paper	71%	90%
Metal	20%	44%
Glass	37%	54%
Plastic	39%	52%
Cardboard	60%	75%
Cans	39%	61%
Scrap metal	15%	41%
TetraPak cartons	12%	19%
None	15%	6%

Source: YouGov (2007) Recycling in the UK Plc: A State of the Workplace Report, Commissioned by Taylor Intelligence, October 2007.

8.4.5. Policy and Legislation

8.4.5.1. Packaging Waste

The Packaging Waste Directive (94/62/EC) is the most important legislative driver for cardboard recycling in the UK. In the UK the Packaging Directive is implemented through the Producer Responsibility

Obligations (Packaging Waste) Regulations 2007[422] and the Packaging (Essential Requirements) Regulations 2003 which are enforced by the Department for the Environment, Food and Rural Affairs (Defra) and the Department for Business, Enterprise & Regulatory Reform (BERR). It applies to the packaging passed onto the next company in the supply chain. SMEs with a turnover of less than £2 million, or who have less than 50 tonnes of waste packaging, are excluded from this legislation. Local authorities are also not subject to this legislation. However, nor do local authorities receive direct compensation for efforts in collecting packaging which contributes to the discharging of what are, essentially, corporate obligations.

Targets revised in 2004 set minimum recovery rates of 60% for packaging. Evidence of recovery and recycling by local authorities and companies has to be provided in the form of Packaging Waste Recovery Notes (PRNs) or Packaging Waste Export Recovery Notes (PERNs) which are issued by reprocessors and enforced by the Environment Agency.

PRNs are certificates issued by accredited reprocessors when packaging waste is recycled or recovered. These PRNs are put onto the open market to be purchased by obligated companies, as evidence that they have met their calculated obligation. This can be done directly, or through a compliance scheme like Valpak. PERNs can be issued by UK businesses who export the material and can certify that it is going overseas to be recovered or recycled.

PRNs are tradable, and the revenue derived from sales provide a mechanism by which to direct producer funding directly towards packaging recyclers to support the reaching of UK packaging recycling targets.

Material specific targets are set each year which aim to enable the UK as a whole to reach overall Packaging Waste Directive targets. By 31st December 2008 the minimum recovery rate for board should be 67.5%, with targets increasing by 1% every year up until 2010.

8.4.5.2. Landfill Directive

The Producer Pre-Treatment Requirement is part of the European Landfill Directive and came into force on 30th October 2007. It requires businesses of any size to pre-treat their non-hazardous waste before sending it to landfill. The pre-treatment must:

1. reduce the volume of the waste, or
2. reduce the hazardous nature of the waste, or
3. facilitate its handling, or
4. enhance its recovery.

Segregation of waste is therefore an acceptable, and accessible, form of pre-treatment. Some waste collection companies are seeking to encourage businesses to recycle through making them aware of these requirements.

Another effect on collection infrastructure relates to the way in which the UK has implemented the Landfill Directive, specifically, its approach to seeking to reduce the landfilling of biodegradable municipal waste in line with Article 5 of the Directive.

[422] This is the consolidated version of Regulations passed at an earlier date, and amended several times.

It is known that local authorities are withdrawing from the market for collecting non-household waste. This is because the UK's Landfill Allowances Schemes (LASs) relate to municipal waste which is effectively defined in the LASs as household waste and other similar waste collected by, or on behalf of, the local authority. Local authorities will generally improve the prospects of meeting their obligations under the LASs where they divest themselves of their commercial collections since they have quotas (allowances) related to the amount of biodegradable waste which they are allowed to landfill. In principle, separately collecting biodegradable materials, such as card, for recycling ought to help to meet these targets, but in practice, many authorities are simply seeking to ensure that other providers of commercial waste collection services are able to move in as they (the local authorities) withdraw. This may have an impact on the availability of commercial waste recycling services, given that SMEs may be heavily reliant upon local authorities to provide such a service (see Table 74).

8.4.5.3. Quality Standards

Although not strictly legislation or policy, it is worth mentioning that in 2007, WRAP introduced a quality assurance measure by publishing a Publicly Available Specification (PAS) 105 applicable to recovered paper (and board) for UK end markets. Having identified potential quality issues arising from commingled collections the specification aims to keep recovered paper of a high quality[423].

The UK version of the European Standard EN643, is a non obligatory Standard which 'defines grades and combinations of acceptable types of recovered paper'[424]. The Standard is particularly relevant to those producing board with recycled content which is intended on being used in contact with food.

8.4.5.4. Courtauld Commitment

This issue of requirements to utilise recycled materials is of interest in that such requirements could help close the loop for recycled card markets. There is no such policy or legislation in place at present. WRAP's 2002 study 'UK Paper Mills: Review of Current Recycled Paper Usage'[425] states that legislation has thus far concentrated on the *collection* of packaging waste in support of the "polluter pays" principle. No legislation has been specifically aimed at the utilisation of recycled materials in packaging. Voluntary agreements, such as the Courtauld Commitment, have given more attention to this. The Courtauld Commitment is the retail sector's voluntary agreement to promote recycled content of packaging.

8.4.6. Reprocessing

Comparing 2005 and 2006 data reveals some interesting changes in corrugated reprocessing in the UK, as shown in Figure 44. The most notable difference is the 10% increase in waste material being exported. However the majority (57%) of corrugated waste is still recovered for UK mills. There are no known statistics specifically for carton board but is it known that carton board can be recovered for production of corrugated board in the UK but due to the lack of a recovered carton board mill it is otherwise exported.

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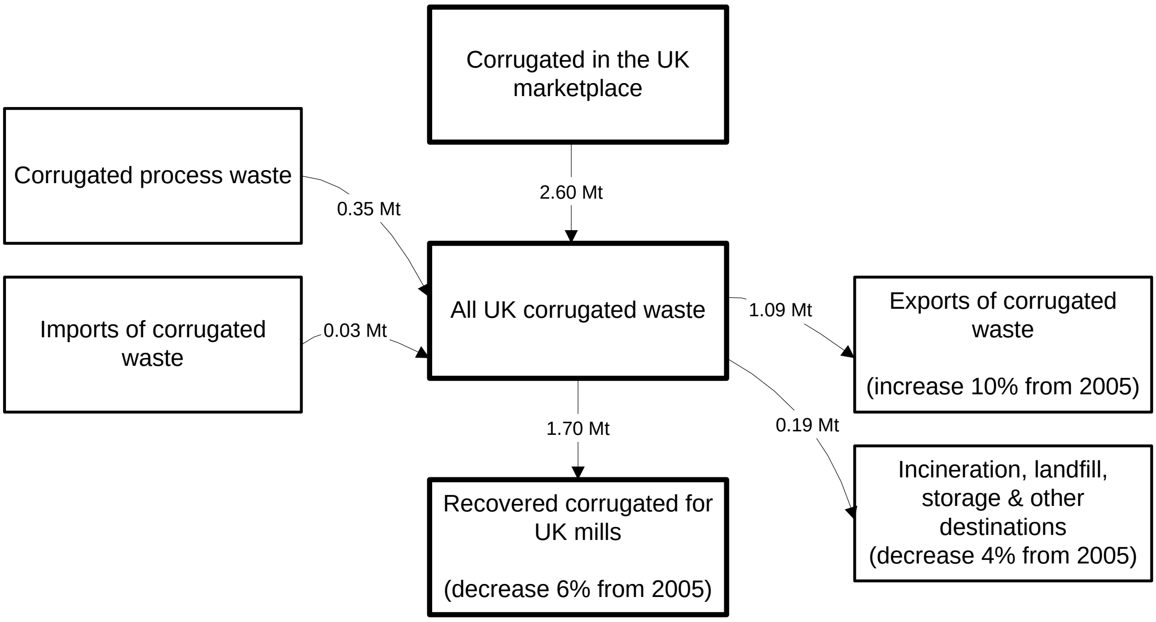
[423] WRAP (2007) *Introduction to PAS 105: Recovered paper sourcing and quality for UK end markets – Code of Practice*, http://www.wrap.org.uk/manufacturing/info_by_material/paper/paper_specifications.html

[424] Corrugated Packaging Association et al *A guide to the quality requirements of recovered paper: A guide for those involved in paper recovery and recycling.*

[425] WRAP (2002) *UK Paper Mills: Review of current recycled paper usage*, Prepared by AF-QPS and NLK Associates for WRAP in March 2002, http://www.wrap.org.uk/downloads/Secondary_fibre_study.c420a0d7.pdf

Figure 44: Corrugated Recovery Material Flow[426]



CPI data from 2006 shows quantities of recovered paper by sector and Table 76 shows those categories relevant to cardboard production. The figures for corrugated materials imply that much of the material produced in the UK uses recovered materials, and that there is some reliance on trade outside of the UK. The 'Other' category, important due to its inclusion of packaging boards, shows that just over a third of the total produced was sourced from recovered materials.

Table 76: Quantity of Recovered Paper Used Per Sector

Type of Paper	**UK Production ('000 tonnes)**	**Recovered Paper Usage ('000 tonnes)**
Corrugated Case Materials	1,532.3	1,650.5
Others (including Packaging Boards)	544.3	197.9

At the time of writing (May 2008) delivered merchant prices for cardboard were £10 - £19 per tonne. This was preceded by an upper range value of £17 per tonne in March and £20 per tonne in April. UK domestic mill prices for ex-works, baled cardboard were £68 - £75 per tonne in March 2008, £68 - £74 per tonne in April 2008 and £65 - £69 per tonne in May[427].

8.4.6.1. Alternative Treatment

Cardboard is commonly collected from households with garden or food waste which is then composted. In 2003/03 WRAP's statistics showed 32% of UK local authorities co-collecting cardboard with organic

[426] Confederation of Paper Industries (2007) *Annual Report*, Adapted from 'Figure 7: Summary of Material Flows in 2006'.

[427] Paper Prices (2008) [Online] Available: http://www.letsrecycle.com/prices/paperPrices.jsp [Accessed May 2008]

waste. Including board in the compost collection helps to meet LAS targets – the introduction of which is leading to authorities' prioritizing the biodegradable municipal waste fraction of the waste stream.

A potential problem is that cardboard dries the composting process and depending upon the proportions of cardboard to food and garden waste, water may need to be added to the process[428]. A further concern from the CPI regarding composting board is the impression portrayed to the general public. In their opinion, when cardboard gets composted it gives the impression that it is 'bad' paper fibre, as opposed to newsprint and pamphlets, which are usually collected in the recycling stream and therefore are perceived as 'good' paper fibre. The CPI believes that the only legitimate time when fibre should be composted is at the end of its life when the fibres become too short. At this stage it can be used as a soil improver. Despite the environmental benefits being far greater to recycle the board, under the UK's Producer Responsibility Obligations (Packaging Waste) Regulations, PRNs are obtained for cardboard that goes to a composting facility. [429]

Animal bedding is an alternative use for re-using cardboard as a substitute for wood shavings. The benefits of using cardboard are that it is biodegradable and breaks down more quickly than straw or shavings.

Recovered fibre is also used for moulded paper products and insulation. However, WRAP (2007)[430] estimates that alternative cardboard treatments, such as those mentioned above, account for only 1% or so of the paper recovered in the UK.

8.4.6.2. Export

The UK is currently the world's second largest exporter of recovered paper and board second only to the US. Paper and board export in 2006 saw a continued growth (10% increase between 2005 – 2006 for corrugated board) which was mainly associated with the decline in UK reprocessing capacity, not increased collection. The CPI expects this trend to continue. The majority (49%) of UK exports of paper and board went to China as shown in Figure 45. It has been recognised that due to China's vast demand for materials, it exerts considerable influence over the UK and the US's export markets. In order to get the best price for recovered fibre, they have the potential to play the UK market off against the US market, and vice versa, causing a 'see-saw' effect in prices across the two market places[431].

Export prices for cardboard in May 2008 are £72 - £75 per tonne which shows a continuing decline through April 2008 (£81 - £83 per tonne) and from March (£85 - £92 per tonne)[432]. These lowered export prices are thought to soon have repercussions throughout the recovered board market with UK board

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[428] WRAP (2007) *Feasibility of Composting Wood and Cardboard Waste with Green Garden or Household Kitchen Waste: Trials Research Report*, Prepared by ADAS UK Ltd for WRAP in September 2006, http://www.wrap.org.uk/downloads/Feasibility_of_Composting_Wood_and_Card_-_Trials_Research_Report.2f3d0979.pdf

[429] WRAP (2006) *Environmental benefits of recycling* , http://www.wrap.org.uk/wrap_corporate/about_wrap/environmental.html

[430] WRAP (2007) *Market Situation Report – July 2007: Realising the value of recovered paper*, http://www.wrap.org.uk/downloads/Paper_report.ee2f2503.pdf

[431] *Paper News: Used cardboard prices come under pressure* (May 2008) [Online] Available: http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=217&listitemid=9987 [Accessed 13th May 2008)

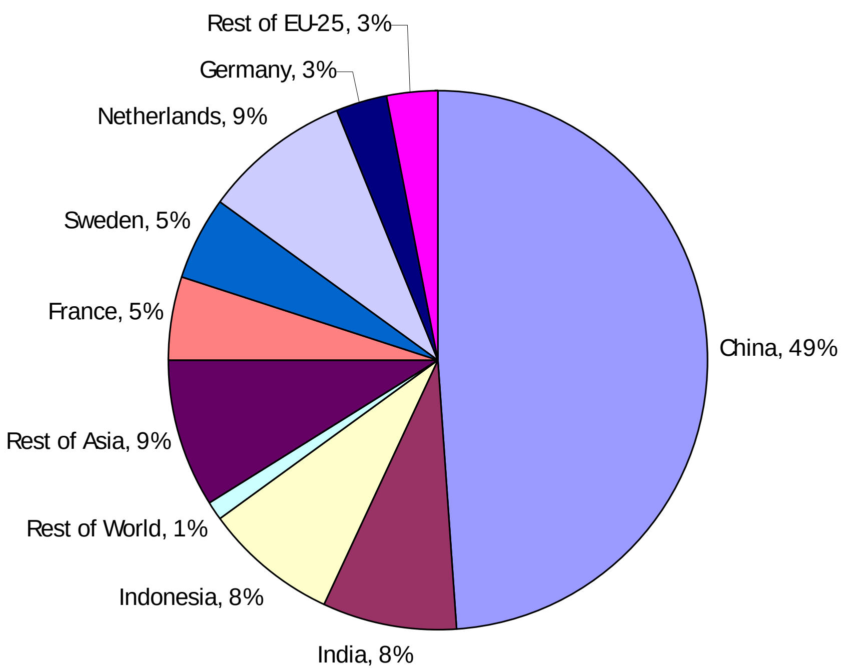
[432] Paper Prices (2008) [Online] Available: http://www.letsrecycle.com/prices/paperPrices.jsp [Accessed May 2008]

mills beginning to pay reduced prices for materials. The demand in China is still very high although orders recently are at a lower level. This could indeed be a lull in the UK market due to American demand with China being the main market driver, but at this early stage in the changing price trend it is merely a speculative view.

It is standard for the UK to reprocess the higher quality grades of recovered paper and board whilst secondary grades are more likely to be exported. There is currently such a huge demand, in China especially, that this is not currently thought to be jeopardising the UK's export market.

Recovered cardboard is non-hazardous waste therefore has to meet the simplest 'green list' export requirements. However the CPI report that there has been some conflict between exporters and the Environment Agency regarding interpretation of the 'green list'. As a result of this the CPI have developed a voluntary Export Code of Practice to prove that those meeting this standard are endeavouring to conform to global paper mill standards.

Figure 45: UK Exports of Recovered Paper by Destination 2006[433]

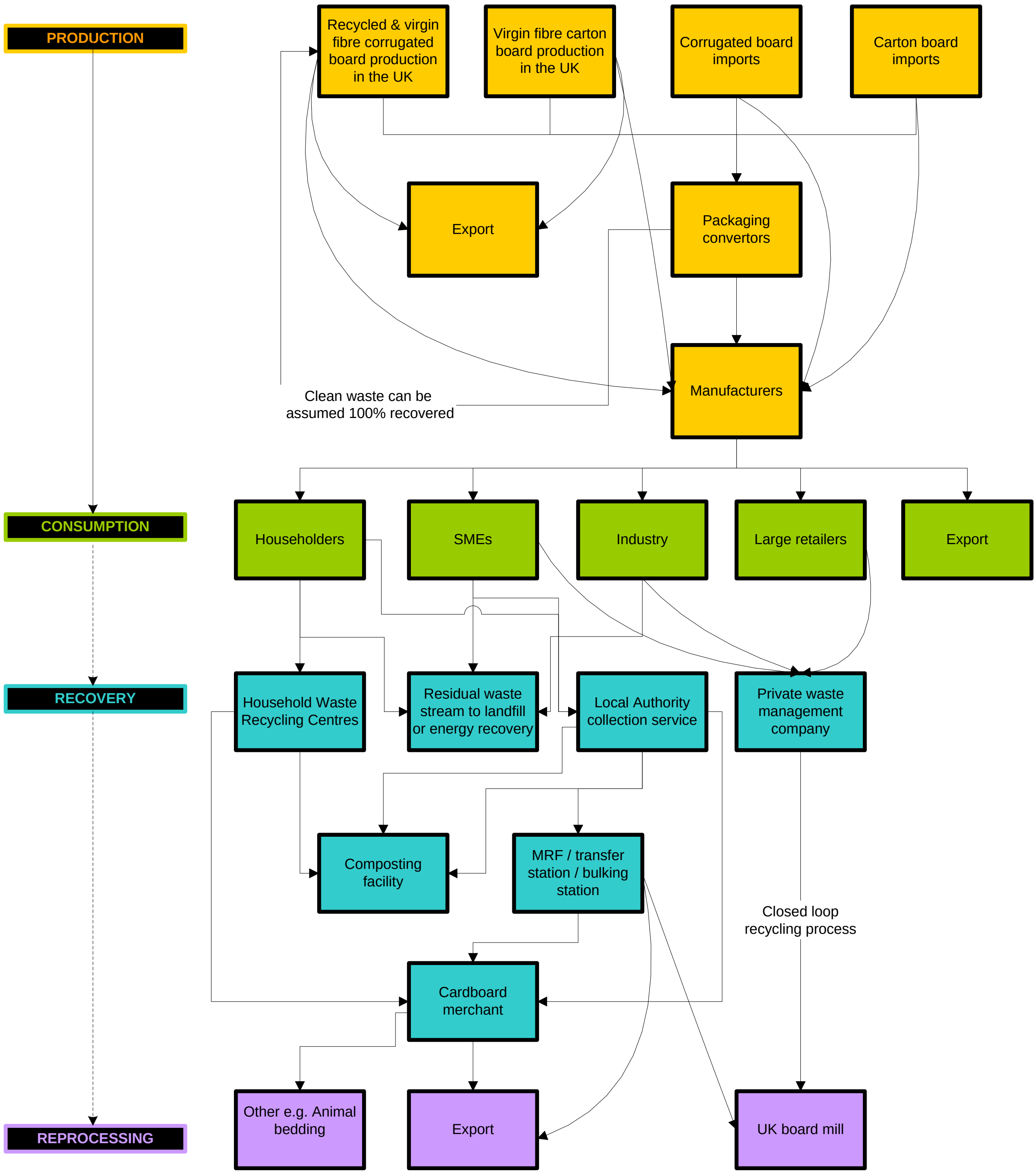


8.4.7. Flow Diagram

Figure 46 gives an overview of the main paths which corrugated and carton board follow during their life-cycle from production through to reprocessing.

433 CPI Industry Facts (2006) http://www.paper.org.uk/info/statistics/fact2006colour0707.pdf

Figure 46: Corrugated and Carton Board Material Flow Diagram



8.4.8. Market Failures in the Market for Cardboard Recycling

With impressive recycling rates it seems that the recovered board market is functioning relatively efficiently. However, some market failures and potential future market barriers have been identified.

8.4.8.1. Search Costs

It is quite clear that many companies, and particularly SMEs, do not access a cardboard recycling service. Yet many others do. The suggestion is that cost is not a major barrier to most companies where cardboard recycling is concerned. Indeed, over recent years, the market for recovered cardboard has been buoyant. For suppliers of cardboard recycling services, and probably for the would-be users of the service, there are issues related to identifying prospective customers / suppliers.

Identifying an SME in need of waste board collection is far less lucrative for a waste management company than securing a contract with a large retailer. It would also require a lot more time and effort in order to develop the collection business in this area (in collection of card, as with other materials, there are economies of scale in terms of quantities collected per pickup).

From the SME's point of view, the clause for companies with less than £2 million turnover, or producing less than 50 tonnes packaging per year applying to the Packaging Directive implies very little incentive to actively search for a collection company. This was highlighted by the YouGov report which showed 47% of their SME sample do not use a recycling contractor and have never tried to find one, compared with only 9% of the corporate sample saying the same. However, the Producer Pre-treatment requirement of the Landfill Regulations essentially calls for all companies, including SMEs, to segregate their waste from October 2007. The CPI has indicated that cardboard recycling within the SME sector is therefore beginning to gain momentum as the SMEs are prioritising recycling for the first time and recycling companies are looking further afield for opportunities aside from the large companies. This is also driven by rising disposal costs as the Landfill Tax increases.

8.4.8.2. Information Failures

With regards to commercial waste collection from SMEs there is insufficient information about both waste quantities that they produce and the level of service uptake that is likely to occur if a collection service were to be offered. With these unknown factors it is very difficult to cost a new service and this situation is likely to be off-putting to those potentially interested in collecting recyclables from SMEs.

The reason for the current low recycling levels for board amongst SMEs in-part could be due, in part, to an information failure highlighted by the YouGov report which showed that only 4% of the SMEs contacted had a 'very thorough' knowledge of the Producer Pre-Treatment Requirement prior to its implementation.

At the household collection level, an information failure could be resulting in a trend for commingled and mixed grade board collections. These result in much higher sorting costs, greater levels of contamination and a less commercially attractive end product with a lower value. Some local authorities are choosing a mixed board with garden or kitchen waste collection which, although feasible, has a negative environmental impact. This collection system is a financial burden to the authority that has to pay gate fees to the composting facility. However, if the cardboard was collected separately revenue could be attained from the sale of the material. Coupled with the lack of information known by households, due to the current pricing system of flat rate council tax payments, households have no incentive to engage with the recycling system. The price they pay for board collection does not reflect either the quantity or quality of material or the increase seen in disposal costs. A similar, but less severe situation is seen in the commercial sector where pricing is 'per skip' or 'per pick-up'.

Finally, it is worth commenting on the effect of local authorities withdrawing from the commercial waste collection market. Many SMEs do not have, in our experience, knowledge of their Duty of Care obligations regarding the management of their wastes. In some metropolitan areas, and in some remote rural areas, local authorities tend to be 'providers of last resort'. Withdrawing the service can lead to SMEs failing to gain satisfactory replacement service. Although this could be classified as an information failure, it is also possible that alternative services are available, but at high cost. As such, this becomes an issue of cost, and the fact that the fragmentation of the collection market leads to a loss of scale economies for all competitors.

8.4.8.3. Consumption Externalities and Risk Aversion

As the recovered board market has matured use of recycled content in packaging seems to be accepted as standard so any misconceptions over the quality of the secondary material over the primary seem to have, on the whole, been overcome.

There are some products which specifically require no recycled content, purely for practical reasons. The best example is fruit and vegetable boxes commonly found in large retailers to display the goods. Exclusion of recovered fibre is regarded as essential if the box is to retain maximum strength and resistance to high moisture conditions when the goods are in transit. EU standard EN643 (and the UK version BS EN 643) recommends not using packaging with recycled content where the material is in direct contact with food.

Problems have been identified with the corrugated box system by the retail sector and recently there has been a shift towards plastic crates as a substitution. This change has happened with a focus on risk aversion for the retailers. Plastic crates are standard, rigid, strong and easily stackable. The quicker they can be moved, the fresher the produce is on the shelves.[434] The corrugated sector argues that their product is more environmentally friendly when assessed using life cycle analysis.[435]

The main downfall of the re-usable plastic crates is the lack of washing facilities and the distance that has to be travelled to reach these. In recycling of corrugated boxes the fibre can be re-used in other packaging with virgin fibre used for the fruit and vegetable boxes.

The corrugated sector feels that in order to reverse the current trend towards plastic crates, marketing and promotion to large retailers, considered to be the key decision-makers, is their key priority. It is felt it is very timely for pushing the environmental benefits of their products as large retailers, for example WALMART and Tesco, are introducing schemes such as 'Sustainable packaging scorecards'.

8.4.8.4. Policy and Legislative Barriers

Much doubt has been expressed about the workings of the PRN system by the Local Government Association (LGA). They argue that collection authorities have a weak position in the system which leaves them removed from any financial support which such a scheme might provide if it was organised along the lines of 'Green Dot' schemes as used in other EU Member States. They would like to see packaging producers taking more responsibility for the packaging they produce, a proportion of which is currently collected, and paid for, by authorities from kerbside collections. The solution they would like to develop would bring together authorities and industry to develop a system whereby funds are transferred to the authority to pay for the collection of packaging materials for recycling.[436]

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[434] Landell Mills Consulting (2005) *An Assessment of the Position of Reusable Plastic Crates in Europe, 2000 – 2008*, report commissioned by FEFCO.

[435] FEFCO (2008) *The Corrugated News*, information taken from work carried out by the Institute of Packaging Technology, Transport, and Logistics, Valencia, in cooperation with the Polytechnic University of Valencia in November 2005.

[436] Local Government Association (2007) *Position statement: Packaging* , http://lga.gov.uk/lga/aio/28726

Further criticism of the PRN/PERN system has recently come from the CPI.[437] Recovery rates of paper packaging have far exceeded targets set by the EU Directive resulting in very low value for the PRNs and PERNs. This is barely covering administrative costs and leaves no funds to support further investment. The CPI believes that consequently, significant amounts of material are being exported from the UK outside the Regulatory framework because it is not deemed beneficial to register the material as having been recycled under the formal scheme operated by the Environment Agency. This suggests that packaging recycling rates are even higher than the recorded levels.

One consequence of the low PRN price and the absence of a mechanism to make producers fully responsible in the financial sense is that there is a reduced incentive for companies using cardboard packaging to reduce their consumption through changing product design.

8.4.8.5. Technological Externalities

We've already discussed some technological issues affected by the PRN scheme and it is clear that the system is not proving to be a strong driver, through lack of financial incentive, to increasing recovery and recycling rates. If the targets were raised the value of the board PRN would increase and investment could be directed towards collection at the household level, where the systems are currently ineffective.

With the introduction of the producer responsibility scheme, manufacturers have some incentive to design their products with recyclability in mind. However, barriers to recycling still do exist for board especially in cases when it has been coated with plastic and / or foil. The technology does exist to recycle this type of composite material but it has not proven to be financially feasible to collect and reprocess this composite material with there being no facility for this currently operating in the UK.

8.4.8.6. Market Power

Although the market for recovered board in the UK consists of a few large suppliers and a lot of small players there is no clear evidence to suggest any collusion or cartel formation has taken place, as can occur in extreme circumstances[438].

Much of the market power within the recovered board sector is held by China. With such great demand, and therefore reliance, upon the export market WRAP (2007)[439] highlighted 3 potential threats to the market:

1. Volume risk, whereby a surplus of recovered paper and cardboard becomes too great to be absorbed by the international market. UK usage of recovered paper and board has been decreasing since 2000 when mill capacity began to reduce, and the amount collected is increasing, thus increasing reliance on the export market. However, currently the export market is steady with strong prices for recovered paper and board.

2. Price risk, where export price for recovered paper and card is too little to cover collection costs

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[437] CPI (2008) *Press Release: UK Paper Packaging Recovery Levels Smash Targets,* 19th March 2008 http://www.paper.org.uk/news/2008/pr1903ukpaperpackagingrecoverylevelssmash.htm

[438] As happened in Australia in October 2007 when a price-fixing cartel between Visy and rival Amcor was found out.

[439] WRAP (2007) *Assessment of the UK export market for recovered paper, UK exports of recovered paper, a risk analysis,* April 2007, http://www.wrap.org.uk/downloads/International_Markets_Paper.191c2aef.pdf

3. Political risk, whereby export opportunities become limited

However, the report concluded that with the reliance so heavily placed on exports to Asia their demand is likely to uphold the volumes the UK needs to export. The risks highlighted could become threatening in the long-term future for the recovered paper and board export market. Nevertheless, WRAP see the introduction of hedging tools and development of a derivatives market as an important next step in order to stabilise the market in the UK.

Although China’s huge demand for material looks set to continue there are issues over quality in the long-term. It is currently normal practise for the UK to keep the best grade and for the secondary grade to be exported. There is such a huge demand in China that this is currently not jeopardising the UK’s export market (which is important given the growing reliance on it). However, it is likely that this will not be able to continue long term since as China develops they will want to source higher grade paper.

8.4.8.7. Network Externalities

The explanation for the lack of recycling services available to SMEs could in-part be down to a failing network effect. Without enough collection points within an area the recycling service could become unviable due to travel expenses, so until enough SMEs decide they need the service the service will not become viable. Information from cardboard collection companies suggests that this trend is changing with action being taken both by SMEs and collection companies.

Essentially waste collection costs exhibit economies of scale. More accurately they exhibit economies of density. The more pick-up points there are in a small area, the lower will be the unit cost of serving a given premises. An issue for commercial collection is the fact that companies compete in the marketplace on an ongoing basis. This makes the collection density for any given company relatively low, increasing unit costs.

9. CASE STUDY: FRANCE

9.1. STRUCTURE OF THIS CHAPTER

This Chapter takes a closer look at the specific situation of the four waste streams under consideration in France. We begin the chapter with some basic information on French society (Section 9.2) and waste policy (Section 9.3). Section 9.4 provides key waste statistics. Extended producer responsibility plays a central role in French waste policy – an overview is given in Section 9.5. Cardboard and beverage cartons' recycling fits within the policy on packaging waste, which is described in Section 9.6. The detailed analysis for the different waste streams follow then in Section 9.7 (PVC), 9.8 (batteries), 9.9 (food waste) and 9.10 (cardboard). In the summer of 2007, a wide public consultation on environmental issues was held in France, the "Grenelle de l'Environnement" – the conclusions of the consultation are discussed in Section 9.11 and the follow-up actions in Section 9.12. A final evaluation is offered in Section 9.13.

9.2. GENERAL INFORMATION

With a surface area of 543.965 km² and 61.167 million inhabitants (2008), France has a population density of 112 inhabitants /km²[440].

It is divided in 22 regions, composed of, in total 95 "départements". In total, France counts 96,000 municipalities. 57 urban areas in France have more than 100.000 inhabitants, and 5 have more than 1.000.000 inhabitants.

Table 77: largest French cities

1. Paris	9.6 millons
2. Lille	1,7 millions
3. Lyon	1,4 millions
4. Marseille	1,3 millions
5. Toulouse	1 million

In 1999, 75 % of the French population lived in urban areas[441].

Its GDP per capita relates as follows compared to the EU average[442]:

	2006 GDP per capita (PPP)	2006 GDR per capita (EUR°
France	26,500	28,400

[440] http://www.insee.fr/fr/themes/tableau.asp?reg_id=0&ref_id=nattef01209 ; figures limited to metropolitan France.

[441] http://www.institut.veolia.org/en/cahiers/urban-development/veolia-services/urban-sprawl/urbanisation-evaluation.aspx

[442] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001-01/EN/KS-CD-07-001-01-EN.PDF

EU27	23,500	23,500

France can thus be characterized as an affluent country with a low density of population but a high degree of urbanisation.

9.3. GENERAL REGULATORY CONTEXT

The information provided in this Section is based upon information from the websites of the French Ministry of the Environment[443] and its executive agency ADEME[444] and the EEA Fact Sheet[445].

9.3.1. Summary of the legislation relevant to waste management

At the national level, environmental policy is determined by the Ministry of the Environment[446] and the executive agency ADEME[447].

The general principles of waste policy are laid down in the 'Code de l'environnement'[448]. This code:

- defines the priorities for waste management;
- prescribes departmental and regional plans for waste management;
- contains the nomenclature for waste treatment facilities and prescribes the accreditation of waste treatment units and the storage of waste.

The national legislative framework on waste is based on Act n. 633 of 15 July 1975, as modified by Act n. 646 of 13 July 1992, which established the main objectives of French waste policy:

- implementing the waste management hierarchy: (quantitative and qualitative) prevention, recovery, treatment and disposal
- enhancing recovery (material and energy)
- organising and limiting waste transportation
- waste planning at a departmental or regional level
- by 1 July 2002 only "final waste" (i.e. waste that cannot be treated anymore under the present technical and economic conditions) would be accepted in landfills.

In accordance with these requirements, the local waste management plans were revised with a stronger orientation towards recycling. Separate collection of waste, in particular of paper, was developed. Landfilling and incineration of waste have been decreasing since 1992 but current levels are still important – see Section 9.4.

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443 http://www.developpement-durable.gouv.fr/

444 http://www2.ademe.fr/servlet/getDoc?id=38480&m=3&cid=96

445 http://eea.eionet.europa.eu/Public/irc/eionet-circle/etc_waste/library?l=/country_fact_sheets/fr_finalpdf/_EN_1.0_&a=d

446 Ministère de l'Ecologie, du Développement et de l'Aménagement Durable.

447 Agence De l'Environnement et de la Maîtrise d'Energie.

448 Code de l'environnement' (Partie législative) « Livre V Titre IV Chapitre I° Elimination des déchets et récupération des matériaux articles 541-1 à 541-50 » and « Livre I Titre II Chapitre IV Autres modes d'information article 124-1 ».

9.3.2. Division of responsibilities

Businesses are responsible for the collection and treatment of their waste, except in the case of waste similar to household waste[449].

The responsibility for municipal waste collection and disposal lies with the municipalities (the smallest administrative unit in France) or with groupings of municipalities. Municipalities are responsible for the collection and disposal of[450]:

- waste from households
- other *waste similar to household waste* (waste from businesses, shops, small industries, which can be collected in the same conditions as household waste).

In practice, 20 to 30% of waste taken charge off by the local authorities is not from households. In Paris and the large cities, this can even exceed the 30%[451].

The collection and disposal operations can be carried out either directly by the local authority, through its services, or by a private company under contract with the local authority.

The non-profit sector can be involved in some operations but remains relatively marginal.

The autonomy of the municipalities is far-reaching. For instance, the municipalities decide whether or not they want to organise selective collection systems. In case selective collection is organised, the way waste is grouped also falls within their responsibility[452].

However, there is an incentive for local authorities to put in place separate collection schemes as this gives them access to a reduction of the value added tax on waste management services (5.5% instead of 19.6%).

The administrative units above the municipalities, the "Départements", are involved in waste disposal planning but do not have actual responsibilities over collection and disposal.

Planning at the level of the "Départements" played an important role for the development of valorisation through:

- The promotion of valorisation,
- The planning of valorisation and treatment capacities on a scale that enables scale economies
- Subsidies for investment (although not systematic).

9.3.3. National Strategy for Sustainable Development

The National Strategy for Sustainable Development of 3 June 2003 (NSSD) contained a series of action programmes, dealing with all environmental aspects. According to the NSSD, a sustainable waste policy

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[449] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

[450] Code général des collectivités territoriales : articles L 2313-1, L 2224-13 à L 2224-17 , L 2333-76 et L2333-78, modifiés par la loi n° 2004-1485 du 30 décembre 2004 de finances rectificative pour 2004 : articles 61,62,64, 66, 67, 68 et 69 (JO du 31/12/04)

[451] Information provided by Loic Lejay of AMORCE per e-mail of 30 June 2008.

[452] Information provided by Sandrine Wemisch and Philippe Tauvin of ADEME (phone interview on 24 June 2008).

should preserve natural resources and limit environmental and sanitary impacts. The main actions provided by the Strategy are related with Integrated Product Policies and sustainable consumption.

According to the NSDD, actions would focus on reduction at the source, collection systems and recovery of waste:

- To implement at the national level measures for reduction at source of waste. Precise and concrete actions would be taken towards manufacturers (eco-design) and retailing (partnership agreements). Consumers (awareness) and local communities would be involved.
- To improve procurement policies and to favour green procurement.
- To improve waste collection and recovery rates : recycling target for waste paper: 60% by 2008[453]
- Due to its volume (32 million tonnes per year), treatment of C&D waste would be given priority; the objective was to treat within 5 years 30% of arising compared to 10% in 2003. For this purpose, research would be conducted on selective demolition. Separation and recovery would be promoted.
- The impact from treatment of waste on human health and the environment would be reduced, particularly through closing and containment of illegal dumps and the modernisation of incinerators as required in European directives.
- The impact from waste treatment facilities on the greenhouse effect would be better abated, in particular through the extension of methane gas collection from landfills.

9.3.4. National Action Plan for Waste Prevention

In February 2004, the government presented a national plan aimed at stabilising the production of household waste by the year 2008. With this objective in mind, a three-year national communication campaign was launched in the fall of 2005.

This awareness-raising campaign was supplemented by other initiatives, including (but not limited to):

- The recruitment by local governments of 100 "prevention" project leaders;
- ADEME’s technical and financial support of small and medium-sized businesses, particularly as part of the “10% less waste” operation;
- National plan for the development of individual composting;
- Initiatives to promote the repair and reuse of items;

The main actions included two symbolic actions:

- Plastic bags: the plastics industry and the largest retailers have expressed their commitment to reduce the quantities of plastic bags (end 2003)
- Unsolicited mail: a “no thanks” sticker has been introduced; in addition, Parliament adopted a piece of legislation introducing a mandatory contribution by producers of unsolicited mail to the management costs of their waste[454] - see Section 9.10.3 for more details.

The following 4 axes would be pursued:

<u>Axis 1) Responsible consumption and more environment-friendly products:</u>

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[453] This has been reached – see Section 9.10.1.

[454] Décret du 1er mars 2006 relatif à la contribution à la collecte à la valorisation et à l’élimination des déchets d’imprimés.

Overall objective: to stabilise municipal waste generation by 2008.

- National guideline for responsible consumption, focusing on waste prevention (published before end of 2004)
- Eco-labelling for more product types (id. national strategy for sustainable development)
- Promotion of eco-design (id. national strategy for sustainable development)
- Definition of trial standard for useful life of products
- Qualitative prevention

Axis 2) Environmental management and industrial processes:

Objective: to stabilise waste generation in enterprises by 2008.

- Promotion of environmental management by integrating product design
- Promotion and recognition of enterprises' voluntary commitments
- Two calls for tender for projects directed at enterprises (eco-design, less waste-generating technologies)
- Capitalisation of experience: less 10% waste.
- Promotion of prevention by end-of-life product groups (cf. Packaging waste/green dot)

Axis 3) The State as example:

- Objective: reduction by 5% per year in five years of waste generated by the public administration Better management of waste generated by the administration and reduction in quantities generated
- Development of Green Procurement policy in the public administration

Axis 4) Local approaches and householders' management of goods and waste:

Objective: stabilisation by 2008 of household waste generated per capita

- Continuation of inclusion of waste prevention in departmental waste management plans
- Improvement of reuse opportunities (exchanges etc.)
- Support to local initiatives and exchange of experience (working group, internet site)
- Pay-as-you-throw schemes (for non-household waste)

9.3.5. Renewed waste policy

On 20 September 2005, the French Minister of Ecology and Sustainable Development announced new priorities for waste management within the context of the aforementioned National Strategy for Sustainable Development. The main prepositions set out in the Law 13 July 1992 were re-affirmed but more emphasis was put on waste prevention and on the development of recycling[455].

Therefore, the Ministry of Ecology and Sustainable Development has proposed new quantitative objectives in order to decrease the amount of municipal waste sent to incineration or landfill plants[456]. Awareness raising campaigns also played a central role[457].

[455] Nouvelle politique des déchets- septembre 2005: http://www.ecologie.gouv.fr/article.php3?id_article=4862

[456] Nouvelle politique des déchets- septembre 2005: http://www.ecologie.gouv.fr/article.php3?id_article=4862

[457] http://www.reduisonsnosdechets.org/

9.3.6. Landfilling

In 1992, a landfill tax was introduced in France.[458] The objective of the instrument is to prevent landfilling and to boost waste reduction and recycling. The tax base is the amount, expressed by weight, of waste disposed of in landfill or in incineration plants without energy recovery. Revenues from the tax were collected within the Fund for Waste Management Improvement instituted on the 1 April 1993 and managed by ADEME. From 1 January 1999 the landfill tax was included in the General Tax on Pollutant Activities (TGAP) and the revenues are due to state budget.

Landfills have to be licensed by the préfet[459]. Some landfills are still operated without license, but, following the introduction of the landfill tax, numbers are decreasing since 1992. The Circular of 23 February 2004 deals with the identification and the remediation of illegal landfills. Regulations 31 December 2001, 3 April 2002 and 19 January 2006 amended Regulation 9 September 1997 in order to transpose Directive 1999/31/EC (the Landfill Directive) into French legislation.

9.3.7. Incineration

The EU Directives on Hazardous Waste Incineration and on Waste Incineration[460] have all been transposed into French Law. There are approximately 130 incinerators at present in France. Some waste management plans foresee the construction of new incineration plants, some of which are already under construction. It is estimated that the amount of waste going to incineration will increase by 1- 2% in the next years.

9.3.8. National strategy for the reduction of biodegradable waste going to landfills

France already largely respects the 2006 and 2009 targets for biodegradable waste going to landfills set by EU Directive on landfills (article 5(1) of Directive 1999/31/EC on the landfill of waste). However, the estimated amount of biodegradable municipal waste going to landfill in 2016 is 40% of the total amount produced in 1995.

In order to achieve the objectives of the Act of 13 July 1992 (see above Section 9.3.1), the waste management plans have been revised with a stronger orientation towards recycling. Separate collection of waste, in particular of paper, has developed.

9.3.9. Mechanisms for funding MSW Service:

Local authorities in charge of waste management can choose between two ways to fund municipal waste management.

9.3.9.1. Funding by local tax

Financing takes place either as a part of the general municipal budget or through a tax specific to waste management (the Taxe d'Enlèvement des Ordures Ménagères: TEOM). The TEOM is determined by the

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[458] Law n. 646 of 13 July 1992.

[459] The "préfet" is the local representative of the State in the "Département". The Préfet issues environmental permits relating to classified installations – see Brenot and Werner (2008), "France" in The International Comparative Legal Guide to: Environment Law 2008, published by the Global Legal Group, http://www.iclg.co.uk/ .

[460] Directives 89/369/EEC, 89/429/EEC (new and existing municipal waste-incineration plants), 94/67/EC (incineration of hazardous waste) and Directive 2000/76/EC.

Municipal Council or by the assembly of the authority (in the case of groupings of municipalities) and paid by people subject to the tax on buildings, and collected in the same conditions. The TEOM doesn't always cover all the costs of the service, and additional financing by the general budget is possible. In the case of tax financing, the amount of tax is determined on the same basis as the property tax on buildings (value of the building, social criteria). It is thus disconnected from waste production and does not provide an incentive to waste reduction.

9.3.9.2. Funding by a service fee

The Municipal Council or the assembly of the responsible authority can choose to establish a service fee (REOM: Redevance d'Enlèvement des Ordures Ménagères). The REOM is not a tax revenue; it is the financial counterpart for a service and thus has to cover the total cost of the service. Its purpose is to implement the "polluter-pays" principle (PAYT scheme) and to boost waste reduction. In principle, the REOM is linked to the actual service provided and should thus take into account the amount of waste produced. However, the determination of the cost of the service per household is complex and often generates litigation. Up to recently, pricing was determined on the basis of the volume made available the household (variable pricing with collection weighting is being experimented in some municipalities). Additional financing, for example through the municipal budget, is not permitted. The REOM is collected by the municipality.

The main drawback of REOM is that it penalises large households and does not take into account social criteria. In addition, with the current development of separate collection and sorting, the costs of waste management are usually growing and their invoicing to households too.

Since January 1993, the management of waste from professional activities comparable to municipal waste has to be financed with a specific fee that must be introduced by the municipalities. The special fee for the financing of assimilated waste, although it is mandatory, has not been set up in every municipality. In practice this means that this fraction is paid for by household financing (see Section 9.11).

9.3.9.3. Other sources of funding

In addition to funding by municipalities, financial support to waste management can be given to municipalities or to groupings of municipalities by 3 types of sources:

- Other local authorities (regional, departmental governments)
- The State (through the environment agency ADEME)
- For dry recyclables, private organisations in charge of supporting separate collection of waste for valorisation (see Section 9.6 for more details).

Support from local authorities and the state are usually in the form of investment subsidies.

9.4. BASIC STATISTICS

9.4.1. Waste production in France in 2004

849 million tones of waste were produced in 2004[461]:

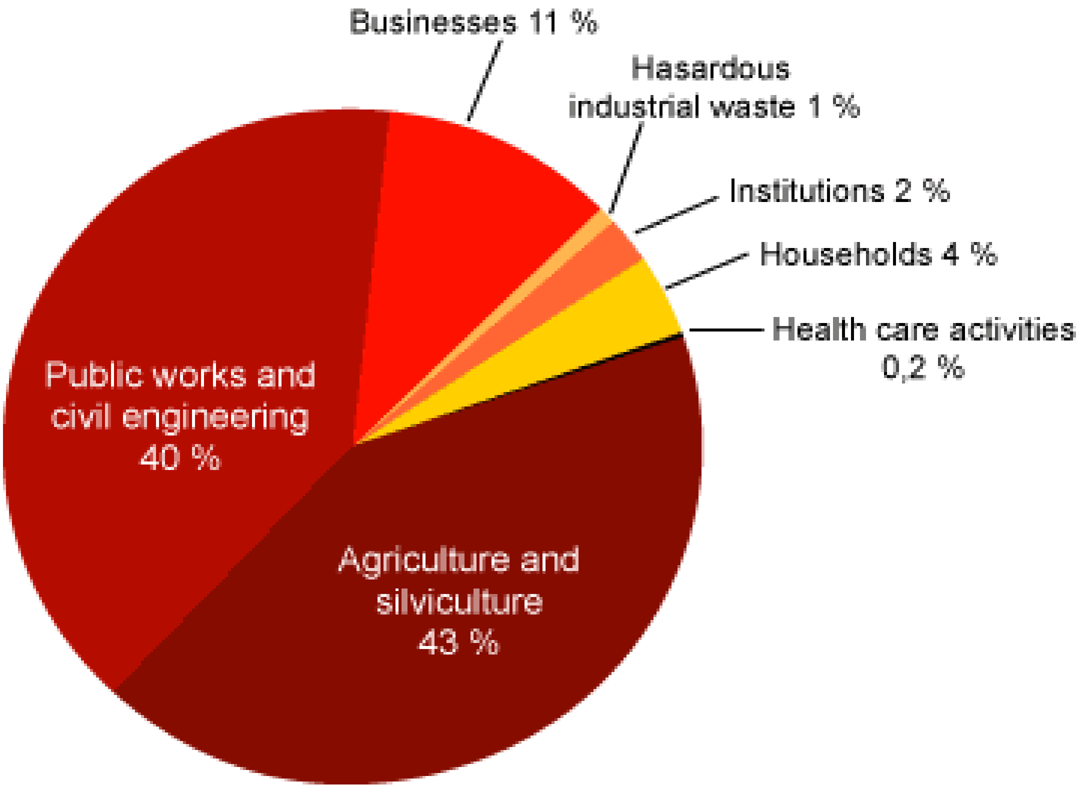
- Institutions : 14 million tons

[461] http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=17571 .

- Households : 28 million tons
- Businesses : 90 million tons
- Agriculture and silviculture : 374 million tons
- Health care activities : 0.2 million tons
- Mines, quarries and public works and civil engineering : 343 million tons

The share of the various waste producers is represented in the graph below:

Figure 47: Origin of French waste in 2004



In 2004, each person in France produced 353 kg of waste[462]. No systematic information exists on its composition. However, the MODECOM project, which consists in a sampling of household waste, will allow in 2009 to obtain a clear view of the composition of waste[463].

In line with the objectives of the National Action Plan for Waste Prevention, the annual quantity of waste produced by the household decreases since 2002: it was reduced by 6 kg /habitant/ year over the period 2002-2004[464].

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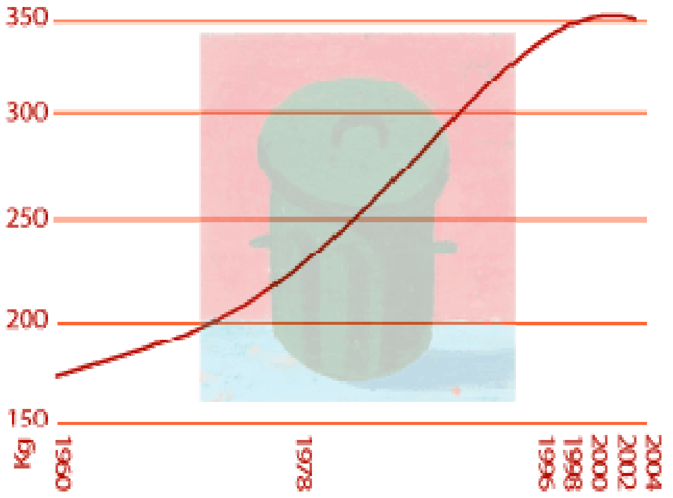
[462] It is not clear to the project team how this figure was calculated. 28 million tons of household waste with (approximately) 61 million inhabitants yields 459 kg, which is significantly more. The information available on the ADEME website does not allow to identify the definitions used.

[463] It is impossible to obtain any preliminary results before 2009. E-mail of Erwann FANGEAT (ADEME) of 13 June 2008.

[464] http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=17571 .

Figure 48: Waste produced per capita in France (1990-2004)



Household waste was disposed of as follows:[465]

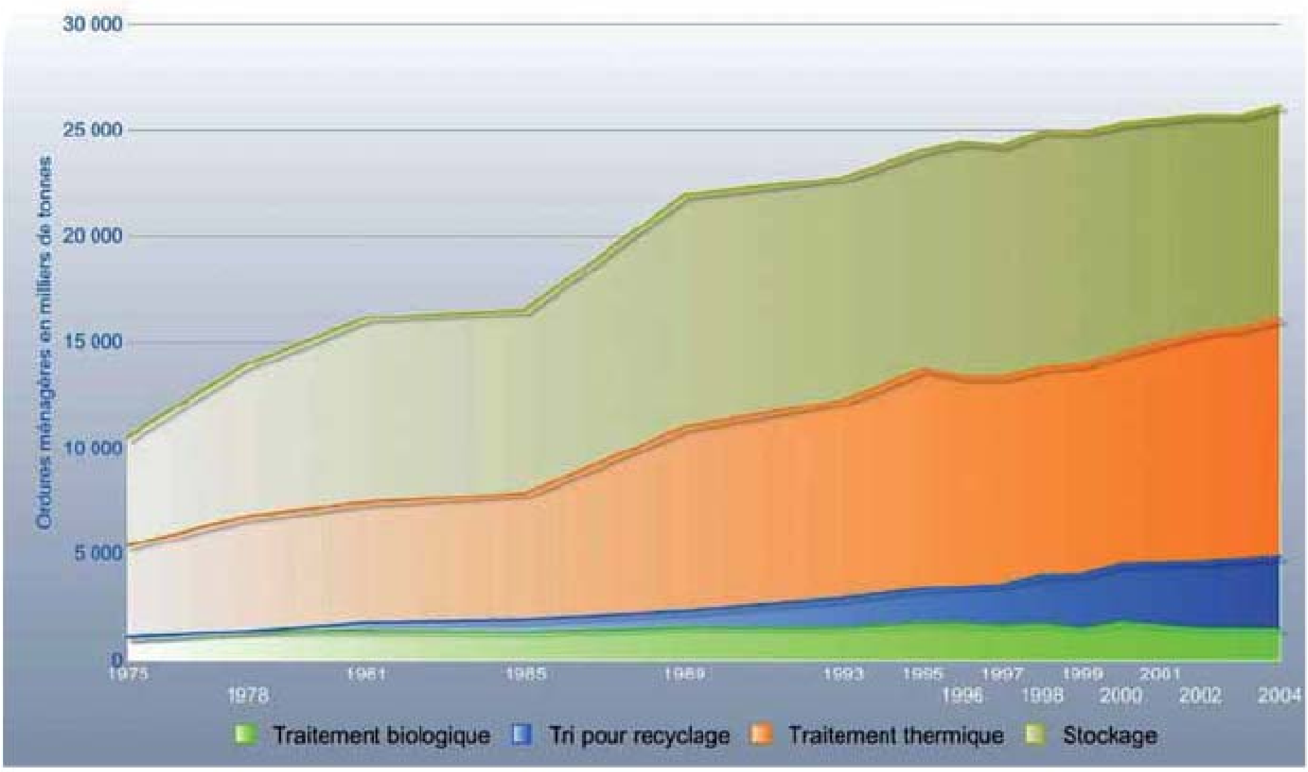
- Landfill : 38 % of quantities collected
- Incineration : 43 % of quantities collected
- Recycling : 13 % of quantities collected
- Biological treatment : 6 % of quantities collected

The following graph shows neatly how these shares have evolved through time[466] :

[465] Ibid.

[466] ADEME, Les déchets en chiffre, Données et références, Edition 2007.

Figure 49: Disposal options in France (1975-2004)



Source ADEME
Enquête ITOM 2004

Where

- Traitement biologique : composting, anaerobic digestions
- Recyclage : recycling
- Traitement thermique : incineration
- Stockage : landfilling

The amounts of waste sent to landfills have decreased significantly between 1999 and 2002, as compared to previous years: 49% in 1993, 46% in 1999 and 42% in 2002[467].

ADEME expects that the landfill industry will enter a further lengthy period of decline. If household composting, mechanical-biological treatment (MBT) and the different separate recovery system develop as expected, the level of household waste destined for landfill could drop from its current level of 9 million tons. ADEME also points out that the progressive banning of all recyclable waste in landfill sites could eventually penalise the production and recovery of biogas[468].

Still in 2004, the incineration of 12 million tons of waste resulted in the production of 3,800 GWh of electricity and 10,085 GWh of heating.

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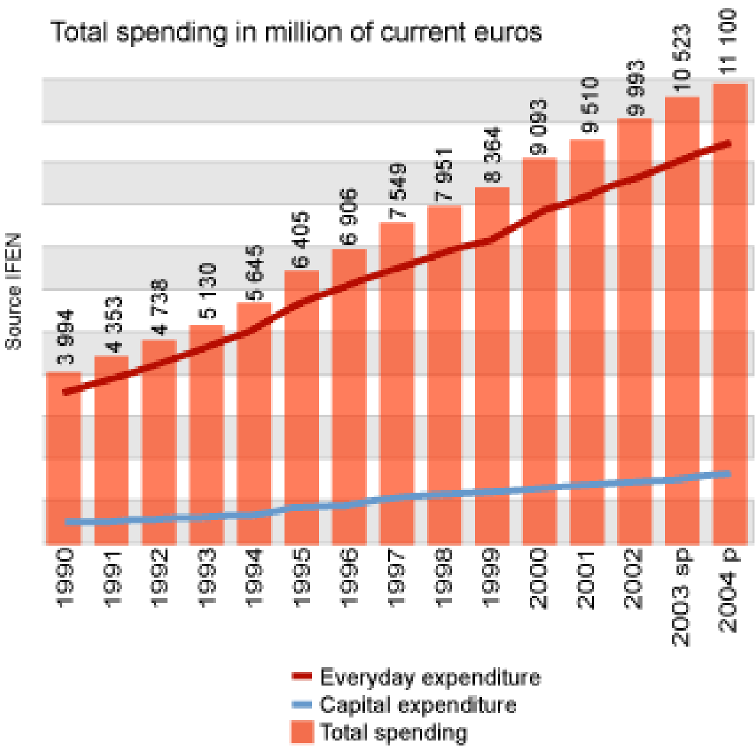
[467] EEA Country Fact Sheet.

[468] ADEME, MARKETS IN WASTE RELATED ACTIVITIES, Situation in 2005-2006 – Outlook for 2007, March 2007, Study realised for ADEME by In Numeri.

According to the IFEN[469], in 2004, more than 11 billion euros was spent on waste management, that is an increase of nearly 5 % compared to 2003. This increase is due partially to the increase of the investments in the sector (1.6 billion euros in 2004), especially in order to bring the incinerators into compliance. The current expenditures (9.5 billion euros) are financed at 59 % (that is 5.2 billion euros) by the households and the local authorities. The tax (TEOM) or fee (REOM) paid for the collection and treatment of household waste cover 86 % of this cost (see Section 9.3.9)[470].

Figure 50: French spending on waste management (1990-2004)



9.4.2. Separate collection of recyclable materials from household waste[471]

There are 2 systems for the separate collection of household waste in France[472]

- In a bring system, there exist usually individual containers for glass, paper waste and for packaging waste (including beverage cartons).
- In kerbside collection, there are specific garbage bags for paper waste on the one hand and for packaging waste on the other hand.

Glass is usually limited to bring systems, although some municipalities group glass waste with packaging.

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469 Institut Français de l'Environnement.

470 http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=17571

471 Unless stated otherwise, all information in this section comes from ADEME, MARKETS IN WASTE RELATED ACTIVITIES, Situation in 2005-2006 – Outlook for 2007, March 2007, Study realised for ADEME by In Numeri.

472 Information obtained from the ACN website.

It should be noted that none of the systems described above is compulsory, and that some municipalities collect beverage cartons together with waste paper.

Selective collection has been increasing steadily in the recent past. In 2002, it has increased by +17% as compared to 2000[473].

Between 2002 and 2005, the amounts of waste collected seperately grew by over 4% per year (3.9% in 2005). At the time of writing of the ADEME report, an increase of around 2.6% was expected for 2006, partly due to improvements made in sorting at source.

As a result, in 2005, 97% of the population benefited from the kerbside separate collection of various materials or had access to a public collection point. Between 70 and 90% of the population participates in a kerbside scheme, whilst 50 – 85% use public collection points.

Now that the separate collection has become almost universal, ADEME claims that the service is entering a period of optimisation of the system, with regards to both organisational and technical aspects.

For ADEME, the main focus should be on lowering costs and improving sorting at source. Amongst the factors encouraging the further progress of separate collection, efforts to improve the quality of public spaces should be mentioned, for example improving shared spaces around apartment blocks. Further increases in the amounts of waste collected should cause a rise in productivity and a drop in the average cost per ton of waste collection.

According to contractors, the price of separate collection rose by 2.5% in 2005 and by 3% in 2006. This is due mainly to increases in fuel prices, to the introduction of the 35 hour working week and to the application of safety measures. On the one hand, ADEME claims that the high level of competition between regional contractors (and in some cases businesses from the transport sector) has limited price increases. On the other hand, ADEME reckons that several factors seem to suggest prices will keep rising: the spiralling cost of fuel, the introduction of expensive equipment, the use of new technologies and a reduction in the share of glass in the collected waste.

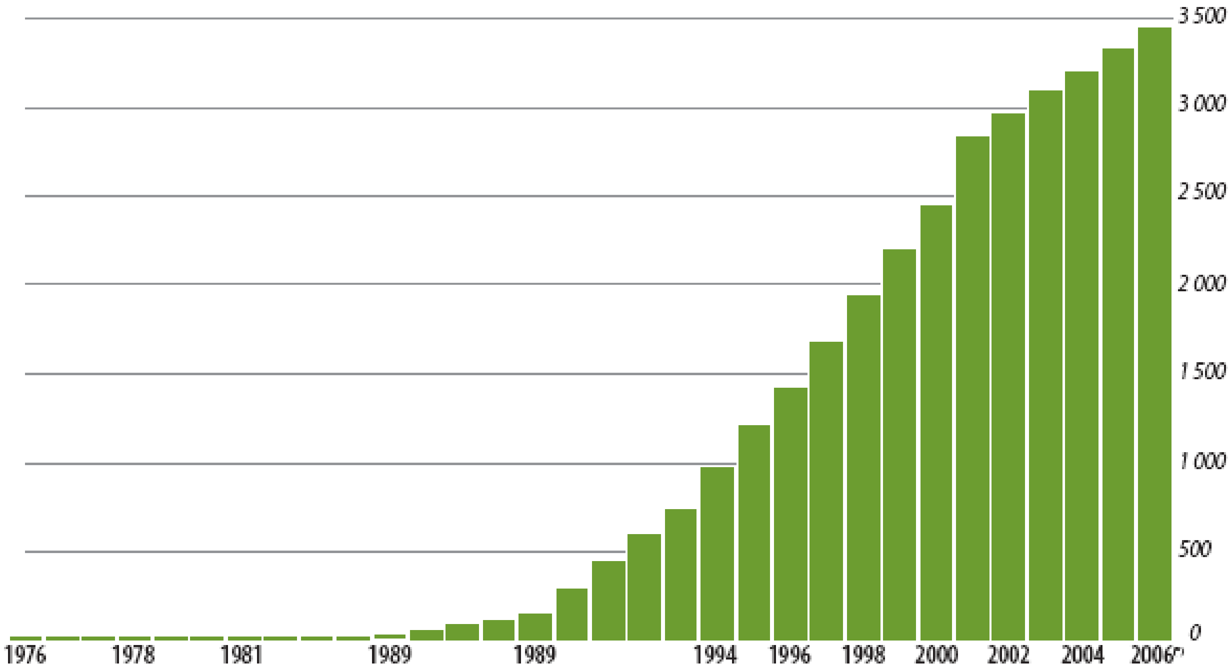
9.4.3. Management of container parks

It is interesting to see the evolution of the number of container parks, with a very pronounced take-off at the beginning of the 1990s:[474]

[473] EEA Country Fact Sheet.

[474] ADEME, Les déchets en chiffre, Données et references, Editions 2007.

Figure 51: Container parks in France (1976-2006)



In 2001 this service reached 73% of the population. By 2007 openings had slowed to a level of roughly 150, with annual growth hovering at around 4%.

According to a cross-section of around 20 Local Authority reports, the average composition of waste arriving in these sites is as follows ; ¼ rubble, ¼ green waste and ¼ bulky goods. The remaining ¼ was made up of various categories including scrap metal, wood, card and 'special waste' such as used oil, batteries and hazardous household waste.

Collecting an average of 124kg of waste per person, container parks are the second most important channel for the collection of waste. However, the amount brought per person varies wildly, depending on factors such as the number of sites in the area, but also on the region's urban or rural character. ADEME claims that, in a well equipped rural zone, up to 300kg of waste could be collected per person.

The low cost of collection in container parks means that they are fast becoming the most popular means of collecting garden waste and bulky goods. ADEME reckons that the difference in cost between kerbside collection and container parks for these types of waste can be as much as 1 to 4.

Based upon the Local Authority reports mentioned above, ADEME estimates that the average cost per ton for collection in container parks – not counting treatment and transport – is 40 €/t (ranges from 20 to 100€/t). This cost varies according to factors such as the size, opening hours and equipment used in each centre.

At the time of the writing of the report, ADEME thought it was still too early to tell what the future would hold for *mobile* container parks (such as those at Perreux, Nogent and Strasbourg) and their role in using special vehicles to collect hazardous waste from household.

9.4.4. Mixed collection of households waste

The actual amounts of *household* waste continue to rise, albeit slowly: around 1% per year alongside a total increase in household consumption of 2.5%. However, the increasing share of separate collection has led to a reduction in the amount of 'residual' waste to be collected.

Prices of mixed waste collection have risen by 3.5% between 2004 and 2005. This is mainly in response to the rising cost of labour and fuel. ADEME reckons that the high level of competition between regional contractors has limited price increases.

New systems such as GPS, on board weighing and mechanised collection are becoming more common, but ADEME judges that productivity is being held back by the flat rate tax pricing system. According to ADEME, productivity will, however, certainly improve as collections by 2 man teams, the collection of several types of waste at a time, and the multiple uses of equipments are developed further.

9.4.5. Mixed collection of non-hazardous waste from economic activities[475]

According to ADEME's 2005 survey, private collection is growing in comparison to own account waste collection and transport or collection by municipalities. Private sector collection share has risen from 71% to 90%, whilst public collection only accounts for 2.5%[476]. However, this increase in private collection is mainly concerned with monomaterial collections (+13%) and separate collection for sorting centres. Mixed collection for landfill and incineration is in decline.

ADEME expects the drop in amounts of mixed waste collection to continue, thanks to the combined effect of efforts to reduce waste at source and increased sorting. This is favoured by new service provision contracts for operators: pre-sorting at source and monitoring the production of non-hazardous waste. However, ADEME reckons that the rate of reduction at source will slow down, since this has mostly been put in place in large businesses.

The amended Packaging and Packaging Waste Directive (Directive 2004/12/CE) could provide a new impetus to separate collection and sorting. New services are being developed as part of the outsourcing of waste management: kerbside collection for each business, internal waste management, detailed reporting.

9.4.6. Collection of non-hazardous waste from economic activities for sorting facilities

Separate collection has grown over the last few years. According to ADEME, this can be attributed to the progress made in sorting by businesses, which is in turn partly due to outsourcing contracts for managing waste at large industrial sites. This trend also benefits from the favourable context created by the rise of raw materials prices.

ADEME reckons that sorting at source still has significant prospects for growth, especially with regards to small and medium sized businesses. However, other constraints threaten further productivity, such as the reduction of collection times or the increase in tests on entering and exiting plants.

[475] In this section 'non-hazardous waste from economic activities' means all non-hazardous and non-inert waste produced by economic activities; waste from forestry, fishing and food-processing industries is not covered, nor is waste from the building industry or public works.

[476] However, this can constitute a significant fraction of municipal waste.

According to ADEME, operators would favour the development of shared collection (collective grouping in industrial or commercial zones, which raises the problem of mistakes in sorting at source, especially when it comes to hazardous waste).

We will come back to the issue of waste from economic activities in Section 9.12.2.

9.5. EXTENDED PRODUCER RESPONSIBILITY IN FRANCE[477]

For the waste streams covered by this study, the following Decrees have introduced extended producer responsibility (packaging waste is covered in more detail in Section 9.6 and batteries in Section 9.8):

- Since August 2005, all those who put EEE on the market in France are compelled to organise and to finance the free take-back of WEEE[478]. Producers can be exempted from these obligations if they create an individual take back system or if they contribute to an accredited body[479]. In the field of WEEE, 4 bodies have been accredited (Ecologic, Eco-systèmes, ERP-France et Récyclum[480]) for the collection and the treatment of WEEE, and one coordinating body (OCAD3E) that is in charge of paying the financial compensations to the local authorities. In October 2006, no accredited body was yet put in place for professional WEEE. A working group on eco-design has been created by the Ministry of the Environment and the eco-systems.
- The ELV Directive (Directive 2000/53/EC) was transposed in French legislation in 2003[481]. This legislation holds the vehicle manufacturers responsible for putting in place a system for vehicle recovery by accredited treatment facilities. It also imposes the following targets:
    - No later than 1 January 2006, for all ELV the reuse and recovery shall be increased to a minimum of 85 % by an average weight per vehicle and year
    - No later than 1 January 2015, for all ELV the reuse and recovery shall be increased to a minimum of 95 % by an average weight per vehicle and year

9.6. FRENCH POLICY WITH RESPECT TO PACKAGING WASTE[482]

9.6.1. Regulatory framework: overview

Packaging waste in France is covered by the Directive on Packaging and Packaging Waste[483].

These Directives have been transposed in French Law by the following Decrees:

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477 All information in this Section has been obtained from Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Décembre 2006, Etude réalisée pour le compte de l'ADEME par In Numeri.

478 Decree 2005/829 transposing Directive 2003/96/EC (the "WEEE" Directive).

479 Or "éco-organisme" in the French terminology.

480 Recylum is specialised in the recovery of lights.

481 Décret sur la construction des véhicules et l'élimination des véhicules hors d'usage: n° 2003/727 of 1 August 2003" (published in the Official Journal n° 179 of 5 August 2003)

482 Unless stated otherwise, all information (including the graphics) in this Section has been obtained from ADEME, Emballages industriels et ménagers, Collection Repères, Données 2004.

483 Directive 94/62/EC amended by Directive 2004/12/EC

- Decree 92-377: the producer, the importer or the entity putting *household* packaging on the market is compelled to contribute to or to organise the removal of all its packaging waste.
- Decree 94-609: companies who hold *non-household* packaging waste are compelled to recover them (through material recycling, organic recycling or energy recovery).
- Decree 96-1008: the plans for the removal of household and assimilated waste have to contain a chapter on the prevention and the recovery of packaging waste, with objectives at least equal to those required in the Directive; these plans must include the organisation of separate collection systems. This Decree has been modified by Decree 2005-1472 to take account of the revised version of the Packaging Waste Directive.
- Decree 98-638 requires enterprises to incorporate environmental requirements in the design and the manufacturing of packaging.

9.6.2. Household packaging waste

In the case of household packaging waste, there are three ways in which the company who has put the packaging on the market can comply with Decree 92-377:

- It can work with a deposit-refund system. For household packaging, this is rarely used.
- It can organise an individual take-back system that has to be authorized by the authorities.
- It can participate in a collective body accredited by the public authorities.

In the case of household packaging, there are two accredited bodies (or "éco-organismes" in the French terminology): Adelphe and Eco-Emballages. Eco-Emballages and Adelphe operate according to the Green Dot principle whereby they collect funds from the companies that put packaging on the market and use these funds to support separate collection, sorting and recycling.

Eco-Emballages is a non-profit limited company incorporated in 1992: Producers (packers-fillers, sectorial federations) hold 70% of Eco-Emballages' share capital which is divided between 240 shareholders. The material organisations hold 20 % and distributors hold 10 %. In 2007, 47,000 companies were members of Eco-Emballages.

Adelphe was licensed on February 1993. It is a limited company whose shareholders are mainly producers from the wine and spirits sector[484].

Following organisational and financial problems experienced by Adelphe, in 2005, Eco-Emballages took a 85% share in Adelphe's capital[485]. On this specific issue, association AMORCE[486] claims that the contributions from pharmaceutical packaging have been used to finance the deficit of ADELPHE[487].

The accreditation of Eco-Emballages and Adelphe was renewed on 30 December 2004.

The local authorities remain responsible for the management of packaging waste and receive financial support from one of the accredited bodies. Funds are given to municipalities /groupings of municipalities

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[484] http://www.pro-e.org/Organisation_france.html

[485] Eco-Emballages, Annual Report 2005, http://www.ecoemballages.fr/fileadmin/contribution/pdf/instit/rapports-annuels/rapport-annuel-2005-english.pdf

[486] Amorce is an association of local authorities and professionals involved in, amongst others, municipal waste management – see http://www.amorce.asso.fr/ .

[487] AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

for separate collection and sorting in the form of a subsidy per quantity collected. Subsidies are material specific and rise with the performance measured in terms of kg/head of sorted materials.

Since 1993, most packs participating in Eco-Emballages have been paying 0.15 € cent irrespective of the material or weight.

From year 2000 on, the principles of the new fee structure provide for a fee by weight of each material plus a fee per pack – taking account of the weight should provide better incentives for packaging waste prevention.

Figure 52: Fee structure of Eco-Emballages in 2007

Fee by weight of material euros/kg (2007) [488]	
Steel	0.0226
Aluminium	0.0453
Paper/cardboard	0.1221
Plastics	0.1778
Glass	0.0036
Other	0.1221

Eco-Emballages also carries out communication campaigns in favour of separate collection and plays an active role in providing services to local authorities (including cost accounting, optimisation software for sorting centres, decision support tools) and to SME (prevention campaigns, support for ecodesign). It also provides certification for local authorities and promotes the exchange of "best practices"[489]. As we shall see below, the Centre National du Recylage[490] questions that this should be part of the activities of the "éco-organismes".

Eco-Emballages and Adelphe provide financial support to local authorities that fulfil 5 conditions[491]:

- Waste must be sorted and supplied to the recycling industry according to predetermined materials standards.
- They must provide a proof of effective recycling
- The quantities and the quality of the household packaging waste must be traceable
- They must control that evidence exists that recycling has taken place within conditions that are broadly equivalent to those prescribed by Community legislation

[488] http://www.pro-e.org/Financing_france.html

[489] Eco-Emballages, Rapport annuel 2007

[490] The Centre National du Récyclage is an association of actors involved in recycling – see http://www.cercle-recyclage.asso.fr/ .

[491] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006.

- The industrial and financial processes must be transparent in order to allow synthetic reporting

In the current system, local authorities can choose between three collection systems[492]:

- **The "Guarantie de Reprise" provided by Eco-Emballages and Adelphe**. This system complements the financial support and guarantees the take-back for recycling of waste products following *predetermined* technical and financial conditions (for a 6 year period). The system guarantees a positive or zero takeover price for waste. For each material stream, specific organisations have been created (Arcelor Mittal Packaging, FAR, Revipac, CSVMF and Valorplast). These organisations, the so-called "filières", take back the waste collected by the local authorities according to the pre-determined contractual conditions. Participation in each "filière" is open to any recovery company meeting the technical, economic and environmental requirements. The recovery company pays the local authority for the waste provided. Eco-Emballages and Adelphe subsidises the transportation costs between the local authority and the first industrial facility[493] and reimburses 50% of the operating costs of each "filière". As Eco-Emballages and Adelphe themselves point out, the economics of each "filière" are different, and one should avoid making sweeping generalisations based upon the functioning of an individual "filière".
- **The "Reprise Guarantie" provided by the professional waste management associations FEDEREC and FNADE**. In an agreement signed in 2004 between FEDEREC, FNADE, Eco-Emballages and Adelphe, the professional waste management associations FEDEREC[494] and FNADE[495] committed their members to respect a certain number of principles: the traceability of the recycled quantities, effective recycling, and minimum prices guaranteed for the complete territory of the country and for the duration of the contract. Thus, the professional associations guarantee that all waste collected and sorted by the local authorities who have signed a contract with the accredited bodies will be taken back and recycled for the duration of the accreditation. Moreover, they guarantee that the price for this takeover will be positive or zero. Eco-Emballages and Adelphe reimburse part of the incremental costs linked to compliance with the requirements described above.
- **The "Reprise collectivité" under the sole responsibility of the local authorities**. In this case, it is up to the local authorities to show that they comply with the conditions that are required for obtaining the financial support.

In 2007, the income of Eco-Emballages was 411 million EUR, 92.3% of which was paid to local authorities. In total 36,161 out of the 36,679 French municipalities are covered by the system, corresponding to 59.5 million inhabitants[496].

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[492] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006.

[493] Thus promoting the proximity principle.

[494] Fédération de la Récupération, du Recyclage et de la Valorisation (http://www.federec.com/). FEDEREC is member of the BIR.

[495] Fédération Nationale des Activités de la Dépollution et de l'Environnement (http://www.fnade.com/).

[496] Eco-Emballages, Rapport annuel 2007

It is important to point out here that the Centre National du Recyclage[497] (CNR) reckons that the amounts paid by the accredited bodies are largely insufficient to cover the expenses of the municipalities, and thus that the costs linked to waste recovery are not internalised[498]. Therefore, the CNR claims the French EPR for packaging does not have a real impact on waste prevention. Of course, internalising this cost would imply higher contributions from the producers of packaging waste, and would also be reflected in the prices paid by the consumer.

The CNR also points out that the expansion of the scope of the activities of Eco-Emballages (to consulting services for authorities and SMEs[499]) raises several important questions (cross-subsidisation of these new activities by the members' contributions, conflicts of interest), even if the accreditation conditions of Eco-Emballages does not prevent it from doing so[500].

Association AMORCE thinks that reduction at the source remains too limited. Therefore, AMORCE thinks that the Green Dot fees should be differentiated to reflect recyclability of the products. AMORCE also regrets that the financial contribution to waste management coming from the éco-organismes remains too limited. According to AMORCE, numerous local authorities claim that Eco-Emballages is becoming stingier in its support to waste management[501].

9.6.3. Industrial packaging waste

In the case of industrial packaging waste, the final waste holder has three possibilities to comply with Decree 94-609:

- Recovery in its own accredited waste management facilities
- Hand over to an accredited waste management facility
- Hand over to an intermediary involved in waste transport, trade or brokerage activities.

In the two last cases, a contract must cover the transaction. If the waste holder produces less than 1.100 litres per week and hands over his waste to a public service, he is exempted from the recovery clause.

There is currently no collective accredited body and each enterprise must comply individually. However, the packaging industry has created bodies assisting the waste holders:

- For plastics: Ecofut[502], CSEMP, EcoPSE[503],

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[497] The Centre National du Récyclage is an association of actors involved in recycling – see http://www.cercle-recyclage.asso.fr/ .

[498] Centre National du Recyclage (2007), Analyse des rapports d'activité 2006 des sociétés agrées Adelphe et Eco-Emballages.

[499] In this context, it should be mentioned that, together with ADEME, AMORCE is also promoting the use of the cost accounting tool ComptaCoût. Notwithstanding important efforts, response has remained limited - see AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

[500] Centre National du Recyclage (2007), Analyse des rapports d'activité 2006 des sociétés agrées Adelphe et Eco-Emballages.

[501] AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

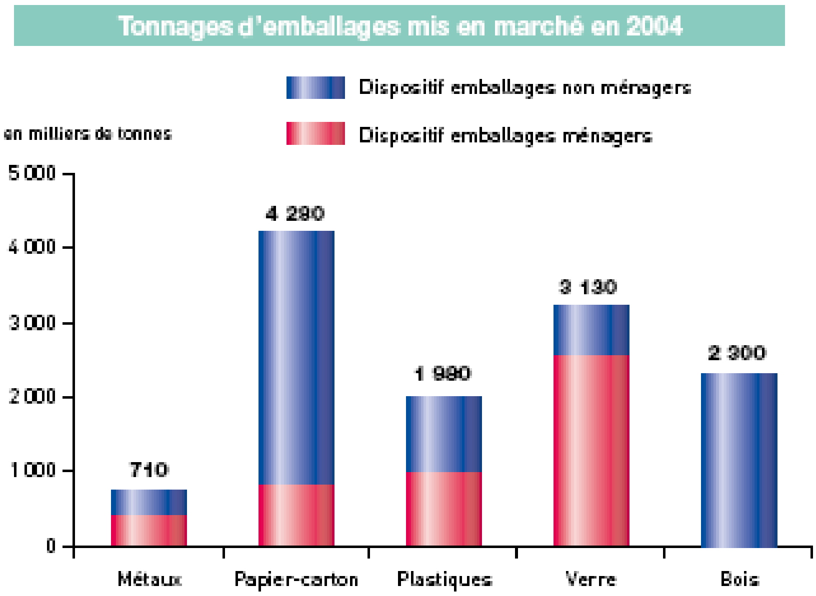
[502] In France, ECOFUT organises the recovery of HDPE industrial packaging and PP buckets – see http://www.ecofut.org/ .

- For paper and cardboard: Revipac
- For metals: Recyclacier, France Aluminium Recyclage
- For wood: Grow, Synarep

9.6.4. Facts and figures

In 2004, 12.4 million tonnes of packaging have been put on the market in France (of which 4.8 million tonnes of household packaging waste).[504]

Figure 53: Packaging in France in 2004



Since 2001, the amounts of packaging in France have stabilised, mainly due to a reduction in the unit weight of packaging. This is shown below:

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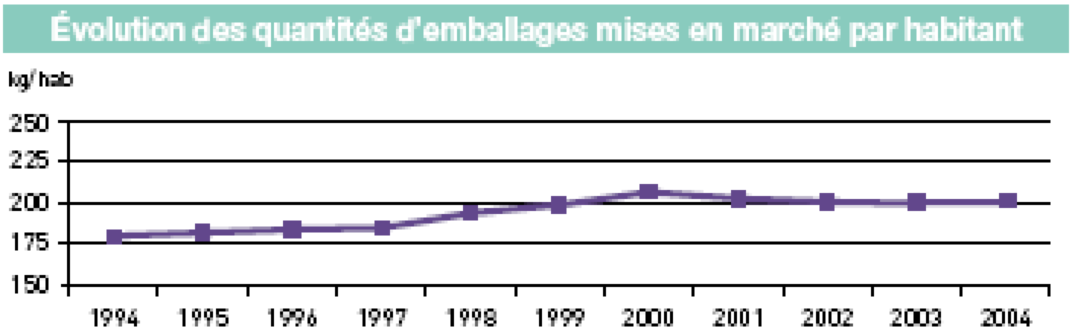
[503] ECO PSE is an industry sector association founded in June 1993 to represent the common goals of the Expanded Polystyrene (EPS) Packaging French manufacturers – see http://www.ecopse.fr/site/core.php?page=6.1 .

[504] In this figure, "métaux" stands for metals, "papier-carton" for paper and cardboard, "plastiques" for plastics, "verre" for glass and "bois" for wood.

Figure 54: Packaging per capita in France (1994-2004)



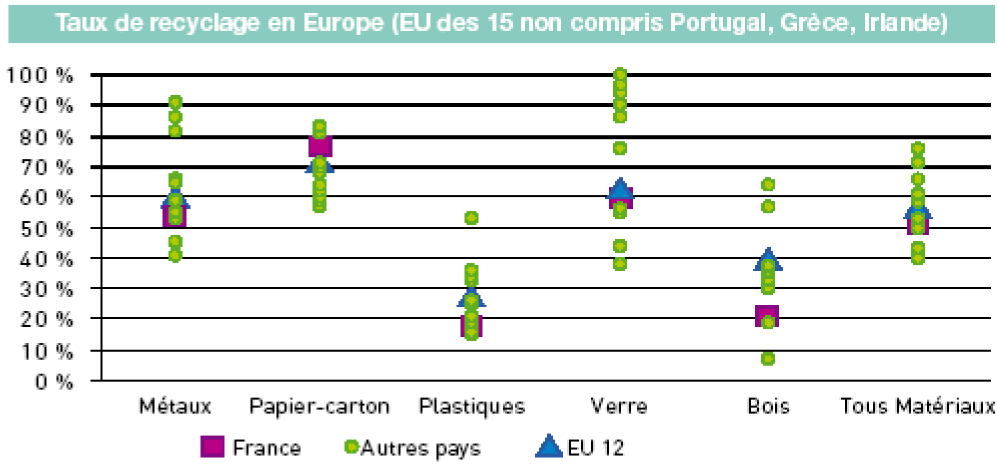
In 2006, the amounts of household packaging waste had decreased to 4.4 million tonnes (this is less than in 1994)[505].

France has the highest consumption of packaging in the EU-15 (200 kg per inhabitant per year), which ADEME reckons to be mainly due to its use of glass and wood. The use of glass is due to the specificities of the alcohol drinks consumed and the absence of a deposit refund system. ADEME claims that the higher consumption of wood is mainly a statistical artefact due to incoherencies in data across countries.

Local authorities collect 55% of packaging waste, one third of which does not originate from households.

Global packaging recycling rates are low in France compared to the EU15 average. For plastics in particular, recycling rates are very low, whilst they are above average for cardboard:

Figure 55: Recycling rates in France in an European perspective



Between 1994 and 2004, the quantities of *recycled* packaging waste have increased on average by 6% per year. ADEME claims that this is mainly due to the separate collection of household packaging waste. In the case of industrial packaging, the recycling rates have also improved following a further expansion of recovery channels, structured by the professional organisations we have described above.

77% of the waste contributing to Eco-Emballages has been recovered, and 61% recycled. 55% of paper and cardboard was recycled.

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505 Ademe, Eco-emballages et Adelphe, Le gisement des emballages ménagers en France, Evolution 1994/2006

The 2 most important areas of concern are the low levels of selective collection in apartment blocks and during events. Several public awareness campaigns aim at improving collection rates.

9.7. PVC

In this Section, we will discuss the three PVC waste streams on which we have found some data: C&D, ELV and households. However, we first discuss plastics waste in France in general.

9.7.1. Plastics waste in France: generalities

ADEME has organised surveys of the plastics waste streams in 1995, 1997, 2000, 2002 and 2005. The graphs below show the relative shares of the different polymers in 2005 and 2002 [506]:

Figure 56: Relative shares of polymers in French plastics waste streams in 2005

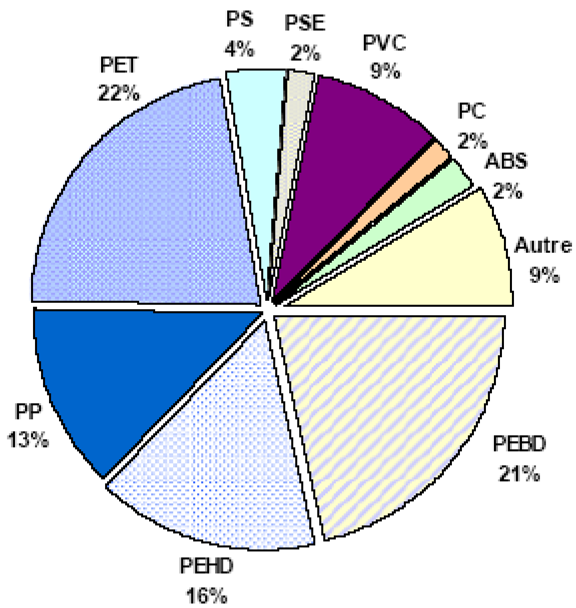
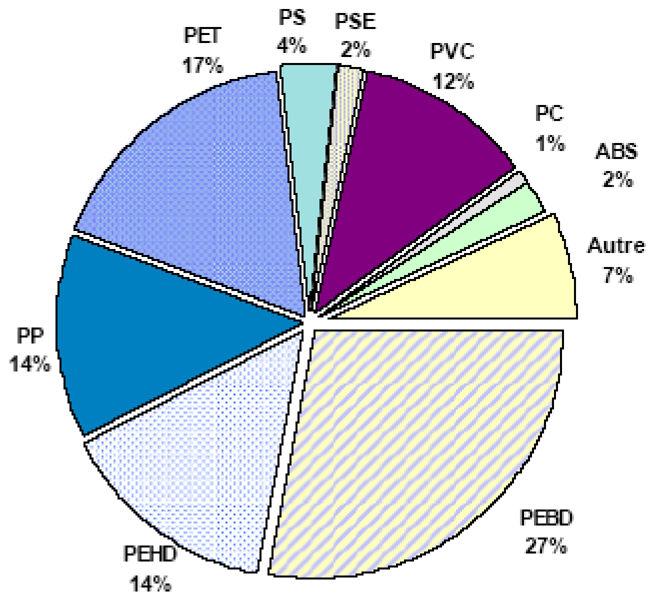


Figure 57: Relative shares of polymers in French plastics waste streams in 2002

[506] In Numeri (2007, Enquête sur le recyclage des plastiques en 2005, Etude réalisée pour le compte de l'ADEME, Rapport final, Février 2007.



The share of PVC is relatively small and decreasing.

According to OVAM (2008b), half of the plastic waste in France is landfilled. Recycling (including feedstock recycling) corresponded to 13% and incineration with energy recovery 37% of total waste. OVAM has not identified any specific measures taken to promote plastics recycling.

Recently, a working group coordinated by ADEME has made the following observations[507]:

- The current cost of landfilling does not provide enough incentives for collecting and sorting plastic waste.
- Very little is known on the actual amounts of plastic waste available. This is due, on the one hand, to the absence of any reporting requirements and, on the other hand, to the uncertainties with respect to the lifetime of plastics.
- The information that would allow determining the plastic waste streams for which there exists further potential for improvement is not available.
- The long lifespan of plastic lead to a discrepancy between the needs of the recyclers and the waste that becomes available.

The working group had discussed generalizing the approach of Vinyl 2010 (see Section 3.3.1) to other plastics and markets than PVC from C&D waste[508]. However, plastic producers opposed the idea of having to finance the collection of plastics for recycling.

The working group discussed several issues related to the costs of sorting and recycling technologies, but no points were raised that we have not discussed before in this report.

On the demand side, the French situation is also characterised by potential buyers who are suspicious of the quality of recycled products. FEDEREC expects this attitude to change if commodity prices continue to increase.

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[507] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

[508] Note that this can be seen as an application of the principle of extended producer responsibility.

Two points are noteworthy on this issue:

- The working group has not proposed to further develop standards for recycled plastics, but rather to develop specifications that are independent of the origin of the material. Some participants had indeed voiced the concern that standards for recycled products would emphasize the differences between virgin and recycled products.
- Industrialists are reluctant to make known to the public that they use recycled products, even if they are themselves convinced that there is no difference in quality compared to virgin products.

The working group also agreed on the necessity to create a recycling research knowledge centre that would help to focus research on priority subjects and would supervise projects in an industrial environment.

Finally, the working group has pointed out that the automobile sector is the only sector that is confronted with recyclability requirements. Several measures to stimulate ecodesign have been proposed, such as including recyclability requirements in tenders.

9.7.2. PVC Recyclage

The main source of PVC waste in France is C&D waste[509].

PVC Recyclage fulfils the commitment of Vinyl 2010 (see Section 3.3.1) in France. It was created by the French converters of rigid PVC.

It takes back all rigid PVC waste, sorted according to its specifications. This waste is then recovered in applications such as pipes and profiles.

It collects the following types of PVC waste:

- Pipes, drainpipes in all colours except black, gutters
- Profiles: windows, doors…

Since Vinyl 2010 has become active, the amounts of PVC waste collected have increased from 200 tonnes per year (in 2002) to 12.000 tonnes. This corresponds to 5% of the amounts of PVC sold each year. [510]

9.7.3. PVC from vehicles

In France, the potential amount of *automotive* plasticized PVC to recycle includes[511]:

- 6 000 tonnes per year of PVC waste from production scraps: 75% are land filled and 1500 tonnes per year are recycled
- 6 000 tonnes per year of PVC waste from End-of-Life vehicles (ELV): this volume has been calculated by assuming that (1) 4 kg per vehicle of PVC become available by dismantling and/or coming from the automobile shredder residue (2) 1.5 million vehicle reach the ELV status per year.

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[509] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

[510] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

[511] Information obtained from http://www.autovinyle.com/ .

On 23 January 1997, various companies involved in automotive PVC created the Association AUTOVINYLE, with the following objectives:

- Developing and promoting PVC waste recycling coming from ELV or production scraps in order to cut down land filling.
- Progressively increasing the volumes being processed: 5,000 tonnes of plasticized PVC should be recycled in 2010 at recycler facilities.

The current members of the association are:

- Carmaker: PSA-Peugeot / Citroën.
- Equipment manufacturers: Faurecia and Griffine Enduction
- PVC producers: Arkema, LVM, Résinoplast and Solvin France
- Recyclers: Etablissements Bernard Chaize, Vinyloop

We have referred elsewhere (see Section 5.2.7.3) to the pilot studies AUTOVINYLE has sponsored in the field of selective dismantling.

Three dismantler members of the INDRA network collected several tonnes of PVC waste in 2004. These flexible PVC products were tested in existing recycling technologies such as the densification process from CHAIZE Company and dissolution process from VINYLOOP Company[512].

9.7.4. PVC from packaging[513]

PVC currently represents less than 1% of plastic bottle waste. In the "guarantee de reprise" system, local authorities were originally requested to sort PVC, PET and HDPE. Now that PVC has been replaced almost entirely by PET in bottle packaging, the sorting takes place according to the following criteria:

- "clear" PET, "dark" PET (together with PVC) and HDPE (together with PP)
- Or: colourless PET, coloured PET and HDPE (together with PP)

The following table gives the quantities per resin:

	PET	HDPE	PVC	Total
Tonnes in 2006	103,053	43,163	589	146,806

The total amounts of PVC in packaging represents less than 0.5% of the total plastics fraction. They have been entirely recycled in Asia.

The "guarantee de reprise" system covers 67% of the population, and 74% of weight. The average price obtained in this system is 188.58 EUR per tonne.

The "reprise guarantie" covers 30% of the population and 26% of weight, and the average price obtained is 140 EUR per tonne. In this system, PVC collected (210 tonnes) corresponds also to less than 0.5% of the plastics fraction in packaging waste.

[512] We have found no independent assessment of the potential of these pilot projects.

[513] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006

9.7.5. PVC from WEEE

Eco-systèmes collects annually 2,500 tonnes of plastics from WEEE that go to recyclers who sort out the different polymers. As PVC is not included in the Annex 2 list of the WEEE Directive, there are no specific data on the amounts of PVC collected[514].

9.8. BATTERIES

The last official report on the situation in France was written by Ernst & Young on behalf of ADEME[515]. This report was published in December 2007, and described the situation in 2006. Unless states otherwise, all information in this Section comes from this report.

9.8.1. Statistics

28,700 tonnes of batteries have been sold in France in 2006, which is an increase of 0.5% compared to 2005. This slow-down in growth is partially explained by a gradual switch to rechargeable batteries. 4,939 tonnes of rechargeable batteries were put on the market, which is a 23% increase compared to the 2005. This increase is at least partially due to the increased sales of portable electronic equipment (digital cameras, MP3 players, portable GPS etc). Finally, 1,579 tonnes of industrial accumulators have been sold in 2006, which is 23% increase. However, according to the Ernst & Young report, this is not due to a real increase in sales, but rather to more accurate reporting. Finally; 191,343 tonnes of non-portable lead batteries were sold, which is a 5% decrease.

8,769 tonnes of batteries were collected in 2006, which is 25% increase compared to 2005. 1,519 tonnes of non-lead accumulators were collected, which is a 11% percent increase compared to 2005. Finally, 175,333 tonnes of lead accumulators were collected. This is small increase compared to 2005, which can be attributed to the high price of lead.

With respect to collection rates, the objective of 25% imposed by the new "battery" Directive was already reached. However, as national collection rates had been stagnating at around 30% for several years in a row, the concern was raised that it would be difficult to reach the 45% objective in 2016 without supplementary measures.

In 2006, there were 16 recycling plants in France.

12,332 tonnes of batteries were treated in France in 2006, which is a 46% increase compared to 2005. 5,000 tonnes were imported, including a significant fraction *from* Asia! The quantities of non-lead accumulators decreased with 20% compared to 2005 (3,105 tonnes in 2006). Finally, 224,796 tonnes of lead accumulators were treated (2% increase compared to 2005).

9.8.2. Regulatory and organisation framework

The Ernst&Young report describes a situation that is still covered by Directive 91/157/CE instead of the new "battery" Directive 2006/66/CE.[516] However, in 2006, French regulations already complied with most

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[514] Information provided by e-mail by Soline Van Wymeersch of Eco-systèmes.

[515] ADEME, Piles et accumulateurs, Synthèse, 2007.

[516] According to the latest information available on the website of ADEME, transposition is expected by the end of 2008.

requirements of the new Directive: selective collection of *all* batteries and accumulators[517], producer responsibility for household battery waste, take back obligation for retailers on a 1/0 basis.

The clauses that still needed to be transposed in national law were:

- Upper limits on the cadmium contents
- Indication of the capacity
- Producer responsibility for professional batteries and accumulators

There are currently two collection systems for the batteries and accumulators coming from households:

- Almost all retailers selling batteries and accumulators currently have containers for take-back. However, there are sometimes problems with the visibility of these containers…After-sales services also take back significant amounts of batteries and accumulators.
- Local authorities also take back batteries in container parks. Some local authorities have also started collection points in schools.

These collected batteries and accumulators are then taken charge off by accredited bodies. These bodies are either:

- Collective bodies created by several producers and importers; the members of the collective bodies pay an annual contribution. The two most important ones are Corepile and Screlec –we discuss them more in detail below. There are also 2 smaller bodies. Compared to 2005, the number of collective bodies has decreased, but their affiliation has increased.
- Individual bodies created by single producers; this is for instance often the case with chains who sell batteries under their brand name and use their retail network to collect the batteries and accumulators. In total, there are 14 individual bodies. There is also a tendency for these individual bodies to integrate themselves in collective systems. Individual bodies have to pay themselves for the cost of treatment and are responsible for treatment in compliance with legislation.

The accredited bodies use the services of waste collectors to transport the waste batteries to triage or treatment facilities.

Local authorities receive no financial support for the selective collection systems they organise[518].

Waste batteries and accumulators coming from professional users are managed by the waste generators themselves[519]. The majority of companies directly contract with private waste collectors, or integrate the collection of batteries and accumulators in their maintenance activities. However, they can also use the services of collective accredited bodies[520].

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[517] In the first Decree introducing EPR in France, collection was limited to batteries containing hazardous materials. This was problematic to implement, as households had difficulties to differentiate between batteries that required collection and the others. Decree 99/374 of 12 May 1999 mandated collection of all used batteries. – see Arnold, O. (2005), Efficiency of the battery channel, Ministère de l"Ecologie et du Dévelopement Durable, Working Paper 2005 - 02, p. 13.

[518] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

[519] It should be mentioned here that, apparently, the containers set up by companies contain a significant amount of household waste originating from their employees.

[520] Information from the ADEME website.

Thanks to the high value of their metal content, lead batteries have been part of a self-financed collection system. Therefore, there is no need for a financial contribution coming from the producers.

9.8.3. WEEE[521]

A specific WEEE collection system was put in place in November 2006. It was expected that the effects would be felt in 2007-2008.

Consumers can take back their WEEE free of charge to retailers, waste collection centres in the municipalities and the social organisation Emmaüs. The collection points receive financial support from the eco-organisms. In parallel, some consumers go to scrap dealers that are willing to pay for WEEE, but who do not necessarily maintain high environmental standards. Due to their nature, activities taking place outside the official circuit are not included in the calculation of recycling rates[522].

The mixed small appliances containing batteries (laptop computers, GPS, DIY and gardening tools, toys) pose two particular problems.

First, their collection rate is significantly smaller than for other categories of WEEE, for several reasons:

- hoarding
- the financial or emotional value of the product
- ignorance of the private user with respect to the presence of batteries or accumulators
- their small size which makes it more attractive to dump them with mixed household waste

Second, often, batteries are not separated from the equipment before shreddering. As 25% of batteries and accumulators put on the market are integrated in electronic and electronical equipment, this is a significant problem.

In principle, the batteries and accumulators contained in WEE should be collected seperately by the eco-organisms responsible for batteries. If batteries are found in small household appliances, the eco-organisms responsible for WEEE extract them and send them to Corepile and Screlec[523].

The eco-organisms responsible for WEEE would like now to be involved also in the collection of batteries. It is not clear how the dividing line between PRO for batteries and PROs for WEEE will evolve in the future[524].

A specific concern of AMORCE is that the accredited bodies for WEEE have divided the French territory amongst themselves instead of respecting the freedom of local authorities to choose the body they want to collaborate with[525].

According to the Centre National du Recyclage, the proliferation of accredited bodies can be attributed to difficulty of having competitors collaborating on the issue of take-back of waste.

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[521] Information obtained from SCRELEC website.

[522] Information provided by e-mail by Soline Van Wymeersch of Eco-systèmes. As 98% of retailers in France are member of Eco-systèmes, this information can be considered to be representative.

[523] Information provided by e-mail by Soline Van Wymeersch of Eco-systèmes.

[524] Phone interview between Mr Gros (COREPILE) on 29 May 2008.

[525] AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

Finally, the transposition of the WEEE Directive in France has led to the rapid implementation of recycling techniques already in use abroad[526].

9.8.4. COREPILE[527]

In 2007, Corepile had 6 shareholders and 131 affiliated companies, corresponding to a market share of 60%[528]. Corepile's typical members are producers of batteries and large retail chains. The contribution of the members is based upon the weight they put on the market, corrected for the cost of recycling (the costs of collection, administration etc are the same for all the battery types).

In 2007, it collected 6,125 tonnes (collection rate of 31%). The main priority axes for the further expansion of its existing collection network (23,000 collection point) are schools and companies.

Concerning its costs structure, the total cost of 5,238,000 EUR is composed as follows:

Table 78: Cost structure of Corepile

Cost category	Share in %
Operational costs	76
Administrative and studies	13
Marketing	11

It is interesting to see how the total amounts of collected batteries are distributed amongst the collection points:

Table 79: Corepile collected batteries according to collection points

	Year 2004	Year 2005	Year 2006	Year 2007
Food retailers	1003	1432	1753	2095
Container parks	2142	2380	2678	2999
DIY retailers	60	68	79	80
Companies	243	260	391	592
Others	177	195	234	359
Total	3625	4335	5135	6125

[526] Information provided by e-mail by Soline Van Wymeersch of Eco-systèmes.

[527] All information in this section is based upon COREPILE, Bilan d'activités 2007and a phone interview of Mr Gros (COREPILE) 29 May 2008.

[528] It had started in 2004 with 34 members.

"Others" includes libraries, shops, (tobacco, toys, electricity, gardening, garage, TV), schools.

Actual collection rates are the lowest in densely populated areas (Ile de France, Pas de Calais, Nord).

Corepile works with small waste collectors, who have grouped themselves in a federation. The market is allocated on geographical base. There is no tendering of the market but prices are renegotiated each year – Mr Gros of Corepile thinks that the tendering procedure is too heavy.

9.8.5. SCRELEC

In 2008, Screlec had 9 shareholders and 258 affiliated companies (51 more than in 2006). In 2007, it had collected 1,500 tonnes of batteries and accumulators (1,119 tonnes in 2006).

Screlec targets mainly integrators (Philips, Sony...), wholesalers of electric and electronic products[529].

The SCRELEC network covers the entire French territory. Membership fees are transparent[530], depend both on the weight and the type of metals used in the batteries, and cover all costs.

9.8.6. Evaluation

According to a study undertaken for ADEME, since 2001, there has been an average annual increase of 25% in the collection of batteries and accumulators. However, the study concludes that collection and treatment costs remain high and the quantities collected are still insufficient to supply French recyclers. It was expected that the collection system for WEEE and the new Battery Directive would lead to an increased supply. The study also points out that batteries have a low recycling potential because of the difficulties linked to their collection (low unit weight, low quantities, low geographical density) and high treatment costs[531].

In its most recent annual report, AMORCE has taken the position that the collection rates for batteries are too low compared to the quantities that are put on the market – however the report does explain which criteria are used to classify the rates as "too low"[532]. The Centre National du Recyclage attributes "low" collection rates to insufficient communication concerning the taka-back systems[533].

Mr. Gros of COREPILE points out that recycling rates are difficult to define and therefore easy to manipulate. However, the most important criterion is the collection rate. He admits that in France, collection rates are lower than in some other countries (Belgium for instance), but the unit collection and recycling costs are quite low. Generally, speaking, he claims it is more difficult setting up a collection system in a large country, due to its heterogeneity. According to Mr Gros, the following factors are important for higher collection rates[534]:

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[529] Phone interview of Mr Gros (COREPILE) on 29 May 2008.

[530] http://www.screlec.fr/telechargements/screlec_bareme_2007.pdf

[531] In Numeri (2006), Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Etude réalisée pour le compte de l'ADEME

[532] AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

[533] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

[534] Phone interview on 29 May 2008.

- The key to success is the behaviour of the consumer. Communication campaigns are not sufficient for this (although, in the case of EEE, the fact that the financial contribution from the consumer is labelled seperately from the price has certainly been useful free publicity). The culture of a country, and specifically the attitude towards the environment, is very important.
- The collection networks must be dense, but the cost of collection should remain acceptable.
- It is essential that all producers (as understood in the Battery Directive) participate in the system. In France, sanctions for free riders are very low or are not applied. A lot of producers are not registered (for instance, some retail chains, all types of small importers, some fast food chains who hand out toys containing batteries...). However, participation is essential as this determines the financial resources of the eco-organism and affects the density of the collection network.
- The system should not be too complicated.

ADEME takes the position that in order to improve recycling, the collection rates have to increase. Low collection rates are primarily due to hoarding and to the long life cycle of accumulators. The actions proposed by ADEME are[535]:

- National awareness campaigns
- Linking the WEEE and the battery registries

9.9. FOOD WASTE[536]

9.9.1. Regulatory framework

There is no specific regulatory framework for food waste in France.

Industrial food waste is usually recycled in technical applications[537].

Household and assimilated food waste is managed by local authorities. Depending on the quantities of food waste put on the market and local circumstance, they can be collected seperately, followed by biogas recovery or composting.[538]

However, as in other MS, French policy is affected by the requirements of the Landfill Directive with respect to the quantities of bio-degradable waste going to landfill. The estimated amount of biodegradable municipal waste going to landfill in 2016 is 40% of the total amount produced in 1995. However, the objective set by the EU Landfill directive for 2016 is 35%. In accordance with this requirement, the waste management plans have been revised with a stronger orientation towards recycling.

The Communication of the Council of Ministers of 4 June 2003 on household waste provides measures to promote the development of the biological treatment of bio-waste. Therefore, our discussion of food waste policy will be intimately linked with biowaste policy.

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[535] Information provided by Virginie ROCHETEAU of ADEME on 10 July 2008.

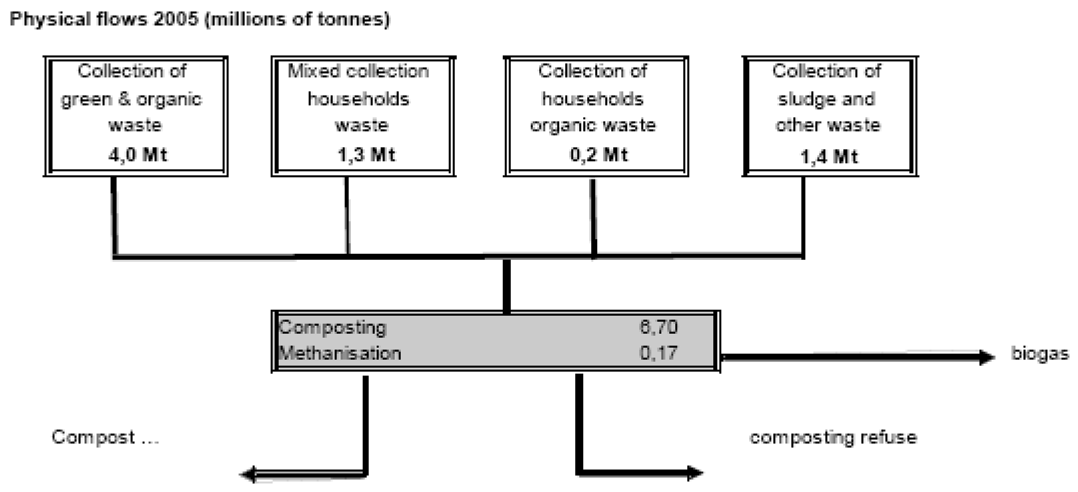
[536] Unless stated otherwise, all information in this Section comes from the EEA Country Fact Sheets, Barth et al (2008) and In Numeri (2007), MARKETS IN WASTE RELATED ACTIVITIES, Situation in 2005-2006 – Outlook for 2007, Study realised for ADEME .

[537] Phone interview with Mr Le Blan (FNADE) of 11 June 2008.

[538] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

In order to put the discussion in perspective, the figure below represents the physical streams in 2005.

Figure 58: Physical streams for biological treatment



9.9.2. Integrated treatment centres

The biological pre-treatment of waste is not widespread in France, but the experiences of the existing sites are followed with interest.

There has been a relatively steady rise in the use of biological treatment centres in 2005 and 2006, growing by 3.6% and 4.8% respectively.

ADEME expects that the future development in the field of household waste is more and more likely to lie in the construction of integrated treatment centres. ADEME sees the initial sorting process in the bio-mechanical processing stream (mechanical sorting followed by biogas recovery) as the principal means of developing sorting centres and thinks that the whole sector may reorganise itself around these centres.

ADEME reckons that such centres could solve the problem of fermentable household waste without having to resort to a costly system of separate collections for bio-waste[539]. In this context it will be important to develop a system for the collection of hazardous household waste so it doesn't end up mixed with organic waste. This could be done via material recovery sites or by mobile collection centres.

9.9.3. Composting

In France, compost has a very wide meaning and includes all waste that is spread as soil improver, including industrial sewage sludge, champost…[540]

[539] It should be noted here that, during a telephone interview, one Belgian actor involved in waste collection had expressed the opposite opinion: that separation at the source was the cheapest option. This divergence in opinions may just reflect the difference in waste collection logistics attributable to the respective population densities and urban structures of the countries under consideration.

[540] Contrary to compost, champost also requires non-vegetable inputs such as horse and chicken manure (http://nl.wikipedia.org/wiki/Champost).

9.9.3.1. Statistical data

The Ministry for Ecology and Sustainable Development's 2005 survey highlighted a significant rise in the number of composting stations in recent years ; 35% more than in 2002. Of the 4.5Mt of green waste estimated by the Ministry in 1999, 4Mt were being composted by 2005.

In the last years the collection of green waste has strongly progressed through the setting up of collection points. Also, ADEME has supported numerous composting projects.

The circular of 29 June 2001 fixed rules to ensure the harmlessness of compost produced.

Household composting is a possibility which has met with a favourable reception and would reduce waste loads at source. Local Authorities are providing more and more household composting programmes. The cost of these compost bins is 50% subsidised, bringing the cost of a 320 – 800 litre compost bin down to around €15 – 30.

ADEME reckons that the continued growth of composting will largely depend on the development of green waste collections.

Co-composting (green waste and sludge) could increase as existing plants are extended and new ones opened. It should be pointed out here that, at the European level, the Directive on the use of sewage sludge in agriculture is currently under review as part of preparation of a new Soils Directive[541]. ADEME points out that if the final wording of the new Directive is strict, then users will be more confident, but further development of the sector could be limited.

Generally agricultural uses for green waste compost are significant.

According to the "household waste treatment facilities" survey in 2004, the average size of plants was less than 20,000 tons. Of the 224 privately owned stations, 111 received less than 10,000 of waste. ADEME reports that some professionals are worried by the rise of 'rustic' stations. Although regulations state that composting must take place on waterproof bases, and the treatment of effluents requires high levels of investment, these rules are not always respected by the small facilities which are springing up around small towns.

9.9.3.2. Quality assurance

The new standard for industrial and urban by-products (NFU 44051) mainly concerns products made from organic and animal waste, and urban compost made from household waste. All types of compostable waste including mixed municipal waste is allowed with the exception of sewage sludge[542]. It was ratified by the French standardisation body AFNOR in April 2006.

The standard seeks to fix designations, definitions and specifications, labelling, contents to declare and dose limits for the use of organic soil improvers with and without fertiliser. Use and marketing of the compost as a product requires a certification according to the standard.

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[541] As we have seen in Section 3.5.5 , the Commission has adopted a Soil Thematic Strategy (COM(2006) 231) and a proposal for a Soil Framework Directive (COM(2006) 232) on 22 September 2006. Both have been sent to the other European Institutions for the further steps in the decision-making process. See http://ec.europa.eu/environment/soil/index_en.htm

[542] Standard NF U44-095 sets conditions for the use and marketing of sewage sludge as product

This standard sets upper limits for heavy metals, polycyclic aromatic hydrocarbons, impurities, organic materials, germs…It also introduces labelling requirements.

Flows in heavy metals, and elements are restricted to the maximum loading limits[543]:

- Per year g/ha: As 270, Cd 45, Cr 1,800, Cu 3,000, Hg 30, Ni 900, Pb 2,700, Se 180, Zn 6,000
- Over 10 years g/ha: As 900, Cd 150, Cr 6,000, Cu 10,000, Hg 100, Ni 3,000, Pb 9,000, Se 600, Zn 30,000
- Application should follow good agrarian practices, and agronomical needs which are taken into account for the use of composts.

It has to be produced in installations that comply with the technical requirements of 'Arreté du 07/01/02 – rubrique nr. 2170'.

There is no regular external approval or inspection scheme. Samples can be taken by compost producer. However, there exists a legal inspection by the competent authority based on the IPPC procedure which in France is also applied to composting facilities.

If compost complies with the standard NFU 44-051 there is no rule for the use.

It was expected that the standards would contribute to improvements in quality and to the continuation of recycling in the agronomic sector.

Compost which is not produced according to the standard is waste and has to follow a spreading plan. However, as it may apply for a temporary product authorisation, Barth et al claim that the standard can easily be by-passed.

9.9.4. Methanisation

Methanisation has increased greatly, but remains marginal.

The biogas produced is mainly used to generate electricity, but also for heating (generally used internally given its low temperature – 80 to 150°C), and for fuel (used in fleets of local authority vehicles as in Lille and as planned for Morsbach). This stream is a potential outlet for certain kinds of waste from the food and catering industries. Fats contain a high level of methanogenic capacity (they are in any case limited to 10% of the load for digesters). At the Calais plant, the addition of one ton of waste from local fish factories to 27,000 tons of waste will allow a 20 – 25% improvement in biogas production.

In a recent study undertaken for ADEME and Gaz de France, two questions were treated[544]:

- Which is the best valorisation method for biogas produced from the anaerobic digestion of separately collected biodegradable waste: fuel, heat or electricity? ("Biogas'" question)
- Which is the best treatment for the separately collected biodegradable waste: anaerobic digestion (methanisation) or industrial composting? ("Composting" question)

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[543] Besides Belgium, France is the only country imposing maximum metal loads on soil in compost standards (Barth et al (2008), p. 121).

[544] RDC-Environnement (2007), Life Cycle Assessment of different uses of biogas from anaerobic digestion of separately collected biodegradable waste in France, report for ADEME and Gaz de France.

The goal of the study was not to evaluate in detail the environmental impact of industrial composting. The conclusions refer to the variation between these different biological treatment systems but not on the absolute value (which strongly depends on the underlying hypothesis). The study concludes that:

- Whatever the use of the recovered energy, the avoided emissions of GHG and the avoided consumption of primary energy are higher for the utilisation of biogas method than for composting.
- Biogas production has a higher impact on eutrophication than composting because of the large amounts of liquid discharge during the anaerobic process except if it is used as fuel with diesel oil substitution in busses or waste trucks.
- With respect to the criterion "air acidification", anaerobic digestion is preferable to the direct composting of biodegradable waste if biogas is used as fuel with diesel or petrol substitution and for heat production with fuel oil substitution. The other biogas applications (electricity, or the substitution of natural gas or natural gas for vehicles) generate acid emissions that are the same or slightly higher than the emissions linked to direct composting of the biodegradable waste. The ranking is sensitive to the rate of the air emissions of ammonia from the composting pad.

9.9.5. Suggestions for improvement

In the summer of 2007, a wide public consultation on environmental issues was held in France, the "Grenelle de l'Environnement" (see Section 9.11).

According to the working group on waste, the issue of organic waste merits some more attention. Currently, 30% of collected household waste is composed of organic waste, but only 6% is recovered through biological treatment.

The report of the Grenelle points to several factors that plead in favour of a further extension of this treatment:

- Requirements following from the Landfill Directive
- The need to decrease methane emissions
- The need to improve soil quality
- The need to increase the production of renewable energy, which can be contributed to by biogas recovery

Moreover, a significant part of the waste generated by local authorities themselves (sludge, waste from public markets, green waste) is organic waste.

The following measures were proposed by the Grenelle working group on waste:

- To provide financial incentives for the recovery of organic waste originating from catering and public marketplaces.
- To promote household and neighbourhood composting. However, it is pointed out that this requires good training and motivation in order to prevent nuisance and biological hazards.

It is suggested that the cost increase linked to selective collection of organic waste could be compensated by a decrease in the frequency of unsorted waste collection.

The working group concluded that MBT does not allow, in general, to produce compost of sufficiently high quality, even if it does allow to reduce the quantities of waste going to landfill.

A specific concern is the low demand of compost by the agricultural sector. For this sector, the highest priority is the spreading of manure and of food industry by-products.

The following policy measures have been proposed:

- Take back obligation of composts by the agricultural sector
- Recovery targets for local authorities
- Integration of composts in land spreading plans
- Revision of standard agricultural contracts

However, the working group also reckons that the promotion of biogas should be developed in parallel.

Association AMORCE would like to see an extension of Extended Producer Responsibility to food waste. More specifically, it would like to see a requirement for the food industry to purchase a yearly quota of quality compost[545].

9.10. CARDBOARD

9.10.1. General facts and figures

Between 1996 and 2005, total French production of paper and cardboard increased from 8,531 Ktonnes to 10,332 Ktonnes. Between 1996 and 2000, the annual growth rate was 2.1%; between 2000 and 2005 it slowed down to 0.6%. The growth in packaging cardboard explains 42% of total growth[546].

The use of cartonboard packaging has decreased mainly in the following submarkets: packaging of fresh food, cigarettes and milk cartons (mainly due to the increase in the consumption of plastic bottles). However, this is compensated by an increase in the production of delivery packaging following the increase in Internet sales. Globally speaking, this market is stabilising[547].

Since 2000, the separate collection of paper has strongly developed. The percentage of population served has risen from 62% in 2000 to 83% in 2002 and 92% by the end of 2003. The rate of paper recycling has risen from 59% in 2000 to 61.5% in 2001. Further efforts will be made in the coming years with the new objectives set by the revised Packaging and Packaging Waste Directive. Further progress is expected for the paper print distributed in mailboxes and on public ways[548].

Between 1996 and 2005, the use of recovered paper and cardboard increased from 4,192 Ktonnes to 5,953 Ktonnes, this is an annual increase of 4%. However, there was a marked slow-down to 0.6% per year from 2000 on[549].

In 2006, recovered paper and cardboard corresponded to 60.5% of the supply of the French paper industry[550].

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[545] AMORCE, Assemblée Générale Ordinaire, Rapport moral, Octobre 2006/Octobre 2007.

[546] In Numeri (2006), Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Etude réalisée pour le compte de l'ADEME .

[547] Ademe, Eco-emballages et Adelphe, Le gisement des emballages ménagers en France, Evolution 1994/2006

[548] EEA country fact sheet, p. 10.

[549] In Numeri (2006), Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Etude réalisée pour le compte de l'ADEME

[550] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

The use of recovered paper and cardboard depends on the type of paper and cardboard that is being produced. Whilst it has reached now 100% for the production of newspapers and 90.6% for corrugated cardboard, it is below 15% for letter paper[551]. Lavatory tissue contains 47% of recycled fibres[552].

New, non-deinkable inks are under development; this could have a negative impact on recycling.[553]

9.10.2. Packaging waste[554]

4,280 Ktonnes of paper and cardboard packaging have been put on the market in 2004. 80% of cardboard packaging is in industrial applications. Corrugated cardboard corresponds to 2/3 of the weight. Drink cartons correspond to 110 Ktonnes, and is thus a relatively small stream compared to other paper and cardboard packaging waste.

3,255 Ktonnes of cardboard have been recycled (85% of which was industrial packaging waste) and 551 Ktonnes have been incinerated with energy recovery. This implies that for cardboard, the recycling objectives required by the Packaging Waste Directive had already been reached in 2004.

Industrial cardboard waste recycling has improved in particular in recent years, mainly due to a better identification of the relevant waste streams.

Paper bags for collection and pre-collection of waste can apply for a "NF Environnement" certification mark. The NF Environnement mark is a voluntary certification mark issued by the French certification body AFNOR Certification. This mark, which was created in 1991, is the official French ecological certification. It is awarded to products that have a reduced effect on the environment while offering an equivalent performance. To be issued the NF Environnement mark, the product must comply with ecological and fitness for purpose criteria. These criteria are the result of negotiations between representatives of manufacturers, consumer, environmental protection and distributor associations and public authorities.[555]

Eco-Emballages and Adelphe have made detail data available on the collection and recovery of packaging waste in 2006, and we summarize these findings below for paper and cardboard packaging for each take back system.

9.10.2.1. The "garantie de reprise" for paper and cardboard packaging[556]

As explained in Section 9.6.2, the "filière" paper and cardboard in packaging recovery is represented by REVIPAC. Following an agreement signed with Eco-Emballages and Adelphe, REVIPAC has made a

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[551] In Numeri (2006), Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Etude réalisée pour le compte de l'ADEME

[552] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

[553] Bilan du recyclage 1996-2005, Synthèse générale et analyse par filière, Rapport final, Décembre 2006, Etude réalisée pour le compte de l'ADEME par In Numeri

[554] Unless stated otherwise, all information in this Section has been obtained from Ademe, Emballages industriels et ménagers, Collection Repères, Données 2004.

[555] http://www.marque-nf.com/Default.asp?lang=English

[556] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006

comprehensive commitment to take back household paper and cardboard packaging waste with the objective of recycling, within the technical and financial conditions imposed by the contracts. The recycling industry has committed to specified recycling volumes.

REVIPAC represents the following professional associations:

- PROCELPAC, the producers of packaging paper, corrugated cardboard and cartonboard
- La Chambre Syndicale des Fabricants de Sacs en Papier (paperbags producers)
- UNITES, Unité National des Industries de Transformation d'Emballage Souple (producers of flexible multimaterial packaging)
- Fédération Française du Cartonnage (producers of cartonboard packaging and corrugated board transformers)
- Emballage Ondulé de France (producers of corrugated cardbaord packaging and boxes)
- REVIPAP (stationers using recycled paper)

The guarantee covers the following waste categories:

- Grade 5.02 of standard EN643 (mixed paper and board packaging waste from the municipal waste streams)
- Grade 5.03 of standard EN643 (liquid board packaging)

Per year, 800,000 tonnes of the first grade are put on the market, and 95,000 tonnes of the second grade.

As the recycling techniques for these 2 types of packaging are different, they need to be sorted. REVIPAC requires local authorities to separate beverage cartons from other household packaging waste[557].The recycling efficiency of beverage cartons is low (close to 50%) and specific equipments are required to separate the non-fibre fractions. Notwithstanding the differences between the two types of packaging, REVIPAC has always maintained the position that they should be treated identically.

Paper and board packaging waste from the municipal waste streams are collected either through bring systems or through kerbside collection. They can be mixed with the "light fraction" (plastic bottles, cans, etc) or with newspapers and magazines.

In 2006, 9.2% of truckloads containing grade 5.02 packaging waste have been downgraded (mainly because their moisture levels were too high or because they were too heavily contaminated). 100% of recycling took place in France. The price paid by the "filière" (41.68 EUR per tonne) was equal to 85% of the price paid for grade 1.04 "supermarket corrugated paper and board". The price differential was justified by, amongst others:

- The non-guaranteed fibre content of grade 5.02
- The guaranteed take-over, independently of the market conditions
- The administrative costs linked to the system
- The uniformity of the prices paid to all local authorities

0.33% of truckloads containing liquid board packaging have been downgraded. 49% of grade 5.03 has been recycled in France by DHP while 51% of this waste fraction has been recycled in other European countries (Alier en StoraEnso in Spain, Niederauermuehle in Germany). The price paid is zero EUR per tonne.

[557] Information obtained from the ACN website.

9.10.2.2. The "reprise guarantie" for paper and cardboard packaging[558]

For household packaging waste, this system covers 27% of the population and 30% of the waste (in weight) put on the market.

Contrary to the paper and cardboard recovered by REVIPAC, not everything was recycled in France. The table below gives the relative share of the markets for this waste category:

Table 80: Relative market shares for paper and cardboard in the "reprise guarantie"

	France	Europe	Outside Europe
FEDEREC	45	34	21
FNADE	46	54	

For beverage cartons, this system covers 27% of the population and 23% of the waste (in weight) put on the market.

The table below gives the relative share of the markets for this waste category:

Table 81: Relative market shares for beverage cartons in the "reprise guarantie"

	France	Europe	Outside Europe
FEDEREC	33	54	13
FNADE	67	29	4

The entire waste stream is subject to visual quality control, but less than 1% of waste collected (expressed in weight) is refused.

Contracts between the collectors and the local authorities are signed with reference to standard EN643. 69% of these contracts have a duration of 6 years.

Prices for the different grades are listed in the table below[559]:

Table 82: Prices for different paper grades

Grade	Contract	Price observed
5.02	Most contracts specify a minimum price; non a maximum price; most contracts refer to the price of grade 1.04	Average price of 47.63 EUR/ton, with 20 EUR/ton as lower bound and 66,6 EUR/ton as upper bound
5.03	Price is 0 EUR, except for 3 contracts where the price is 3 to	

[558] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006

[559] Prices are weighted averages based upon a survey by AMORCE and ADEME quoted in Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006

	5 EUR per tonne	

9.10.2.3. Paper and cardboard packaging waste managed by the local authority[560]

For household packaging waste, this system covers 4% of the population and 10% of total waste (expressed in weight). 40.8% have been recycled in France, 24.7% in Europe, 8.5% in Asia en 1.6 % in Africa. Quite remarkably, 34.4% has not been traced yet. The average price obtained is 47.24 EUR.

For beverage cartons, this system covers 4% of the population and 6% of total waste (expressed in weight). 19% have been recycled in France, 15% in Europe, 1% in Asia en 5 % in Africa. Again, a daunting 60% has not been traced yet. The average price obtained is 0 EUR.

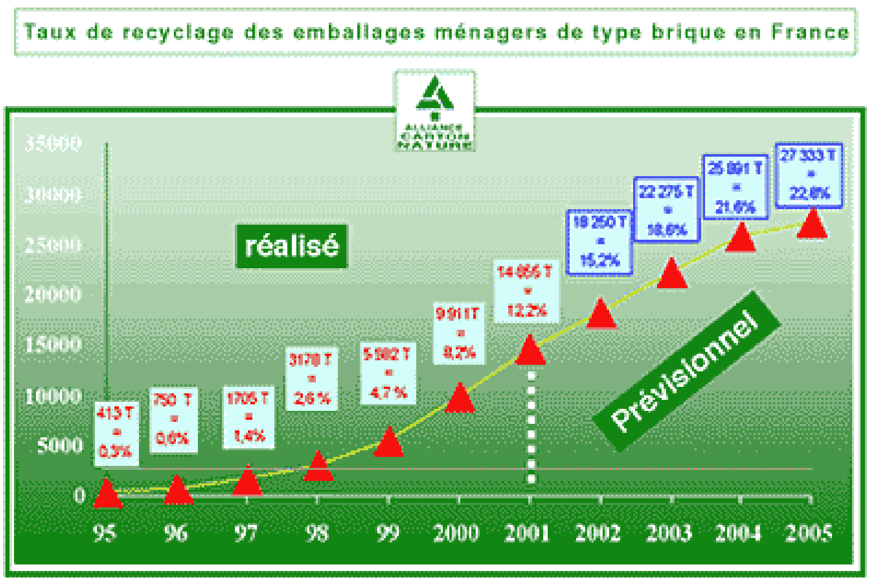
When both grades are mixed, this system covers 4% of the population and 9% of total waste (expressed in weight). 40% have been recycled in France, 24% in Europe, 8% in Asia en 2 % in Africa. 26% has not been traced yet.

9.10.2.4. Beverage cartons in France[561]

As already pointed out above, there is no differentiated "Green dot fee" for beverage cartons. This, combined with the guaranteed lower bound of zero EUR, can contribute to explain the low recycling efficiency obtained in France.

The graph below gives the most recent figures provided by ACN beverage cartons recycling in France:

Figure 59: Recycling of beverage cartons in France



[560] Eco-Emballages and Adelphe, Conditions de reprise des matériaux en 2006

[561] Unless stated otherwise, all information in this Section has been obtained the website of Alliance Carton Nature, http://www.alliance-carton-nature.org , the French counterpart of ACE .

9.10.3. Waste printed matter[562]

For waste printed matter, there is no specific collection or recovery obligation. Local authorities have been asking for years to apply the principle of extended producer liability, such that producers of printed matters would contribute to the management of the corresponding waste.

Article L541-10-1 of the Environment Code has introduced the principle of a contribution, in money or in kind, or, by default, the payment of a General Tax on Polluting Activities for printed matter that is freely distributed to households without their prior request[563]. This article has been introduced in 2003.

In money terms, the contribution is paid to a body accredited by the public authorities, who in turn pays the sum to the local authorities as a contribution to the costs linked to the collection, the recovery and the removal activities they support[564]. In kind, the contribution consists in providing free advertisement space to the intermunicipal association who wish to use them for promoting waste management[565].

Following Decree 2006-239, a unique accredited body, EcoFolio, has been created. Its shareholders are those companies that are the subject of Article L541-10-1. The producers of non-requested printed matter comply with their obligation by participating in Eco-Folio. Their financial contribution depends on the amounts of printed matter they put on the market each year (expressed in weight). The local authorities remain responsible for the collection of waste. The accredited body pays its contribution to the local authorities. Incineration is considered as a type of recovery. The accredited body is allowed to create partnerships with for instance Eco-Emballages. Recovery companies and recyclers sign contracts with the local authorities for the further treatment of the waste paper. Reporting takes place through a collective organism, Revigraph.

One year after inception in 2007, EcoFolio has 5.000 members, corresponding to 98% of printed matter put on the market. Members pay 35 EUR per tonne of paper – for 2007, this means a total of 32 million EUR.

426 local authorities (representing 30.2 million inhabitants) have signed a convention with EcoFolio, allowing them to get compensated for paper collected and treated at their expense, according to the following tariffs:

- 65 EUR per tonne of recycled paper
- 30 EUR per tonne of paper incinerated, recovered per biogas or composted
- 2 EUR per tonne landfilled

Gradually, the scope of producer responsibility has been enlarged. Since 2007, it had covered phone books, prospectuses, and free advertising press (corresponding to 1 million tonnes). From July 2008 on, it also covers sales catalogues, brand magazines and company magazines (corresponding to 1.6 million tonnes). Finally, in January 2008, office paper will also be included (corresponding to 2.7 million tonnes).

However, according to Amorce and the Cercle National du Recyclage, the local authorities still bear 80% of the cost of managing this waste stream.

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[562] Unless stated otherwise, all information in this Section has been obtained from Adème, Imprimés, Collection Repères, Données 2004, or from http://www.actu-environnement.com/ae/news/premier_bilan_ecofolio_5115.php4 .

[563] There are some exceptions that are listed in the article.

[564] Currently, the TGAP amounts to 900 EUR per tonne.

[565] Note the similarity with the instrument used in Flanders.

9.10.4. The quality of recovered cardboard

A working group coordinated by ADEME has identified the following trends affecting negatively the recycling of paper and cardboard[566]:

- Some products integrated in newspapers (perfume samples, DVD, CD-ROMs) contaminate the waste and are difficult to detect at the level of sorting centres.
- The use of glue and flexographic ink increases the costs but without affecting recycling in a fundamental way (see also Section 5.5.2).
- Cardboard imported from Asia can contain phthalates, whose use is prohibited for recycled cardboard that will come into contact with food (see Section 3.6 for the European context in this issue).

However, the working group has also identified how a structural collaboration can limit the inconveniences:

- Following a request from the paper producers, an end has been put to the replacement of metal cords by polypropylene cords for the purpose of binding paper bales (see Section 5.5.2).
- An active collaboration between paper mills, glue and ink producers and the Technical Centre for Paper[567] has allowed the development of new inks and glues that can be eliminated more easily.
- The CTP takes care of a systematic follow-up of new printing techniques.

The following ideas are currently under consideration:

- To encourage testing *in the whole product chain* of each proposed innovation before using it at an industrial scale.
- To use awareness campaigns in order to reduce the presence of contaminating materials such as DVDs and perfume samples.
- To develop ecodesign of products using cardboard (such as packaging).
- To reinforce European rules on packaging used for imported products in order to reduce contaminants

The working group recommended a permanent monitoring of new products that could perturb the recycling chain. The working group also took the position that the valorisation of sludges from recycling is essential (more on this in Section 9.10.5).

The following barriers to investments in new sorting and recycling facilities have been identified:

- The length of the contracts tendered by local authorities becomes shorter and shorter.
- Authorities tend to use more and more separate tenders for each activity in the chain (collection, sorting and treatment). This leads to instability in the supply chain and does not stimulate a global approach to waste management.
- The stakeholders involved in collection and recovery (local authorities, recovery companies, recyclers) still seem to be insufficiently aware of the relevant counterparties that would allow reducing waste transport.

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[566] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

[567] Centre Technique du Papier (CTP).

9.10.5. Disposal and recovery of sludge[568]

The paper industry accounts for over 60% of the total quantity of industrial sludge recyclable for agriculture (in terms of dry matter). According to the Technical Centre for Paper, recycling for agriculture should remain the principal method of disposing of paper sludge, even if some manufacturers continue with on-site incineration in bark-fired boilers.

Around 60% of *all* potentially recyclable sludge is currently recovered for agricultural purposes, as soil conditioner or composted (59% of sewage sludge and a little over 60% of industrial sludge in 2002). The rest is either incinerated or buried in landfills (as long as the sludge is at least 30% dry). Agricultural use includes being spread on agricultural, or increasingly, wooded lands, and to fertilise land that isn't destined for agricultural use. Finally, a small amount of sludge is composted before being returned to the soil.

Landfill of sewage sludge will fall as recycling for agricultural purposes or energy recover rises. Since July 1st 2002, the application of the law of 13/07/02 and the European Directive on waste mean that theoretically only sludge that cannot be disposed in a way that is technologically and economically viable locally can be buried in landfills.

ADEME expects that recycling sewage sludge for agronomic purposes will regain its popularity now that it is favoured by a legal framework.

Indeed, according to the Decree of 18/03/04, which brought standard NFU44-095 into force, all compost containing material of agricultural value made by sewage processing and corresponding to specifications set out in the above standard can now be classed as a *product*. Thus it can be sold according to conditions specified in the standard.

Moreover, ADEME reckons that the forthcoming Directive on the use of sewage sludge in agriculture (revision of Directive 86/278/CEE – see Section 3.5) should raise standards with regards to the presence of undesirable substances (heavy metals and hazardous organic matter) in sludge used as fertiliser, thus improving the sanitary aspect of this activity

As well as these regulatory obligations the Union for Agricultural Recycling Professionals (SYPREA) is working with ADEME towards a system of certification for the soil conditioning services of its clients' recycled fertilisers. This initiative is taking place under the aegis of the Qualicert label.

9.10.6. Selective collection of catering waste

Pilot projects have been conducted in Calais. Mrs LAUBY of SEVADEC has committed to provide information on this issue.

9.11. MEASURES PROPOSED BY THE "GRENELLE ENVIRONNEMENT"[569]

In the summer of 2007, the French president instigated an open multi-party debate in order to define the key points of public policy on ecological and sustainable development issues for the coming five years. This so-called "Grenelle Environment Round Table" has gathered representatives of national and local

568 In Numeri (2007), MARKETS IN WASTE RELATED ACTIVITIES, Situation in 2005-2006 – Outlook for 2007, Study realised for ADEME .

569 Le Grenelle Environnement (2007), Atelier intergroupe Déchets, Synthèse, rapport, http://www.legrenelle-environnement.fr/grenelle-environnement/IMG/pdf/Rapport_Intergroupe_dechets.pdf

government and organizations (industry, labour, professional associations, non-governmental organizations) on an equal footing, with the goal of finding common positions on a specific theme[570].

The working group on waste policy has proposed, amongst others, the following priority measures[571]:

- Providing incentives through the price system. The report provides the following examples: adding a variable component to the TEOM[572], introducing an effective waste charge for small enterprises who do not arrange themselves for disposal of their waste[573], imposing higher taxes on products that generate a lot of waste[574], reduced VAT on maintenance services in order to lengthen the lifecycle of products, an increase of the landfill tax, the introduction of an incineration tax….
- In the case of packaging waste: requiring producers to contribute to the *full* cost of collection, recycling and recovery; to differentiate the Green Dot contribution in order to provide incentives for ecodesign; extension of the Green Dot system to packaging for "on the road" household consumption (railway stations, roadside shops, airport…). It is noteworthy that the French Association of Mayors *opposes a harmonisation of sorting procedures*. Selective sorting in apartment blocks is a specific area of concern.
- For C&D waste, to impose an inventory of materials present in a building before demolition, and to specify the approach to sorting, recycling and waste management; to use economic instruments to promote the use of recycled C&D waste, selective demolition and sorting and recycling of C&D waste; to make public the C&D waste management plans.
- To generalise the use of ERP schemes; to create one single regulator for ERP schemes.
- To increase the quantities of household waste composted. In order to obtain this, to increase the selective collection of organic waste (particularly in urban areas), to introduce a good quality control system, to develop markets…
- To improve the monitoring of existing waste streams and their respective costs of disposal (including a harmonisation of definitions and valuation methods at the European level).The report points specifically to the lack of harmonised accounting approaches with respect to the public contribution to waste management (p.15).
- To improve the planning process
- Information and awareness campaigns, in particular towards SMEs; it is pointed out that SMEs rarely invest time in sorting their waste, even though they have a direct financial interest in doing so if their waste is collected by private collectors

9.12. FOLLOW-UP OF THE GRENELLE

The Grenelle has led to a follow-up project specifically focused on waste. A working group has been created with the objectives of proposing an action plan with quantitative targets, of identifying the barriers to recycling and to identify possible instruments. ADEME has transmitted the minutes of the

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570 http://www.legrenelle-environnement.fr/grenelle-environnement/spip.php?rubrique112

571 This list does not include the discussion of *specific* waste streams that are not the object of this study.

572 As already pointed out in Section 9.3.9.1, in its current form, the TEOM does not provide any incentives for waste prevention.

573 This charge was actually introduced in 1993, but local authorities rarely dare impose it on small business (p. 18).

574 One of the participants has pointed out though that the same effect can be obtained through EPR schemes.

meetings of this working group[575] to the project team – we refer to the Sections on individual waste streams for more details. Here, we limit ourselves to the points that are not linked to individual waste streams.

9.12.1. Marketing of recycled consumer products

A recent study by Eco-Emballages (2007) has shown that French consumers have nowadays a positive view of recycling. During the discussions of the working group, it appeared that, for some brands, recycled contents could be a positive marketing argument. This leads to the paradoxical situation that some brands only wish to use recycled products if they can use it as a sales argument. While some stakeholders think that the use of recycled inputs should be highly visible for the consumer (for instance, through packaging of inferior esthetical quality), ADEME thinks that the emphasis should be put on the quality of the final products, independently of its recycled contents. Finally, NGOs think that consumers are still insufficiently informed.

Globally speaking, no real consensus seems to have emerged on the most appropriate marketing approach.

9.12.2. Selective waste from commercial sources

The working group has identified several barriers to selective waste collection coming from commercial sources.

For the waste owners, the most important barriers are:

- Lack of financial incentives for sorting
- Lack of information with respect to the recyclability of products and the existing supply of selective collection services.
- Excessive cost of selective collection of small waste streams
- Sorting is perceived as costly and difficult to manage
- The weak bargaining position of SME compared to waste collectors, facility owners and suppliers of packaging
- Lack of internal resources to comply with the requirements of waste collectors

A wide range of measures have been proposed, including:

- The traditional financial incentives (landfill tax etc)
- Providing support for collective waste selection projects (for instance, at the level of a business or office park)
- Providing better information to waste owners: databases with prices, local waste exchanges, Internet sites, training for sorting

At the level of the waste collectors:

- The logistical costs are important, certainly for small waste streams.
- Adequate training for sorting is lacking
- Small collectors operating in niche waste streams cannot participate in tenders asking for “package deals”

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[575] ADEME (July 2008), Document de réflexion pour l'élaboration d'une stratégie de développement du recylage en France, Compte-rendu des groupes de travail. Transmitted per e-mail on 10 July 2008.

- There are important costs linked to awareness campaigns

Possible solutions could be:

- Grouped collection of small waste streams – which of course is only possible if the individual streams can be traced and if agreement can be found on the funding of investments.
- Provide training for the collectors
- Create partnerships between waste collectors and facility managers
- Create synergies with the collection from apartment blocks

The working group also discussed several measures that could be taken by local authorities.

Finally, with respect to the role of central government (including ADEME), the following points were made that are relevant for this project:

- Little is known, nor on the magnitude and the composition of the waste stream coming from commercial sources, neither on the origin of the waste stream The working group suggests that C&D waste would be a natural candidate, taking into account the quantities involved and the complexity of the issue.
- The poor example set by public bodies

It is not clear at this stage to what concrete measures these proposals will lead. It is remarkable however that several of the issues and proposals listed here (for instance, the priority given to C&D waste, the focus on SMEs) were already included in the National Strategy for Sustainable Development….

9.13. EVALUATION

According to the Centre National du Recyclage, even if the application in France of the EPR is far from perfect, it has lead to improvements in selective collection and recycling. Moreover, it allows to fund R&D expenditures. Imposing objectives for collection and recycling also provides incentives for both activities. Generally speaking, recycling in France is gaining ground, but remains largely dependent on increases in the prices of raw materials. Currently, several initiatives are underway that should lead to further improvements in French waste management (increases in the landfill tax, new applications of EPR…), more waste prevention…[576]

[576] E-mail of Betrand Bohain of the Centre National du Recyclage, of 11 June 2008.

Mr Le Blan of FNADE reckons that the 2 most important factors that could encourage more recycling are higher taxes on landfill and incineration. He also thinks that the frequency of kerbside collection should decrease and that the design of the garbage bins should be adapted to this frequency[577].

Mr Loic Lejay of AMORCE emphasizes the need to generalise Extended Producer Responsibility to all consumer goods. He also thinks that recycling is not sufficiently recognized as an economic resource. If the take back of used goods at the selling point would be generalised, Mr Lejay thinks the concept of a circular economy would be more firmly embedded in public opinion.

[577] Phone interview of 11 June 2008.

10. CASE STUDY: ESTONIA

10.1. STRUCTURE OF THIS CHAPTER

This Chapter takes a closer look at the specific situation of the four waste streams under consideration in Estonia. We begin the chapter with some basic information on Estonian society (Section 10.2) and waste policy (Section 10.3). Section 10.4 provides key waste statistics. Extended producer responsibility plays a central role in Estonian waste policy – an overview is given in Section 10.5. Cardboard and beverage cartons' recycling fits within the policy on packaging waste, which is described in Section 10.6. The detailed analysis for the different waste streams follow then in Section 10.7 (PVC), 10.8 (batteries), 10.9 (food waste) and 10.10 (cardboard). Section 10.11 discusses the essential points of the new national waste management plan and Section 10.12 concludes.

10.2. GENERAL INFORMATION

Estonia is a small country with a very low population density. However, most of its population lives in urban areas.

Table 83: Estonia - general demographic information[578]

Surface area	43,432 km^2
Population (thousand inhabitants)	1,344
Population density	31 inhabitants / km^2
Average number of persons per private household	2.6
Land use (calculated as a percentage of the surface area)	2% agricultural land - forests and other wooded land - built-up and related land - wet open land - dry open land - water
Household characteristics by urbanisation degree, distribution of households %	70% urban population 30% rural population

Despite high growth, its GDP per capita is significantly below EU average[579]:

	2006 GDP per capita (PPP)	2006 GDR per capita (EUR°

[578] EEA Country Fact Sheet

[579] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001-01/EN/KS-CD-07-001-01-EN.PDF

Estonia	15,900	9,800
EU27	23,500	23,500

10.3. GENERAL REGULATORY CONTEXT

10.3.1. Historical background

The 1990s have witnessed an almost complete overhaul of legislation in the field of waste management. New legislation *relevant for this study* includes[580]:

- The Waste Act (1998), transposing the Waste Framework Directive (75/442/EEC) and the Hazardous Waste Directive (91/689/EEC) and key EU policy instruments such as the EU waste strategy.
- The Packaging Act (1995)
- The Packaging Excise Act (1996)
- The National Packaging Register

Estonia has had difficulty implementing the landfill and packaging Directives. Two transition periods have been requested (1) lasting until 2013 to allow time to close the existing landfills that do not meet the requirements of the Landfills Directive 99/13/EC, and to create a network of new landfills; and (2) to 2009 to develop and implement new methods for the disposal of oil-shale ash resulting from the generation of energy (UN ECE 2001).

By 2001, the total waste generation of Estonia has decreased by 25% since 1993 and by 20% since 1995. This is explained mainly by a decrease in wastes produced in the oil-shale-related power production and chemicals industry. At the same time, the quantities of municipal waste and other wastes have increased significantly[581], but oil-shale-dependent power and chemicals industries alone comprise 85% to 93% of waste generation[582].

Estonia has inherited a waste management system based on landfilling. There were around 350 landfills, often in abandoned sand- and gravel pits. No environmental precautions were taken and, for a long time, there was in fact no control about waste types or amounts taken to landfill[583].

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580 United Nations, Economics Commission for Europe, Committee on Environmental Policy, Environmental Performance Review, Estonia second review, 2001

581 In the case of municipal waste 60%.

582 Oil shale waste is a major environmental issues in Estonia. The EU has accepted a transition period for the implementation of the Landfill Directive concerning liquid and corrosive slurry of oil shale ash. For more details in the historical background see: UN ECE, Committee on Environmental Policy, Environmental Performance Review, Estonia second review, 2001.

583 Peeter Eek (2006a), Director General, Waste Department, Ministry of the Environment, "Bio-degradable waste management in Estonia – long way to go".

10.3.2. National waste management plan

The National Waste Management Plan (NWP), 2003-2007 was the strategic document to achieve a systematic strategy for WM at National level. It intended to harmonise the National WM with the EU strategy and to transpose and implement EU waste handling principles. The next plan covers 2008-2013.

10.3.3. Transposition of the Landfill and Incineration Directive[584]

The Landfill Directive (1999/31/EC), the Incineration Directive (2000/76/EC) and Council Decision 2003/33 establishing criteria and procedures for the acceptance of waste at landfills, were transposed into Estonian law by the Waste Act of 2004, by Regulation of Ministry of the Environment (MoE) N° 38 of 29.04.2004 and by Regulation of MoE N°66 of 04.06.2004[585]. The Waste Act of 2004 rescinded the Waste Act enacted in 1998.

Art 35 of the Waste Act prohibits landfilling of untreated waste unless the amount of waste or its hazardousness cannot be reduced. Art 36 of the Waste Act requires the sorting of mixed MSW before landfilling. As from 1 January 2008, the prohibition on acceptance and deposit of unsorted municipal waste applies to all landfills.

The treatment options referred to in Art 35 shall be established by the Government. Treatment can be mechanical, thermal, chemical or biological, but it shall have effect "to reduce the quantity or harmfulness of the waste, facilitate its handling or disposal or enhance the recovery of the waste".

In line with the Incineration Directive, the Waste Act distinguishes between incineration and co-incineration.

According to the NWP 2002, from July 2009, waste may not be deposited in landfills that do not meet the requirements. The existing landfills can continue operation until that date unless they pose a hazard to the environment and human health. Otherwise they must be closed. The operator of landfill must prepare a conditioning plan to continue operating the existing landfills.

Environmental departments can, on the basis of an assessment of environmental risks, simplify the requirements laid down in the Landfill Regulation if it is not necessary to collect and treat leachate from landfills or in case leachate poses no potential danger to ground and surface water and soil.

In 2004, the Ministry of the Environment undertook an important survey of landfills. Compared to ten years before, the situation had changed drastically –pure wooden waste was no longer landfilled, the demolition waste was largely sorted so that the wooden part is incinerated, sewage sludge was also applied to fields directly after stabilisation or composted and used later in recovery or greening purposes. The separate collection of paper- and especially cardboard and other packaging material - was also developing. However, little appeared to have changed with respect to the ordinary household waste- the green garden waste was diverted from landfills, but household waste bio-degradable part was still landfilled (Eek 2006a).

Although the majority of the small countryside landfills had been closed in 2006, the replacement of the old waste management infrastructure had not developed as fast as was expected. Mr Eek, Director General of the Waste Department, identified two important reasons for this. First, the huge financial

[584] EEA Country Fact Sheet.

[585] The previous version of the Landfill Regulation had been transposed in 2001.

effort that is required. Second, the on-going dispute with respect to the level (national, regional, local) where the waste management projects should be developed (Eek 2006a).

The Ordinance of Sorting requirements for Municipal Waste (January 2007) implemented the sorting requirement of the Waste Act. The following waste streams are subject to separate collection[586]:

1. Paper and cardboard;
2. Packages;
3. Hazardous waste;
4. Bio-degradable garden- and park waste;
5. Bio-degradable kitchen- and food waste;
6. Wastes, covered with the Producer responsibility principle – cars and parts, incl tyres, WEEE, batteries and accumulators;

The Municipalities are obliged to regulate and ensure the collection of waste types 1-4, whereas the collection of packages and packaging waste is the responsibility of the packaging organisations (see Section 10.6). The separate collection of kitchen and food waste is not obligatory, but is on ´wish list´. It is up to the municipalities to decide whether they want to organise it.

A specific challenge is that in Estonia approximately 70 % of the population lives in apartment blocks. In practice, this means that separate collection relies more or less on voluntary compliance – at least the provision of separate containers offers the possibility to comply for those who wish to do so. Although enforcement of waste policy is one of the tasks of municipal police, in practice, it is not very vigorously pursued[587].

Mr Eek claims that notwithstanding all problems, the separate collection is increasing rapidly but that it is yet too early for general conclusions.

10.3.4. Economic instruments[588]

The gate fees for landfills are ca 40 €/tonne (including the landfill tax of 8 €/t on "new" landfills[589] and of 16 €/t on "old" landfills).

For households, the price of waste management service is ca 65 EUR per tonne. On average, in centrally heated apartment blocks, this means that a household pays 2-4 € for municipal waste. This corresponds to 3 to 4% of the costs related to housing in centrally heated apartments. For private housing, the services fee corresponds to 5-8 EUR per month.

With an average salary of ca 600 EUR per month, these fees are considered too high for some groups in society.

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[586] Peeter Eek (2008a), "Organic Waste Legislation and Consequences for the Implementation on the Municipal Level in Estonia" presentation given at the 2nd Baltic Biowaste Conference 2008.

[587] E-mail communication by Peeter Eek on 09 July 2008.

[588] E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment of 05 June 2008.

[589] This is, landfills that comply with the Landfill Directive.

However, at the same time, officials of the Waste Department reckon that this provides insufficient incentives for separate collection.

It is expected that the disposal prise will be about 55 euros in 2009 and that the prise will increase year by year.

There are no local waste taxes. However, to support municipal waste management activities, 8 EUR per tonne of the landfill tax is returned to the municipality where the waste was collected.

To see the figures quoted above from a somehow different perspective, in 2000, the gate fees at landfills never exceeded 10 EUR and were often close to zero. In 2008, except for the Czech Republic, Estonia is the only EU12 country to have introduced a landfill tax on top of the gate fee. In Finland, the gate fee is circa 40 EUR per tonne, in Latvia and Lithuania it is 20 EUR. The Estonian authorities aim at sending a clear signal that landfilling is no longer as cheap as it used to be.[590]

10.3.5. Biodegradable municipal waste

Besides BMW, contained in household and similar non-hazardous waste, large quantities of wooden waste (saw dust, wood park etc.), sewage sludge and even of so called 'green park waste' were landfilled in the past (Eek 2006a).

For Biodegradable Municipal Waste, the NWP gives a general priority to separate bio-waste from mixed MSW; the NWP suggest collecting garden waste in cities and enhancing home composting in rural areas. There is no general requirement for separate collection of BMW in the NWP, but since the NWP reports an average content BMW of 60-70% in MSW, Art 36 of the Waste Act contains an implicit requirement for separating BMW.[591]

The separate collection of BMW has now been imposed by the Ordinance of Sorting requirements for Municipal Waste (see Section 10.3.3).

According to Article 134 of the Waste Act, the percentage of biodegradable waste in the total amount by weight of municipal waste deposited in a landfill shall not exceed:

- more than 45% by weight from 2010 (at the moment about 60 %)
- more than 30% by weight from 2013
- more than 20% by weight from 2020

Assuming that the mean annual generation of municipal waste during the next 10 –15 years will be 500,000 tons/year, the share of landfilled biodegradable waste will be as follows:

Table 84: BMW in Estonia according to the NWP

Year	Municipal waste generation	Landfilled municipal waste	Landfilled biodegradable waste	Amount of recovered bio-degradable waste 1000 tonnes

[590] E-mail communication by Peeter Eek of 09 July 2008.

[591] EEA Country Fact Sheet.

	1000 tonnes	1000 tonnes	1000 tonnes	
2000[592]	633	601	390 - 450	20
2010	500	250	110	225-250
2013	500	225	65	270-290
2020	500	200	40	290-320

According to the most recent version of the NWP, the share of the bio-degradable waste in municipal waste is estimated in 2005 still as 65%. In 2005, 320,000 tons of BMW were generated, 260,000 tons (81 %) of which were landfilled. In that year, the composition of BMW was (Eek 2008a):

- Kitchen waste 43 %
- Paper, cardboard (incl. Packages) – 28 %
- Garden waste 18 %
- Wood – 5 %
- Others – 6 %

10.3.6. Division of responsibilities between levels of government

The waste management planning system comprises three levels (UN ECE 2001):

- National waste management plan
- County waste management plan
- Rural municipality and city waste management plan.

There are 241 units of local government in Estonia. These include towns and rural municipalities. While Tallinn counts 427,500 inhabitants, the population of Ruhnu Island is only 58. Two third of all municipalities have under 3000 inhabitants. In these small municipalities, in the absence of waste management specialists, the necessary expertise concerning waste management requirements and practices is low. Administrative reform, which would reduce the number of municipalities, has slowed down[593].

Local government have to prepare a rural municipality or city waste management plan as a part of the development plan of the corresponding rural municipality or city based on the county waste management plan. Waste holders have to subscribe to the organized municipal waste transport unless they are exempt because they manage the transport or handling of the waste by themselves. In such cases, the waste holders must give a yearly written explanation about the management of their waste. Possessors of waste who have joined the organized waste disposal system are obligated to pay a service charge for waste disposal. Local authorities have to co-operate with each other for managing their waste, if necessary[594].

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592 Real figures.

593 Rein Kalle, Põlva City, Estonia "Waste Management In Estonian's Municipalities: Responsibilities And Cooperation" http://www.envir.ee/orb.aw/class=file/action=preview/id=369657/Waste+management+in+Estonians+municipalities.pdf

594 Ibid

The number of residents to be serviced in a transport area must generally not exceed 30,000. The limits of waste transport fees are established by a regulation of the rural municipality or the city council. Organized municipal waste collection covers municipal waste from households and enterprises. The special or exclusive right to carry out waste transport within the specified transport areas is given for up to five years[595].

Due to the very low population density in the countryside, households there often have to bring the waste to collection points. In some cases, no municipal waste collection is organised and the market is left completely free[596].

In practice, it is estimated that ca 20 % households in urban areas are not connected to any collection system. In rural areas, the average is 40 to 50 % in rural areas, but in extreme cases this goes up to 85 %. These household burry their wastes in the ground, litter, incinerate at home or bring their waste to public waste bins. The process towards the new - municipally organized system - goes very slowly. Officials of the Waste Department expect that most of the illegal disposal and littering would end if local governments approve the "Organised waste collection system", which requires all households to be connected with the waste transport system[597].

The current targets for the Ministry of the Environment are:

- Every municipality must have a waste station or at least one big waste collection point.
- 95% of population is connected with organized waste collection system. 95% of population has access to waste station or waste collection point not farther than 10 kilometres.
- Develop bio-waste separate collection and recycling on the spots.

In this respect, it is worth mentioning that the Estonian Association of Waste Management Enterprises agrees that fragmented administrative systems with small units do not guarantee that local municipalities have sufficient competence or interest in dealing with waste collection. Local authorities have failed to motivate their residents to sort waste and municipalities release too many subjects from the obligation to accede to the waste management services. The Association proposed a number of options for solving the problems, including imposing of a waste tax and adopting a system which is used in Lithuania where competitions on waste transportation licences are organised. This system would force everyone to accede to waste collection services and would make it possible for the subject in possession of the waste to choose the waste collection company[598].

10.3.7. Waste management infrastructure: situation and perspectives[599]

As already noted above, Estonia inherited an underdeveloped and landfill based waste management system. A whole new infrastructure had to be established in the last fifteen years.

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[595] Rüütelmann (2008), Waste Management in Estonia, Presentation given at the Waste management strategies in Baltic region. International conference in Riga

[596] Information provided per telephone by Mrs Rüütelmann of the Estonian Waste Management Association on 08 July 2008.

[597] E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment of 05 June 2008.

[598] http://www.baltic-course.com/eng/markets_and_companies/?doc=2571

[599] E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment of 05 June 2008.

In year 1990 there were over 350 municipal waste landfills in Estonia. There where also 75 industrial waste landfills and 140 animal wastes dumping places.

In 2008, the number of municipal landfills had been reduced to 16 - 6 of them are new and have been built in compliance with the Landfill Directive. The others will be closed in July 2009. On top of this, there are still 22 closed landfills that must be decontaminated.

There are also 10 hazardous waste landfills (mainly to treat the waste from oil-shale industry). 2 of them have been built according to the Landfill Directive. The other will be closed in July 2009 or must be renewed. On top of this there are still 3 closed landfills that must be decontaminated.

There are also 2 landfills for inert wastes (C&D and mining waste), which must be closed in July 2009 or must be renewed.

There are no animal wastes dumping places any more in Estonia. All the animal wastes are incinerated.

Several projects for municipal waste incineration plants are in the pipeline and should be finalised in 2011-2012.

Mr Kiviselg of the Waste Department reckons that the lack of appropriate infrastructure is the main bottleneck for recycling[600]. He refers specifically to the lack of biowaste composting sites, the lack of waste handling structures and the lack of waste stations (36 while there is an estimated need for about 100). Incineration is still considered as a solution for biodegradable waste.

10.4. SOME BASIC STATISTICS

Estonia is one of the biggest waste producers per habitant in European Union. While European average waste production per capita is 3,5 tons per year (of which 3% is hazardous waste), Estonian average waste production per capita is circa 14 tons per year (of which hazardous waste is still about 60 percent)[601].

The production of municipal solid waste is growing, but at the same time the sorting and reuse is also increasing. It is expected that the production of municipal wastes will be stabilizing in 2012 to 650,000 ton/year.[602]

In 2006, the total waste production was 20,012,490 ton, of which 593,270 ton of municipal waste. 373,270 tonnes were landfilled. Of the total waste production, a huge 65% (13,000,000 ton/year) is still generated by oil-shale industry[603].

Disposal was split up as follows:

- 55% of produced wastes are landfilled
- 34% of produced wastes are recovered

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[600] As already pointed out above, Estonia has obtained a transition period for the full implementation of the Landfill Directive.

[601] E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment of 05 June 2008.

[602] Ibid.

[603] Ibid.

- 3,3% produced wastes are exported

As noted above, incineration is limited to some of the hazardous wastes and to animal waste.

Out of municipal waste, 7% is recycled (mainly packaging and paper) and 93% is landfilled[604].

Table 85: Waste generation and treatment in 1000 tonnes[605]

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total waste generation	14196	14687	14398	12984	10848	11616	12839	14397	18397	17500	18500	20000
Municipal waste generated	533	565	593	557	569	633	509	553	567	574	557	593
Seperately collected[606]							3%	6%	7%			
Municipal waste landfilled	529	564	592	556	569	601	403	419	371	382	369	373

Table 86 Waste generation and treatment in kg per capita[607]

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total waste generation	9803	10305	10240	9320	7865	8466	9392	10577	13567			
Municipal waste generated	368	396	422	400	413	440	372	406	418	424	412	441
Municipal waste landfilled	365	396	421	399	412	438	295	308	274			

The most striking figure in the table above is without a doubt the low share of municipal waste in total waste production (3.1 % in 2003). It is also noteworthy that the 1997 National Environmental Strategy had specified that municipal waste per citizen should stabilize to a maximum of 250-300 kg by 2010 (UN ECE 2001) - clearly, there is a long way to go.

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[604] Kriipsalu, M, Technology transfer for waste management, Country report: Estonia, http://irc.innovation.lv/_rict_text/docs/METTTES_EE_Mait.ppt

[605] EEA Country Fact Sheet and Rüütelmann (2008), Waste Management in Estonia, Presentation given at the Waste management strategies in Baltic region. International conference in Riga

[606] Rein Kalle, Põlva City, Estonia "Waste Management In Estonian's Municipalities: Responsibilities And Cooperation" http://www.envir.ee/orb.aw/class=file/action=preview/id=369657/Waste+management+in+Estonians+municipalities.pdf

[607] EEA Country Fact Sheet and Rüütelmann (2008), Waste Management in Estonia, Presentation given at the Waste management strategies in Baltic region. International conference in Riga

10.5. EXTENDED PRODUCER RESPONSIBILITY IN ESTONIA

A specific focus in 2003-2006 was implementing producer's responsibility on certain waste flows such as those from packaging, waste electric and electronic equipment, end-of-life vehicles and end-of-life tires, waste batteries and accumulators[608].

EPR was introduced principally by the following regulations[609]:

End-of Life Vehicles /Tyres	1 - Art 25, 26 Regulations of Estonian Government: 29.04.2004 No 158 (RTI 2004, 38, 259); 13.12.2004 No 352 (RTI 2004, 85, 579) Regulation of MoE 04.07.2004, No 89 (RTL 2004, 97, 527)
Waste of electric and electronic equipment	1 - Art 25, 26 Regulations of Estonian Government: 29.04.2004 No 158 (RTI 2004, 38, 259); 24.12.2004 No 376 (RTI 2004, 91, 628) Regulation of MoE 09.02.2005, No 9 (RTL 2005, 20, 245)
Batteries	1 - Art 25, 26 Regulation of MoE 26.04.2004, No 27 (RTL 2004, 53, 900)

From 1 January 2006 on, 75 to 85% of the weight of all ELV must be recovered or reused.

From December 2006, on average, 4 kg of WEEE must be collected per inhabitant per year. From December 2008, there is an obligation to recover 70-80 percent of the weight of WEEE[610].

According to the Waste Act, a producer is required to ensure the collection, recycling, recovery or disposal of waste resulting from products of concern manufactured, resold or imported (which are put on the market after 12 August 2005) and shall have a sufficient guarantee for these obligations. Guarantee can be[611]:

- participation in collective schemes,
- recycling insurance or
- closed bank account.

A product of concern is a product the waste resulting from causes or may cause health or environmental hazards, environmental nuisances or excessive pollution of environment. Products of concern are: batteries and accumulators, equipments containing PCBs, motor vehicles and their parts, tyres and EEE and their parts.

It is not clear in practice how a recycling insurance would work, as no insurance companies have yet offered this type of contract. In the case of a closed bank account, the monies would be unfreezed when

608 Website of the Ministry of the Environment.

609 EEA Country Fact Sheet

610 E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department of 05 June 2008.

611 http://www.envir.ee/257237

the products are recovered[612].

Each producer is required to register in Register of Product of Concern[613] and introduce data according to the Regulation of Government No 28, 30.01.2006.

10.6. ESTONIAN POLICY WITH RESPECT TO PACKAGING WASTE

The original legislation for the management of packaging and packaging-waste in Estonia comprised two statutes (UN ECE 2001):

- The 1995 Packaging Act and six regulations adopted based on the act;
- The 1996 Packaging Excise Duty Act and three regulations adopted based on the act.

The 2004 Packaging Act has set recovery targets for packaging recovery.

Estonia is the only New Member State that has not requested a transition period for the implementation of the Packaging Directive[614].

10.6.1. The 1995 Packaging Act

The Packaging Act transposes the principles and requirements of the EU Packaging Directive (94/62/EEC) to Estonia.

The Packaging Act required, among other obligations, that (UN ECE 2001):

- Local governments direct the packaging reuse system;
- Manufacturers and distributors collect packaging of their own goods at the place of distribution of such goods;
- A packaging deposit system shall be established by the Minister of Economic Affairs;
- Deposits shall be charged from consumers of packaged goods;
- Sanctions can be imposed on those packaging manufacturers who do not deliver the requested annual information to the packaging register.

However, according to the UN ECE, many of the above requirements have not been implemented by 2001 because practical steps were not in place. For instance, there was no list of returnable packages with corresponding deposit fees; most of the used packages could not be returned because the local authorities had not set up the package collection sites; there was no information in the shops or other places where packaging could be returned; and the data reporting procedure to the packaging register was too complicated.

10.6.2. The Excise Duty

The 1997 Packaging Excise Duty Act introduced an excise duty on sales packaging of alcoholic beverages (as from 1 March 1997), of non-alcoholic beverages (as from 01 December 1998) and other sales packaging (as from 01 July 2005). In case the importer or the producers organises the collection and the

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[612] Information provided per e-mail by Malle Piirsoo, Chief Officer of the Waste Department, on 16 July 2008.

[613] http://proto.envir.ee

[614] Mr Eek (2006b), Status of the collection and recovery of packaging waste in Estonia, presentation at the end seminar of the TWINNING project with Austria.

recovery of used packaging of at least 60% of each class of packaging material, the company is exempt from the excise duty. In the case of metal beverage packaging, the threshold for exemption is set at 40% (Eek 2006b).

In the case of alcoholic beverages and soft drinks, a majority of the industry had fulfilled this requirement by 2001. However, the proportion of beverage containers among all packaging materials was so small that Estonia could not meet the imposed targets for 2001. A specific issue was that the lack of incineration capacity and recycling possibilities implied that an increasing proportion of packaging waste recovery would have to be based on partial export of packaging wastes (UN ECE 2001).

10.6.3. The 2004 Packaging Act

The Packaging Act introduced in June 2004 set recovery targets for all packaging placed on the market. Moreover, it introduced a deposit system for one way and 'multi-way' packaging of beer, alcohol drinks with low ethanol content and soft drinks in glass, plastic and metal packaging as of January 1, 2005.

The recovery targets are[615]:

- 50% recovery by 2004
- 60% recovery by 2010
- EU norms by 2012

The 1995 Packaging Act was repealed in 2005 (Eek 2006b).

The 2004 Packaging Act requires the sellers of goods to take back free of charge the sales packages and the packaging waste of the goods at the sales points or its immediate vicinity. The packaging undertakings may transfer this obligation (if it is not covered by the deposit) by joining a recovery organisation. In the case of the deposit for beverage packaging, the deposit value is added to the price of the packaging and the consumer receives it back when he returns the packaging to the collection points (Eek 2006b).

A specific feature of Estonian packaging waste policy is that it sets as an aim to guarantee selective packaging waste collection all over the country, whilst in other countries, the overall recovery rate is emphasized[616].

In 2004 data, the total recycling rate 33.5% (target 25%) and the total recovery rate 33.9% (target 50%). The rates of recycling for each type of packaging were:

Table 87: Packaging recycling in Estonia

	Recycling rate	Objective
Glass	64%	15%
Plastic	12%	15%
Paper	35%	15%
Metals	28%	15%

[615] EEA Country Fact Sheet.

[616] Information provided by Mr Peter Eek (Ministry of the Environment) per e-mail on 07 July 2008.

Wood	5%	15%

The generation and recycling of packaging waste has evolved as follows[617]:

Table 88: Generation and recycling of packaging waste

	2001	2002	2003	2004	2005
Amounts generated (thousands tonnes per year)	111.1	119.7	123.7	131.4	137.2
Amounts recycled (thousands tonnes per year)	13.3	16.2	29.2	44.6	56.4

10.6.4. Packaging recovery organisations

According to the Packaging Act, the number of recovery organizations is not limited, but they have to fulfil requirements and get a license for operation from the Estonian Ministry of Environment[618].

There are 2 national accredited packaging organisations in Estonia: the Estonian Recovery Organisation and the Estonian PackCycling (EPC).

Both organisations finance their activities by recovery fees. In compliance with the user-pays principle, the recovery fees are calculated on the basis of the material used and the weight of items sold. They also take account of the different costs incurred for collecting and sorting the packaging materials and, in the case of plastics, for recycling. The companies pay only for those items of packaging they put on to the Estonian market.

Both organizations are non-profit organization and do not share profit among its owners. All profit is reinvested to the collection and recovery for decreasing total costs. Both were established in 2004.

The scope of their responsibility is to collect and recover its clients' packaging waste and to guarantee reporting for Packaging Register.

Membership is open to all types of obligated companies including manufacturers, converters, packer/fillers, sellers and also all sectors of industry.

ERO and EPC collect package all types of packaging waste in all municipalities. EPC has 110 members and clients, corresponding to a market share of 25%. ERO has 700 licensed companies, corresponding to a market share of 30%. Their market shares do not sum up to 100% because some 20% of the package volumes are put on the market without being covered by a licensed recovery organisation[619].

On top of this, Eesti Pandipakend LLC is organizing the recovery of packaging under deposit. Retailers are compensated by the recovery organisation for the handling of the deposit (Eek 2006b).

[617] http://eelis.ic.envir.ee:88/seireveeb/envirind_avalik/index.php?l=en&t1=AVALEHT

[618] Information from EPC and PRO-Europe website.

[619] Information provided per e-mail by Andres Siplane of Pakendiringlus on 04 July 2008.

The table below gives the recovery fees for ERO[620], but the fees of EPC are of a comparable magnitude [621]:

Table 89: ERO recovery fees 2007

Sales packaging	EURO/kg
Glass and ceramics	0,1
Paper and carton, including beverage carton (for milk)	0,11
Beverage carton	0,41
Plastic	0,41
Metal	0,26
Wood	0,04
Transport and group packaging	
Paper, carton, corrugated board	0,11
Plastic	0,12
Metal	0,13
Wood	0,04

10.6.5. Organisation of the collection system

In Estonia, the packaging organisations have to provide the collection network for the separate collection. The principal reason why Estonia has deviated from the more usual approach to have the packaging organizations reimburse the additional costs the municipalities incur due to selective collection lies in the limited capabilities of Estonian municipalities in the domain of waste collection[622].

In practice, the packaging organisations are responsible for providing and operating the collection bins. The collection is mostly organised by containers, but there are few areas where they use kerbside collection.[623]

According to the Packaging act, the collection network has to be provided by the packaging organisations, but must comply with the requirements defined in local waste management regulations (adopted by the local councils). For instance, the Tallinn City Council has decided, that, in areas with apartment blocks, at least one container for the collection of packaging waste should be installed per 450 flats. In one-family housing areas, the distance between the packaging containers should not exceed 200

620 Information from EEA Country Fact Sheet.

621 Information provided per e-mail by Andres Siplane of Pakendiringlus on 07 July 2008.

622 Information provided by Mr Peeter Eek (Ministry of the Environment) per e-mail on 08 July 2008.

623 Information provided per e-mail by Andres Siplane of Pakendiringlus on 04 July 2008.

m. However, Mr Eek (Ministry of the Environment) claims that compliance with this local requirement is low[624].

When the local authority has no interest in the issue, then the organisations cooperate with local shops for example. The local authorities do not have to put any money into the collection system. The organisations collect packaging waste in all municipalities since October 2006[625].

In practice, with 1 to 2 containers per municipality, the distance between an average consumer and the container could exceed ten kilometres. Often, the population would not even be aware of such containers. Mr Eek claims that, due to competitive pressures, the packaging organisation cut costs wherever possible, including in the fulfilment of their duty to organise information campaigns. According to Mr Eek, there are also many complaints that the lids of the containers are too small, which makes them unsuitable for packaging. However, the point of view of the packaging organizations is that, as not all households are covered by the municipal waste collection systems, a bigger lid would lead more people to use the packaging containers for mixed municipal waste[626].

The overlapping of the collection systems also leads to a duplication of costs. There are currently on-going negotiations do divide the collection markets geographically (at least as far as the large islands are concerned) [627].

10.6.6. Functioning of the market

Recycling capacity for packaging waste in Estonia is limited to one plant to recycle white glass. All the other waste streams have to be exported. Another factor in the economics of the system is the extremely low population density in rural areas. It is only in the bigger towns that paper and glass bins could be paying for themselves [628].

With respect to the corporate organisation of the Packaging Organisations, in practice, the number of "member" companies can be very low compared to the number of "client" companies. The amounts invested by the "members" can represent less than 5% of funds collected, but only the "members" can take decisions on the applicable tariffs[629].

10.6.7. Perspectives[630]

In 2007, a recovery rate of 55 % was obtained. Mr Eek concludes that the collection and recovery system actually functions pretty well.

[624] Information provided by Mr Peeter Eek (Ministry of the Environment) per e-mail on 07 July 2008.

[625] Information provided per e-mail by Andres Siplane of Pakendiringlus on 04 July 2008.

[626] Information provided by Mr Peeter Eek (Ministry of the Environment) per e-mail on 07 July 2008.

[627] This division will be subject to the approval of the Estonian Competition Board. Information provided per e-mail by Andres Siplane of Pakendiringlus on 07 July 2008.

[628] Information provided per e-mail by Andres Siplane of Pakendiringlus on 07 July 2008.

[629] Information provided by Mr Peeter Eek (Ministry of the Environment) per e-mail on 08 July 2008.

[630] Information provided by Mr Peeter Eek (Ministry of the Environment) per e-mail on 07 July 2008.

An amended Packaging Act will come into force in 2009. It sets now more detailed requirements for the collections network and for public information.

10.7. PVC

According to the household waste survey held in Tallinn in 2004[631], 9.1% of mixed municipal waste were plastics. The official waste classification and the Waste Reports do not split up the figures on waste generation according to plastics type. Until recently, the majority of plastic waste was landfilled. The pressure to increase recycling comes from[632]:

- EU packaging Directive 1994/62 and 2004/12
- ELV Directive 2000/53
- WEEE Directive 2002/96

There are no specific regulations about PVC in Estonia. According to research undertaken by the Ministry of the Environment, there is nearly no PVC in packaging. The PVC in the waste stream is nearly 100 % from C&D waste. Clean and pure PVC is recycled (from windows etc), but the remaining is land filled[633].

According to Mr Eek, there is a lot of uncertainty regarding the plastics waste streams originating from ELV and WEEE.

With respect to ELV, the conventional approach to dismantling consists in de-pollution, dismantling of the bumpers (PVC) and some other plastic items (tanks for screen wash liquid for instance) and shreddering. The “shredder light fraction” (SLF) is still landfilled but Kuusakoski AS plans to separate RDF (mainly plastics) from SLF. Plastics waste from ELV amounts to 1,600 tonnes per year.

The plastics amounts from WEEE are less than 1,000 tonnes per year (out of 4,000 tonnes of collected WEEE in 2006).

10.8. BATTERIES

In 2001, a network of hazardous waste containers and stations had been set up to collect hazardous waste from households and small enterprises, including car batteries (UN ECE 2001).

Currently, no systematic selective collection of batteries is organised in Estonia. Lead-acid batteries are collected, driven by the market value of lead[634].

According to a study undertaken in 2006 by the Ministry of the Environment, the recovery rate for portable batteries was 5.7% and for automotive batteries 64%[635].

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[631] This is, before the Packaging Act came into force.

[632] Eek, P (2007), Plastic Waste in Estonia: Situation today and outlook to the future, presentation given at the RePlast FinEst seminar

[633] Information provided per e-mail by Mr Eek on 09 July 2009.

[634] Information provided by anonymous stakeholder.

[635] Information provided per e-mail by Malle Piirsoo, Chief Officer of the Waste Department, on 16 July 2008.

Regulation of the Minister of the Environment No. 27 of 26 April 2004 (RTL2, 28.04.04, 53, 900) provides the measures for the collection and temporary storage of used batteries and accumulators *containing certain dangerous substances* with the aim to prevent or decrease the hazards resulting from the batteries and accumulators to the environment. These used batteries and accumulators have to be collected, for the purpose of their recovery or disposal, apart from other waste. A waste holder is required to transfer them to a person holding a waste permit and hazardous waste handling licence.

10.8.1. ERP for WEEE

The WEEE and RoHS Directives are transposed into Estonian legislation through[636]:

- Waste Act (definition of producer and product of concern, general obligations for producer);
- Regulation of Government No 154, 06.07.2006 (restricted hazardous substances and exemptions);
- Regulation of Government No 376, 24.12.2004 (specified definition of producer, list of electrical and electronic equipments, marking, targets for recycling and recovery and deadlines for achievement of these targets, requirements for returning WEEE to the producer);
- Regulation of Minister of Environment No 9, 09.02.2005 (requirements for treatment of WEEE);
- Regulation of Government No 28, 30.01.2006 (Register of Product of Concern and registration of producers).

The producer must bear all costs of collection and treatment of WEEE. Producers have also the obligation to collect and treat all WEEE resulting from EEE put on the market before 13 August 2005 (the so called historical waste). The costs of such waste shall be divided between these producers who are in market now in proportion to their market share (by categories).

Retailers of EEE intended for household use are responsible for ensuring that such waste can be returned to the retailer free of charge on a *one-to-on*e basis as long as the equipment is of equivalent type and has fulfilled the same functions as the supplied equipment.

If there are no facilities for collection of WEEE within the radius of 10 km, retailers are responsible for ensuring that such waste can be returned to the retailer free of charge on more than one-to-one basis as long as the equipment is of equivalent type and has fulfilled the same functions as the supplied equipment.

In Estonia, there is no Clearing House System. If, for example a producer has collected more WEEE than he/she put on the market then he can charge those who have collected less than what they have put on the market. If no agreement is reached, then the case goes to Court.

The largest collector of WEEE in Estonia is Eesti Elektroonikaromu. Producers declare the mass of EEE put on the Estonian market during an accounting period and pay to Eesti Elektroonikaromu according to the price-list. Producers delegate all their obligations related to the collection and recycling of WEEE to Eesti Elektroonikaromu. There are over 60 collecting places/points on the list of Eesti Elektroonikaromu covering the entire territory of Estonia[637].

EES-Ringlus has 94 members. Any operator who complies with the requirements of the articles of association and produces, imports or sells electrical and electronic equipment or batteries and accumulators can become a member of the MTÜ EES-Ringlus. Membership fee is EEK 1000 per month.

[636] http://www.envir.ee/257237

[637] http://www.elektroonikaromu.ee/web/?cat_ID=2&page_id=17

After approval of membership the parties MTÜ EES-Ringlus and the producer/importer shall enter into an agreement on organising the treatment of waste generated from electrical and electronic equipment, as well as financing the treatment[638].

Ekogaisma SIA Branch concentrates on lamps – they do not cover WEEE containing batteries[639].

10.8.2. Transposition of the Battery Directive

The new Battery Directive 2006/66/EC has been transposed into Estonian legislation through (as 1 July 2008) [640]:

- Waste Act (definition of producer and product of concern, general obligations for producer, general requirements for waste handling);
- Regulation of Government No. 154, 06.07.2006 (restricted hazardous substances and exemptions);
- Regulation of Government No. 28, 30.01.2006 (Register of Product of Concern and registration of producers);
- Regulation of Minister of Environment No. 5, 10.01.2008 (requirements for treatment of batteries);
- Regulation of Minister of Environment No. 64, 21.12.2007 (requirements for labelling batteries);

Battery producers are subject to the standard requirements for producers of "products of concern" (see Section 10.5).

Producers must also introduce data on the quantities of batteries and accumulators they manufacture, import, export and put on the Estonian market. Producers are also required to introduce an annual waste report.

Producers must bear all costs of collection and treatment of waste batteries and accumulators. Producers have also the obligation to collect and treat all waste batteries and accumulators resulting from batteries and accumulators put on the market before 1 May 2004. The costs of such waste shall be divided between these producers who are in market now in proportion to their market share.

As in the case of WEEE, there is no clearing house for collective systems.

2 WEEE collection systems (MTÜ EES-Ringlus and MTÜ Eesti Elektroonikaromu) have declared that they started to collect also portable batteries and accumulators. For automotive batteries and accumulators there is no collective scheme, but one recycler of automotive batteries has a quite good net of collection points all over the Estonia and they collect automotive batteries already many years[641].

All collected waste portable batteries and accumulators will be treated outside Estonia, most of waste automotive batteries and accumulators are treated in Estonia (in AS Ecometal).

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[638] http://www.eesringlus.ee/1946

[639] E-mail of Aivo Lokk, manager of Ekogaisma SIA Eesti filiaa, on 02 July 2008.

[640] Unless stated otherwise, all information in the rest of this Section has been obtained from: http://www.envir.ee/989937

[641] Information provided per e-mail by Malle Piirsoo, Chief Officer of the Waste Department, on 16 July 2008.

Recently, 6 companies have created another recovery organisation, called MTÜ Patareiringlus[642].

The Regulation setting the requirements for collection and returning the batteries, the collection rates and targets for recycling and recovery and the deadlines for achievement of rates and targets is still in the draft stage.

Selling points for batteries will have to take back batteries of the same type the sell. Waste stations and collection points for hazardous waste will take back portable batteries and automotive batteries and accumulators. Containers for portable batteries will also be placed in schools and workplaces. For industrial batteries and accumulators, other arrangements are possible. No specific measures are foreseen to deal with hoarding by the households[643].

The Ministry of the Environment will launch campaigns to remind companies of their obligations. It is hoped that producers will inform the enforcement authorities when they suspect a company to be a free-rider. [644]

10.8.3. Battery recycling: Ecometal[645]

Ecometal was founded in 1999 and production started in 2003.

It has a total capacity of recycling up to 20,000 tons of batteries annually.

The recycling process in Ecometal Ltd. includes

- Physical treatment – crushing and separation of different parts of batteries
- Chemical treatment – washing of the separated parts and chemical neutralizing of the battery electrolyte
- Thermal treatment – smelting and refining of metal parts of the battery and extraction of the slag generated in process of smelting

Ecometal Ltd generates and manages the following wastes:

- Slag, which is collected and disposed to a special land-fill
- Waste water – and acid is collected, used in process and neutralized. Subsequently, they are forwarded to sewage.
- Exhaust air from furnace and other

Ecometal recycles only lead-acid batteries. The origins of these batteries can be found in the figure below.

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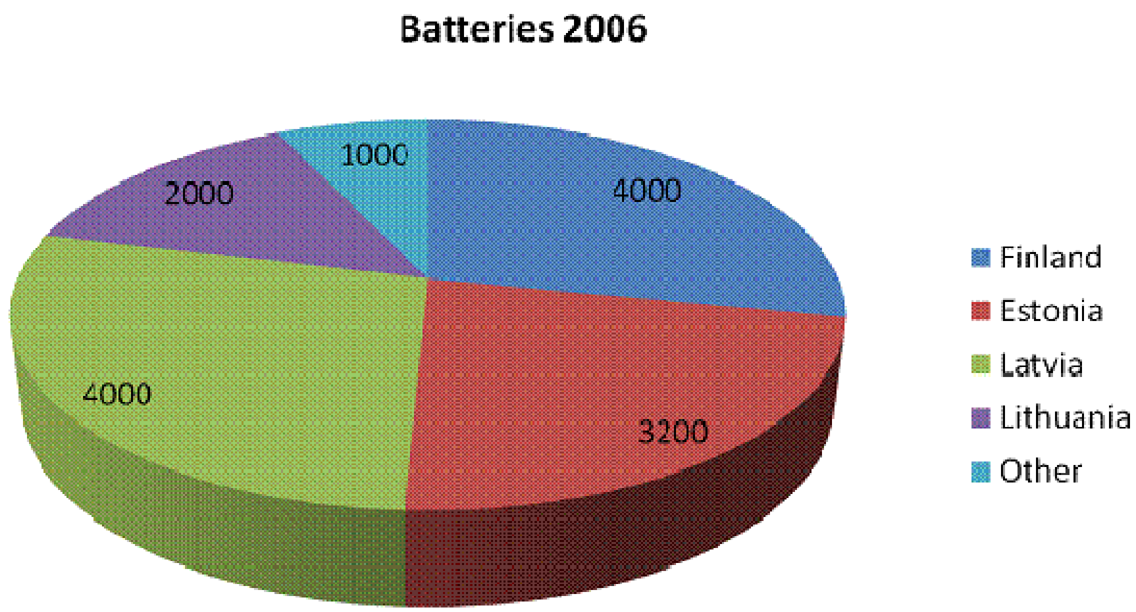
[642] Information provided by anonymous stakeholder.

[643] Information provided per e-mail by Malle Piirsoo, Chief Officer of the Waste Department, on 16 July 2008.

[644] Ibid.

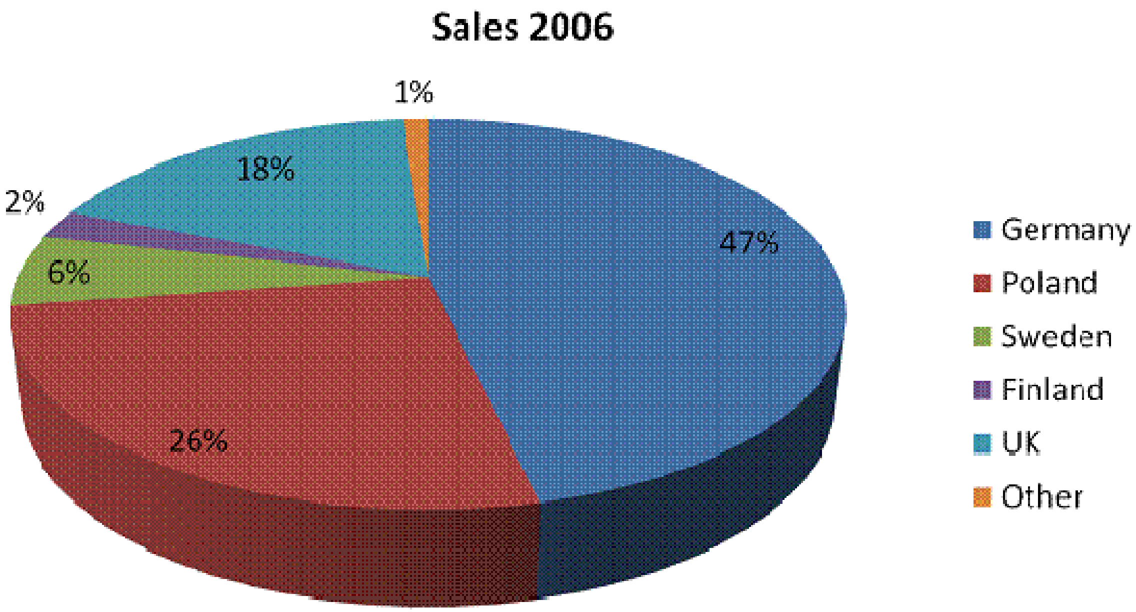
[645] All information in this section comes from the presentation "Lead-acid Battery Recycling in Baltic Countries" (www.ecometal.ee/90est.ppt) and from e-mail correspondence with anonymous stakeholders.

Figure 60: Ecometal battery collection market



The recovered materials are metallic lead and plastics, which are used as raw material by firms. 99.5 % of these materials are exported.

Figure 61: Ecometal sales



The price of lead follows the price on the London Metal Exchange.

The waste batteries delivered to Ecometal sometimes contain NiCd batteries that have been supplied by mistake. Ecometal is currently negotiating a contract with battery recycler SNAM (France). A specific problem here is that SNAM will not accept unsorted waste batteries without being paid for it. Some manual sorting of the batteries will thus be needed in order to obtain positive prices for some battery types. This is an extra cost for Ecometal, which has a fully automated plant.

An important barrier to entry in the market for recycling lead-acid batteries are the important investment outlays that are required.

Because lead-acid batteries have a positive market value that can vary from country to country, a black market has developed where batteries are moving across the borders of countries without consideration for the relevant regulations. According to Mr Ehrlich, the limited resources of the enforcement authorities constitute an important barrier to a stricter control over transboundary movement of hazardous waste.

Another issue is the unclear definition of the hazardous materials. In Estonia, the lead plates (usually together with lead paste and PVC or polyethylene separators attached) are considered as battery scrap and thus should be treated (collected, transported) as hazardous waste. But in some countries, this material is considered as metal scrap (for example in Lithuania, Latvia, Germany) and can be sold (thus also stored and transported) as non hazardous waste. According to Mr Ehrlich, this leads to unfair competition on the battery collection market and also environmental problems (as physical dismantling of batteries can be considered as recycling while better technologies are available).

Mr Ehrlich thinks that the only solution is to identify the hazardous waste more clearly and to have the same rules being applied to all EU MS in the same way.

Ecometal has formulated the following suggestions for improvement:

- All recyclers of the batteries should face the same requirements for the technology in use and environmental control over the activity. These requirements should be equal to every company in such field of business and that rule should be applied in all Baltic States equally to meet the requirements of the Battery Directive of the EU.
- Stronger control over the fulfilment of Basel Convention and relevant EU regulations and directives for movement of hazardous waste between Baltic countries.
- Equal system of Producers Liability should be applied in all Baltic States. It should be concerted and harmonized.
- All information on the national licences and permits on recovery or disposal of hazardous waste and hazardous waste import-export permissions should be available on the Internet.
- Authorities should assure the recycling of lead-acid batteries with best available technology by allowing the trans-boundary movement of such waste to the nearest controlled relevant recycler.

10.9. FOOD

10.9.1. Generalities[646]

There is no specific policy on food waste in Estonia.

However, the requirement to reduce the amounts of biodegradable waste going to landfill (see Section 10.3.5) clearly affects the options that are available.

[646] Peter Eek, Waste Department of the Ministry of the Environment, 29 April 2008, "Organic Waste Legislation and Consequences for the Implementation on the Municipal Level in Estonia" presentation given at the 2nd Baltic Biowaste Conference 2008.

In its 2001 Environmental Performance Review, the UN Economic Commission for Europe Biodegradable advised that waste treatment should rely on separation at source, and central biological waste treatment plants in urban areas and backyard composting in rural areas. It pointed out that remaining organic waste could be source separated and collected separately for energy production purposes, especially in the northeast where the power industry is located (UN ECE 2001).

Currently, most regional Waste Management Centres and some bigger Waste Stations have composting installation, but these are insufficient in the long run. Moreover, the existing installations are not always used correctly, as little preparation has been put in the regulation of the separate collection of bio-degradable waste streams (including the motivation of the participants).

There are also on-going discussions on which composting technology to use. MBT and mass incineration are available and do not require separation at the source. Anaerobic digestion is also thought to be promising, even though the pilot plant in Saaremaa (working on pig-manure) is not yet working properly.

An important issue raised by Mr Eek is the feeling that with respect to technology, there is always something new, better and promising on the horizon.

At the organisational level, Estonia has some experience with the selective collection of food waste, which we describe more in detail below.

10.9.2. Biowaste management in Tallinn municipality

In Tallinn, the selective collection of organic kitchen wastes started in apartment blocks, with more than 10 flats, and in offices, with a weekly production of more than 50 kg. Gradually, enterprises (including restaurants) and individual dwellings have been included in the collecting system. Afterwards the system has extended to areas with small housing and to the whole city of Tallinn. The experience gained in the pilot districts has been used in the design of the new tenders[647].

For the next 40 years, the waste of Tallinn and the neighbouring local municipalities will be managed by Tallinna Prügila. Tallinna Prügila operates both a new landfill that started operations in 2003 and a composting facility in compliance with the Regulation on Animal by-Products. It is able to compost[648]:

- green waste
- household organic waste
- food waste
- category 3 animal waste[649]

[647] Tõnu Tuppits. Tallinn Environment Department (2005), "The organic waste handling program for Tallinn City Government"

[648] Allan Pohlak, "Biowaste management in Tallinn municipality - ecology and economy in public-private-partnership solutions" presentation at the 2nd Baltic Biowaste Conference,

[649] Until now, this is the only facility meeting the requirements for Category 3 Animal Waste. Information provided per e-mail by Mait Kriipsalu (Estonian University of Life Sciences) on 07 June 2008.

Between January 2007 and March 2008, the composition of this stream was:

Figure 62: waste entering Tallinna Prügila composting facility

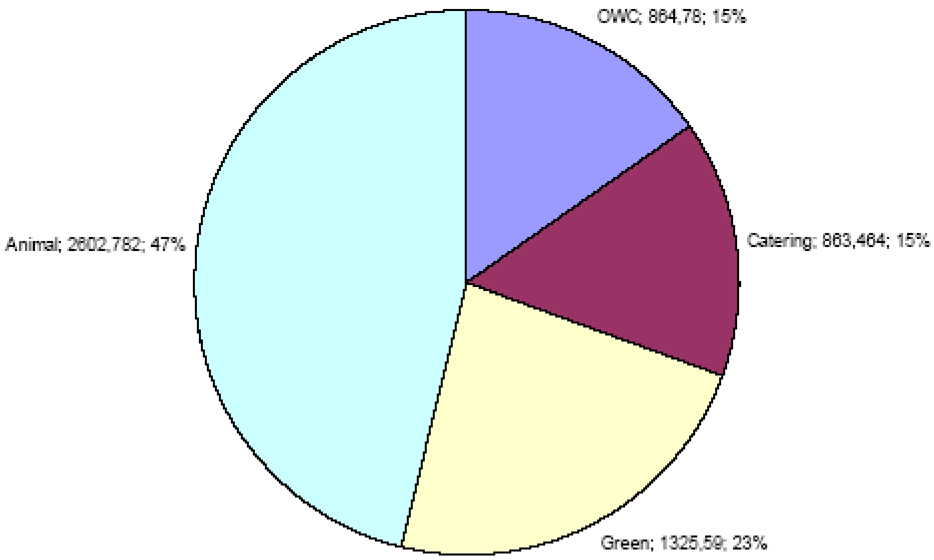
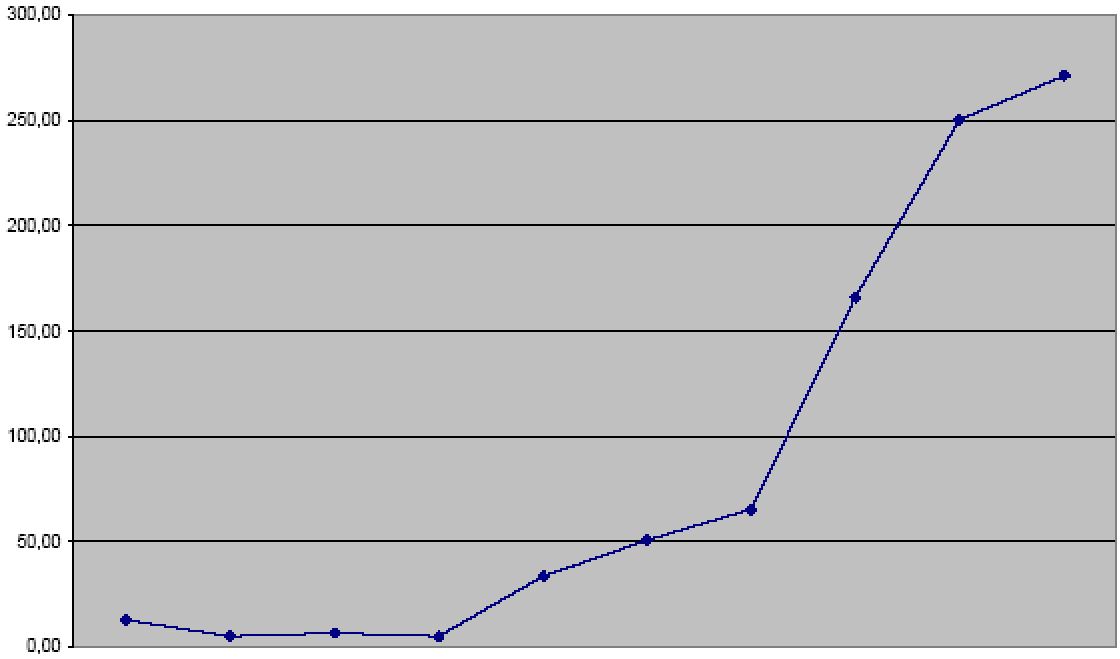


Figure 63: Catering waste from Tallinn Municipality via organized waste collection



If the organic material contains too much packaging waste (plastic, metal, glass) and other non biodegradable MSW, then the waste is landfilled and Tallinna Prügila will charge a higher fee to the company who delivered this unsuitable organic waste. Many companies use biodegradable plastic bags in containers and this is acceptable for the landfill. Plastic bags mixed with the organic material are screened by a drumscreen produced by Komptech. In the final product, some glass remains are left, but it has not been a very big problem till now[650].

Based upon a comparison of the quantity of kitchen waste contained in the landfilled residual waste (30%) and the separately collected waste stream, a rough estimation is that currently ca 10-15 % of the food waste is indeed collected seperately. Tallinn City has been rather soft in the implementation of the regulation on selective collection. However, the quality of the food waste that is indeed collected selectively is relatively good. Mr Eek reckons that, as a general rule, pushing for higher quantities of selectively collected waste will lead to worse quality. Although most compost is of good quality, it faces important image problems with customers[651].

However, according to Mr Pohlak, the compost that is currently produced is not suitable for direct use. Therefore, Tallinna Prügila is looking for co-operation with companies who are mixing soils. As a next step they are planning to co-operate directly with farmers who can add the compost directly to fields[652].

10.9.3. Experiences with separate collection and composting at the Middle Estonian Waste Management Centre[653]

Väätsa Landfill is located in central Estonia and was opened on 15 November 2000. It is a public limited company with 10 local authorities as shareholders. Its service area is about 100 000 people.

In Central Estonia, gardening and kitchen waste has been composted mostly in rural areas and at detached houses in smaller towns. Private homes are used to composting their gardening and kitchen waste in compost heaps.

A compost field was constructed in 2003. The construction of the 2nd stage of compost field started in 2008.

The collection of separate kitchen waste was started in 2007. According to the regional waste plan, biodegradable and kitchen waste must be collected seperately if the apartment block contains at least 4 flats.

The landfill has its own collections system, vehicles and containers. It has signed agreements with collectors and owners' associations. Containers have been placed in two cities (Paide and Türi), but this will be extended to rural areas in the future. Containers are emptied once a week. Some gardening and urban landscaping waste is separately collected at Türi Waste Station and at cemeteries in Paides.

A biowaste container holds:

- Peelings and leaves of fruits and vegetables, also bark and leaves of other plants
- Coffee grounds and tea leaves, also with filters
- Food waste (except liquids)

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650 Information provided by Allan Pohlak on 10 July 2009.

651 Information provided per e-mail by Mr Eek on 09 July 2009.

652 Information provided by Allan Pohlak on 10 July 2009.

653 Toomas Laimets, "Experiences with separate collection and composting at the Middle Estonian Waste Management Centre", presentation given at the 2nd Baltic Biowaste Conference, complemented with e-mail correspondence on 10 July 2008.

- Egg shells
- Soil for indoor plants
- Used household tissues/paper
- Paper tissues and other waste suitable for composting
- Waste packed only in bin-liners or paper bags, also wrapped in newspapers, can be put into biowaste containers

The main problem is the weak enforcement of the Waste Act by the local authorities (especially the small ones). As the prices for mixed municipal and biodegradable waste are very close to each other, people continue to mix biodegradable waste with mixed waste.

As the composting system[654] has not yet been approved by the Estonian Veterinary and Food Board, applications are limited to landfill coverage.

Mr Laimets reckons that there is a lack of demand for compost in rural areas.

10.9.4. Co-Composting of Sewage sludge and Solid organic waste

Sewage sludge contains large amounts of organic components, smells, contains pathogens and is quite liquid. Composting of sludge requires the addition of structure materials.

The following materials offer favourable characteristics e.g.:

- Shredded Bark/Woodchips
- Municipal organic waste/ Food Waste
- Shredded park waste/ Green waste

A pilot project on co-composting of sewage and solid organic waste is on-going at Tartu[655].

10.9.5. Market issues

Mait Kriipsalu of the Estonian University of Life Sciences sees soil (and to a lesser extent, sewage sludge compost) as the most important competitor for organic waste compost[656].

The construction boom has induced a strong need for top-soil, but due to the same large construction works there is also a strong offer of natural clean top-soil (Eek 2006a).

The relevant end-user target group is not much interested in using quality compost as a fertiliser.

There are no standards or quality criteria about the organic waste compost as a product. However, the Sewage Sludge Directive (see Section 3.5) does impose clear rules with respect to the use of sewage sludge compost.

There are also rules for the use of compost as a fertilizer[657] .

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[654] Because the waste contains food remains, a category 3 approval is needed.

[655] http://mi.emu.ee/kompost

[656] Information provided per e-mail on

[657] http://www.legaltext.ee/text/en/X2016K1.htm

Mait Kriipsalu thinks that quality criteria for compost are very much required.

Other constraints are the uncertainties concerning the end-of-waste criteria, sampling and analysing standards and third party quality control. Mr Eek claims that framework conditions at the European level are very much needed to go ahead on the MS level. (Eek 2006a).

Estonia is therefore one of the Member States that support a Biodegradable Waste Directive[658].

10.10. CARDBOARD

Given the abundance of forest resources in the Baltic, the economic pressure on companies in the pulp and paper sector to recycle is rather limited[659].

However, paper and cardboard are now subject to the requirements of the Ordinance of Sorting requirements for Municipal Waste (see Section 10.3.3). The paper and cardboard collection is tendered in several municipalities (including Tallinn). In Tallinn, separate container for paper-cardboard should be installed for every apartment block with more then 5 flats.

However, the level of implementation of the Ordinance on the separate collection varies. According to the most recent analyzes of residual waste, there is still ca 15 % in weight of paper and cardboard.[660]

Due to a lack of local recycling capacity, a significant fraction of collected material is exported. The collection and sorting companies sometimes operate with traders[661].

10.11. THE NEW NWP[662]

On 29 May 2008, the Estonian government approved the national waste action plan for 2008-2013, which is designed to drastically reduce the amount of waste being used for landfill and the danger associated with waste produced as well as to increase recycling.

The key aspects of the waste action plan for the next five years are:

- the sorting of waste where it occurs and collection of different types;
- the development of waste collection points and stations;
- the reduction of the amount of waste produced and the danger it presents, including the recycling of waste for energy production, i.e. the incineration of waste.

One significant difference between this action plan and the last is that it now features waste action plans on a county by county basis. Local governments will have to work together more closely in the production of documents related to the organisation of waste treatment and in the development of the collection of different types of waste.

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658 E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment, of 05 June 2008.

659 Document prepared for DG Regio in the context of the Second Cohesion Report.

660 Information provided per e-mail by Mr Eek on 09 July 2009.

661 Information provided per e-mail by stakeholders who required anonymity.

662 http://www.envir.ee/1074573

Specific significant attention is paid to:[663]

- bio-waste – composting, biogas production, incineration;
- the "products of concern" (see Section 10.5)
- unresolved problems in oil-shale sector;
- homogenize the targets of the EU and Estonia;
- establishing waste management targets for state, for counties, for local government and for private sector until the year 2013

According to the NWP, the most effective measures in achieving the aims of the action plan are the sorting of recyclable waste and the incineration of remaining mixed waste. However, even in Tallinn, it was not expected that household waste incineration could be achieved before 2011. It was concluded that the separate collection of biodegradable waste must be made more effective if the requirements established in the Waste Act were to be met.

The Ministry has also ordered waste research in order to get better data on the contents of mixed municipal waste, and on the distribution of materials in seperately collected waste streams.

An English translation was not available at the time of writing of the report, but will be soon[664].

10.12. CONCLUSION

From the analysis above, it is clear that the main challenges in Estonian waste policy are:

- The long way to go in the funding and development of an appropriate waste management infrastructure.
- The huge amounts of waste (compared to other streams) generated by the oil shale industry.
- The limited institutional capabilities at the level of the local authorities

The huge funding problems linked to the cleaning up of the old landfill system and the establishment of a new waste management system are compounded by the investment needs for oil-shale projects.

[663] E-mail communication by Robert Kiviselg, Chief Officer of the Waste Department, Ministry of the Environment of 05 June 2008.

[664] Information provided by Mr Peter Eek (Ministry of the Environment) per e-mail on 08 July 2008.

11. CASE STUDY: POLAND

11.1. STRUCTURE OF THIS CHAPTER

This Chapter takes a closer look at the specific situation of the four waste streams under consideration in Poland. We begin the chapter with some basic information on Polish society (Section 11.2) and waste policy (Section 11.3). An overview of extended producer responsibility is given in Section 11.4. Cardboard and beverage cartons' recycling fits within the policy on packaging waste, which is described in Section 11.5. The detailed analysis for the different waste streams follow then in Section 11.6 (PVC), 11.7 (batteries), 11.810.8 (food waste) and 11.9 (cardboard).

11.2. GENERAL INFORMATION

At the beginning of 2007, 38,125,479 people lived in Poland and population density equalled 122 persons per square km[665]. In 2005, 62% of people lived in urban areas[666].

Its GDP per capita relates as follows compared to the EU average[667]:

	2006 GDP per capita (PPP)	2006 GDR per capita (EUR°
Poland	12,400	7,100
EU27	23,500	23,500

11.3. GENERAL REGULATORY CONTEXT

The basic principles governing the division of public tasks in the field of environment protection are set forth in the 2001 Environmental Protection Law. The complex system of allocation of administrative and enforcement instruments involves the Minister for Environment Protection, three tiers of local government (on municipality, district and regional levels), state agencies and regional environment inspection offices.[668]

11.3.1. Waste Act

The core legal act regulating the issue of waste is the Waste Law of April 27, 2001 (the "Waste Act"). The Waste law is a specific statute in the Environmental Law and sets forth a definition of waste that is consisted with the one proposed in the Waste Framework Directive (75/442/EEC).

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[665] http://www.stat.gov.pl/cps/rde/xbcr/gus/PUBL_area_and_population_in_the_territorial_profile_2007.pdf

[666] http://encarta.msn.com/encyclopedia_761559758_2/poland.html

[667] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001-01/EN/KS-CD-07-001-01-EN.PDF

[668] Unless stated otherwise, all information in this section has been based on Global Legal Group Ltd, Comparative Legal Guides on years 2007-2008: http://www.iclg.co.uk/khadmin/Publications/pdf/1194.pdf and http://www.iclg.co.uk/khadmin/Publications/pdf/2035.pdf

The producer of waste or other holder of waste may transfer it only to collectors which have the necessary waste management permits (e.g. for collecting, recovery, neutralisation, disposal of waste). If a holder of waste transfers waste to a certified entity, liability for that waste transfers to the new holder. There are no exceptions in law to this rule. Specific duties regarding waste management apply to holders of certain categories of waste, e.g., hazardous waste (any waste classified as dangerous due to its origin or composition), waste attributable to significant industrial accidents, and selected non-hazardous waste (e.g., municipal waste).

11.3.2. National Waste Management Plan

The Waste Act also introduced the obligation to prepare waste management plans which need to be updated at least once every 4 years[669]. The first such national waste management plan (NWMP) was approved 29 October 2002 and the deadline for updating was end of the year 2006.

The 2010 National Waste Management Plan (NWMP 2010) presents the objectives and tasks for the period 2007-2010.

The long-term objective of the national waste management plan is a waste management system in accordance with sustainable waste management principles. In case it is impossible for waste to undergo recovery processes, this waste must be disposed of, while deposition on landfill is generally considered the least desirable method of conduct (NWMP 2010, p.47).

The waste management plan classifies waste as follows (NWMP 2010, p. 7):

- municipal wastes (households and others, if similar to waste generated by households)
- hazardous wastes (f.i. waste oils, batteries, ELV, WEEE, …)
- other wastes (including wastes generated from industrial activities, waste water sludge, packaging wastes; sometimes detailed types of waste have been considered, when significant problems were identified).

11.3.3. Responsibilities of provinces and municipalities[670]

The Polish territory is subdivided into different administrative units (levels): 16 *vovoidships* (regional level), 314 *powiats* (districts, counties), 65 cities with *powiat* status and the *gminas* (municipalities).[671]

Much of the implementation of waste policy is handled at the provincial level. Voivodships issue permits, collect fees and operate their own environmental funds. Voivodships also collect waste data.

Municipalities are responsible for monitoring compliance and issuing permits at the local level. They also have authority over local planning and municipal services, including waste management.

On the one hand, municipalities are required to maintain the tidiness of the communities, to organize separate collection (see Section 11.3.6), recovery and disposal of MSW and hazardous waste and to monitor the handling of waste. On the other hand, they also are required to allow waste collection companies to operate as long as these companies meet the legal conditions. Unless 30% of the

[669] The 2010 National Waste Management Plan, 2006, p. 6

[670] http://eea.eionet.europa.eu/Public/irc/eionet-circle/etc_waste/library?l=/country_fact_sheets/polandpdf/_EN_1.0_&a=d

[671] http://www.stat.gov.pl/cps/rde/xbcr/gus/PUBL_area_and_population_in_the_territorial_profile_2007.pdf

population agrees in a local referendum with a waste management fee, municipalities are not allowed to collect such fees[672].

In many Gminas, municipal waste services have been privatised. The Gminas issue licences to one or more waste contractors that are permitted to collect waste. Each household is obliged to contract with a waste operator and in theory must be able to show the contract and actual bills and payments. In practice, the Gmina rarely control whether households do indeed contract with a waste operator.

In the case of apartment blocks, the owners association organizes a tendering process and all residents have a contract with a single company(Tojo 2006).

If there is no operator collecting municipal wastes, the municipal authorities must provide for a system of municipal waste collection for all inhabitants of this Municipality (NWMP 2010).

In general, the waste producers (households and industry) are required to pay a fee to the waste operator for collection and landfill. In practice, it is difficult to assess what annual fee is paid. There is a wide variation in the population covered by waste management services. Waste collection services in Polish cities cover between 60 – 90% of the population, whilst in rural areas waste collection services at best cover between 20 – 40% of the population (EEA Country Fact Sheet).

A recent article published in EEP European Environmental Press argues that decision-making powers are not clearly defined and that the NWMP reference document is, so far, a dead letter[673].

The EEP article also claims that the high fragmentation of the waste collection market results in very low standards of service. For instance, in the Warsaw urban area alone, 80 companies have obtained a permit [674]. In Katowice, 18 companies collect household waste, 10 of which are involved in selective collection (Tojo 2006).

There is a growing number of uncontrolled dumping-grounds on which municipal waste is left. Although dumping-grounds are removed day by day in many gminas (in 2003 6,109 of them were removed) in a very short time they appear again. At the end of 2006, gmina offices counted 2,509 dumping-grounds on their area. The Central Statistical Office attributes this situation to the fact that still not all of households are served by a waste collection system[675].

11.3.4. Landfill policy

The requirements of the EU Landfill Directive (Directive 1999/31/EC) have been transposed into Polish legislation by means of the Act on Waste. Poland has been granted a transition until 2012 for the full implementation of the Landfill Directive. The Polish strategic objective is to achieve full compliance with the Directive targets by the deadline of July 2016 (EEA Country Fact Sheet).

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[672] Naoko Tojo (2006), Evaluation of waste management policies and policy instruments: three case studies, Report written as part of 6FP project HOLIWAST: Holistic Assessment of Waste Management Technologies, International Institute for Industrial Environmental Economics at Lund University, Sweden

[673] http://waste.environmental-expert.com/resultEachPressRelease.aspx?cid=6725&codi=28996&idproducttype=8&level=0

[674] http://waste.environmental-expert.com/resultEachPressRelease.aspx?cid=6725&codi=28996&idproducttype=8&level=0

[675] Central Statistical Office, Municipal Infrastructure In 2006

The (landfill) facilities for storage of municipal waste are also subject to authorization permits. It appears that, as of today, less than 30% of waste storage facilities in Poland meet European standards.[676]

A general improvement of the landfill situation should result from a programme for closure or modernisation of existing municipal waste landfills and the localisation of new sites for municipal waste landfills (adjustments of landfills, closing, new, expanded, …) (EEA Country Fact Sheet).

There are two types of landfill fees (Tojo 2006): one is an environmental fee determined by the government, and the other is the fee paid to the landfill owners. The size of the fee paid to the landfill owners is freely determined in the market. The size of the environmental fee is differentiated between different waste streams. As the municipality hosting a landfill can receive 50% of the environmental fee, it is easily understood that municipalities are not necessarily hostile to landfilling.

Table 90: environmental fee for landfilling (Tojo 2006)

Categories of waste	Fee [PLN (Euro) per tonne]	
	2003	2006
Mixed waste	13.80 (3.72)	15.39 (4.15)
Market waste	13.80 (3.72)	15.39 (4.15)
Cleaning roads	13.80 (3.72)	15.39 (4.15)
Bulky waste	13.80 (3.72)	15.39 (4.15)
MW not otherwise specified	13.80 (3.72)	15.39 (4.15)
Biodegradable	22.80 (6.15)	25.43 (6.86)
Other non-biodegradable	8.90 (2.40)	9.93 (2.68)
Paper	22.80 (6.15)	25.43 (6.86)
Glass	18.30 (4.93)	20.41 (5.50)
Metals	13.80 (3.72)	15.39 (4.15)
Plastics	13.80 (3.72)	15.39 (4.15)
Wood	22.80 (6.15)	25.43 (6.86)
Batteries	158.00 (42.60)	176.00 (47.46)
WEEE containing hazardous substances (HS)	110.00 (29.93)	129.71 (34.98)
WEEE (non-containing HS)	13.80 (3.72)	15.39 (4.15)

At the end of 2006, 1,008 controlled landfill sites in operation were registered.

11.3.5. Municipal waste

The Polish National Waste Management Plan includes statistical data on the year 2004. The NWMP 2010 states that the unavailability of reliable data is identified as one major problem, practically for all waste streams considered.

[676] http://waste.environmental-expert.com/resultEachPressRelease.aspx?cid=6725&codi=28996&idproducttype=8&level=0

The following table shows the status and composition of the municipal waste generation (NWMP 2010, p.9)[677]:

Table 91: municipal waste generated in Poland in 2004

Name	Quantity [thousand tonnes]
Municipal waste sorted and collected in a selective manner	243
Garden and park wastes	326
Unsorted (mixed) municipal waste, including:	10,417
Biodegradable kitchen waste	*2,486*
Garden and park wastes	*250*
Paper and cardboard	*2,114*
Multi-material waste	*711*
Plastic waste	*1,529*
Glass waste	*889*
Metal waste	*521*
Cloth and textile waste	*160*
Wood waste	*192*
Hazardous wastes	*93*
Mineral waste, including ash fraction	*1 472*
Waste from market places	114
Waste from cleaning streets and squares	251
Furniture and other large-size waste (excluding used electrical and electronic equipment).	451
TOTAL	**11, 802**

[677] The quantity of hazardous wastes amounted up to about 1,680 thousand tonnes in 2004, or a rise by about 12 % since 2000. Waste other than municipal and hazardous waste form the major waste stream generated in Poland and amounted up to 121 million tonnes in 2004. This category accounts for about 90% of the total waste mass generated in Poland (NWMP 2010).

In 2004, about 278 thousand tonnes waste was treated by biological processes – this corresponds to 2.3% of the total quantity of municipal waste generated, and to 5% of the estimated quantity of biodegradable waste entering the municipal waste stream.

44,000 tonnes of waste were incinerated, accounting for 0.4% of the total quantity of waste generated. No progress was noted in this scope when compared against 2000.

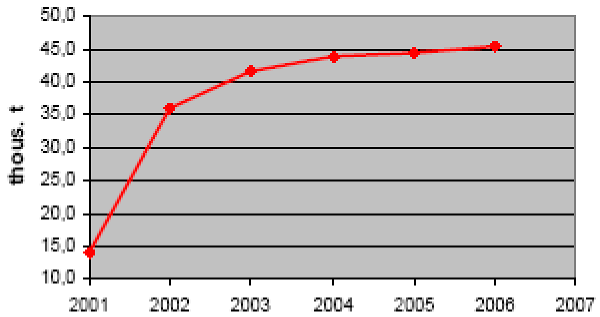
In 2005, about 9,352,000 tonnes of municipal waste was collected (i.e. 23.5% less than in 2000) of which 362,000 tonnes of waste was treated in biological and thermal processes (in 2000 this was 248, 000 tonnes). 8,623,000 tonnes of municipal waste (92%) was landfilled[678].

In 2006 over 9,877,000 tonnes of municipal waste was collected (corresponding to 259 kg per 1 inhabitant).

About 1.5% was sorted out from mixed collected waste[679]. A negligible percentage of waste was treated in biological (3.6%) and thermal processes (0.5%).

The remaining fraction (91%) was landfilled.[680]

Figure 64: Municipal waste incinerated in Poland



About 6,627,000 tonnes of collected municipal mixed waste came from households; 2,279,000 tonnes from commerce, small business, offices and institutions and 568,000 tonnes from municipal services.

11.3.6. Selective collection in Poland

In 2004, there were no reliable data in Poland on the number of municipalities involved in selective waste collection. Estimates made in 2002 by the Ministry of Environment showed that waste was separately collected in about 30% of population. Merely 2% of all generated municipal waste was collected selectively. There's a growing trend, though still painfully slow, as in the year 2000, this rate was only 0.1 %. In weight, the composition of this selectively collected waste was (NWMP 2010, p. 13):

[678] Central Statistical Office, Concise Statistical Yearbook of Poland 2007

[679] Central Statistical Office, Municipal Infrastructure In 2006

[680] Ibid.

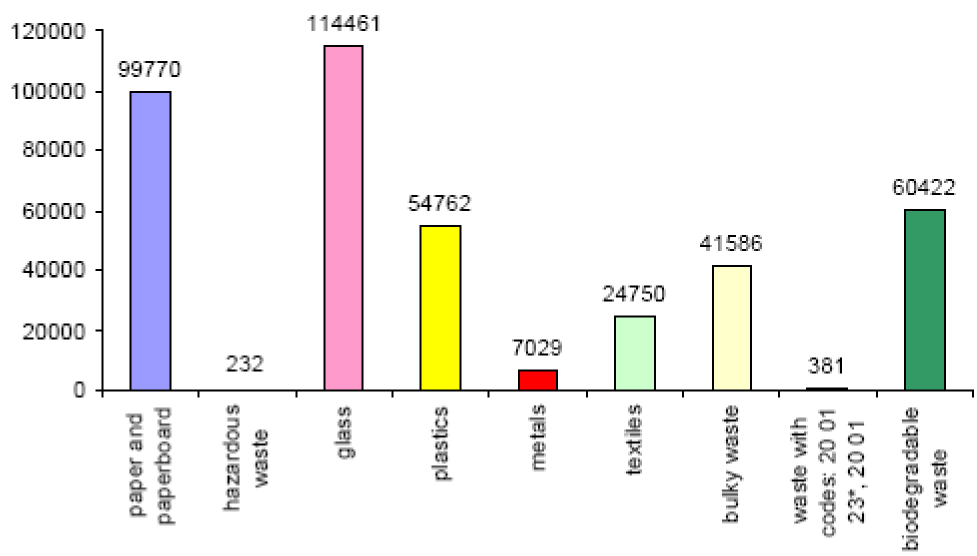
Table 92: composition of selectively collected municipal waste in Poland (1000 tonnes)

Textiles	14.2
Plastics	31.3
Metals	9.7
Glass	73.4
Hazardous waste	0.102
Paper and cardboard	66.7
WEEE	0.012
Large-size wastes	47.9
TOTAL	**243**

In 2006, about 403,400 tonnes of municipal waste (4.1% of the total) was collected separately. The quantity of almost all types of waste collected separately rose slightly in comparison with the previous year. In 2006 the separate collection of biodegradable waste was surveyed by the first time[681].

2,308 gmina offices ran selective collection of municipal waste, but there were only 201 gminas where biodegradable waste was collected separately. It is noteworthy that the Central Statistical Office points specifically to the low social awareness in Poland as the main cause for the low quality of selectively collected waste.

Figure 65: Municipal waste collected separately in 2006



[681] Central Statistical Office, Municipal Infrastructure In 2006

Municipalities have been obliged to report on the implementation of tasks included in municipal waste management plans as from June 2006.

In those municipalities where waste segregation has been initiated, this is done mostly 'at source', at waste collection centres and recycling centres[682].

- Selective collection at source is done by bag or container collection. Waste segregated in bags or containers – in most cases into three or four classes – is collected directly from each household.
- Waste collection centres are containers located at a distance not further than 200 m from either single- or multifamily complexes, serving not more than 500–1000 residents.
- Recycling centres permit segregation of various types of waste: hazardous waste, oversize waste, construction debris, and organic waste. Those centres serve larger areas, with 10,000 to 25,000 households.

In practice, in most municipalities the systems for selective waste collection do not cover the entire locality but are limited to multifamily complexes.

The Ministry admits that the lack of selective waste collection is one of the most important problems facing Polish waste policy.

Grodzinska-Jurczak et al claim that the systems are often not organized well enough (not enough containers, no information on collection guidelines, no rewards for people who segregate, and no regular waste collection) to encourage local residents to get involved in it. Generally, most municipalities cannot afford selective collection. The costs of organizing selective waste management are very high, whereas the costs of landfilling in Poland are still lower than for waste recovery. Furthermore, the waste processing market is still small. Grodzinska-Jurczak et al claim that, in many cases, local governments do not find it convenient or do not understand the need to reduce and segregate municipal waste. Finally, there is no effective system to enforce segregation, and no appropriate legal sanctions against those who fail to meet this obligation.

According to Grodzinska-Jurczak et al many municipalities, especially the smaller ones, cannot afford to buy containers or to collect and transport segregated waste. However, the costs could be considerably lower if they where shared in an association of municipalities. Associations of municipalities would also stand a better chance of obtaining outside supplemental funding.

Grodzinska-Jurczak et al reckon that, in cities, the most economic way is to introduce a system of four or five containers for different classes of secondary materials and to consider welding shut the openings to refuse shafts inside blocks of flats. They think that wet waste segregates poorly, and it seems more economic to segregate it outside buildings.

In rural areas, Grodzinska-Jurczak et al think that segregation systems should cover at least several municipalities, and should operate 6 days a week using a 'sack in a container' for everyone. One of the sacks should be intended for 'non-recyclables', later delivered to a landfill, and the other one for secondary materials for subsequent segregation and recovery. Organic waste should be individually composted in households or collected in a third bag and brought to the nearest composting plant.

As explained above, in the majority of Polish municipalities, no waste tax is collected and waste collectors collect their fees directly from customers. In order to provide incentives for the source separation of

[682] Grodzinska-Jurczak M, Zakowska H and Read A, Management of Packaging Waste in Poland – Development Agenda and Accession to the EU, Waste Management Research 2004; 22, 212

recyclables, the authorities do not encourage companies to charge for the selectively collected fraction. However, due to the increases in selective collection, revenues for waste collectors decrease (Tojo 2006).

On top of this, so-called "informal actors" scavenge the waste bins provided by private waste companies in order to collect items with a positive market value. These practices have several negative side-effects, such as the litter left around the waste containers. Moreover, waste collection companies are left with the contaminated fraction, with a lower market value. Waste collection companies have reacted by redesigning the waste bin (an alternative approach could have been to integrate them in the formal sector) (Tojo 2006).

Generally speaking, there is a lack of supervision of the collection activities, certainly in the case of small companies – large companies on the contrary go quite far in their efforts to keep track of collected waste (including GPS).

11.3.7. Biodegradable waste

According to the article 16 of t*he Act of 27 April 2001 on waste* municipalities must ensure conditions for reduction of quantity of biodegradable municipal waste going to landfills (EEA Country Fact Sheet).

The *2002* NWMP set the national recovery rate target of biodegradable municipal waste to be 12%. Among biodegradable municipal waste, 35% of garden waste, *deemed easy to collect in comparison to food waste*, should have been collected separately in 2006 and 50% in 2010. In addition, the plan suggested that the capacity of composting plants across the nation be enhanced. Concerning waste prevention and minimisation, educational schemes, individual composting of biodegradable waste and application of economic instruments to manufacturers are mentioned as methods that may be applied (Tojo 2006).

Table 93: The quantities of biodegradable municipal waste generated in 2004 (NWMP 2010)

No.	Name	Quantity [thousand tonnes
1.	Paper and cardboard collected in a selective manner	66.7
2.	Cloth and textiles (made of natural materials) collected in a selective manner	7.1
3.	Garden and park wastes	326.0
4.	Biodegradable waste coming into stream of mixed municipal waste	5,040.4
5.	Waste from market places (biodegradable proportion thereof)	80.0
Total		**5,520.2**

As already noted in Section 11.3.5, the quantity of biodegradable waste generated in 2004 was 14% larger than in 2000 and 26% larger than in 1995.

In 2004, 278,000 tonnes (5% of the total amount) was biologically treated thanks to selective collection of wastes from households.

If one assumes that 70% of biodegradable waste generated in villages and 15% of such waste in small towns is utilised for the purposes of composting, feeding animals, and in household furnaces, then a total of 770,000 tonnes of biodegradable waste generated (14% of the total) is utilised by the inhabitants on their own.

It is estimated that in 2004, about 4 million tonnes of biodegradable municipal waste (72.5% of the total) was deposited on landfills.

11.3.8. Waste management infrastructure

According to the NWMP2010, as of 31 December 2005, 762 legal landfills for wastes other than hazardous and inert wastes where municipal wastes were deposited were operated in Poland.

There were 59 waste sorting plants for selectively collected waste, 19 sorting plants for mixed municipal wastes, and 25 sorting plants for sorting of municipal wastes collected both in a selective manner and mixed ones. Moreover, there were 58 composting plants for wastes from greenery and organic wastes collected in a selective manner, 6 municipal waste fermentation plants, 20 plants for mechanical and biological treatment of mixed municipal wastes, and *one* incineration plant for mixed municipal wastes[683].

Considering the predominance of landfilling and lack of sufficient market for compost (see Section 11.8), incineration has been considered as an alternative waste recovery/ disposal option. However, the introduction of incineration plants in Poland has been hindered due to the negative perception among the public and the relative high cost compared to other disposal alternatives (Tojo 2006).

The Ministry of the Environment reckons that, besides the low levels of selective collection, the lack of installation for final recycling is the second largest challenge facing Polish waste management.

11.4. EXTENDED PRODUCER RESPONSIBILITY IN POLAND[684]

An obligation to arrange for a certain level of recovery or recycling rests on manufacturers or importers of certain products. This obligation is a consequence from the Act of May 11, 2001 on waste management obligations, deposit and product fees. Obligations set forth in this Act apply to following products:

- waste oils;
- batteries;
- waste tyres;
- packaging (e.g. glass, aluminium, cardboard or wood);

The Act sets mandatory levels of recovery and recycling for each category of these products. Manufacturers and importers can arrange with a waste recovery organisation to perform recovery and recycling on their behalf. If a manufacturer or importer fails to meet mandatory recovery and recycling levels, it is obliged to pay product fees.

Two other similar acts transpose the WEEE and ELV Directives into Polish law: the Act on Waste Electrical and Electronic Equipment and the Act on Recycling of End-of-Life Vehicles. The Act on Waste Electrical and Electronic Equipment ("WEEE")[685] requires producers and importers of WEEE to finance the collection, treatment, recovery and disposal of WEEE from private households and other users deposited at collection facilities. The Act also sets forth the required annual recovery levels which must be achieved by the entities covered by the WEEE regulations. Pursuant to the Act on Recycling of End-of-Life

683 There are 37 incineration plants for medical and veterinary wastes.

684 Unless stated otherwise, all information in this section has been based on Global Legal Group Ltd, Comparative Legal Guides on years 2007-2008: http://www.iclg.co.uk/khadmin/Publications/pdf/1194.pdf and http://www.iclg.co.uk/khadmin/Publications/pdf/2035.pdf

685 Act of 29 July 2005 on Waste Electrical and Electronic Equipment (Official Journal No. 180, Item 1495)

Vehicles[686], a vehicle manufacturer or an importer should organise its own collection system for end-of-life vehicles provided that the number of vehicles it markets annually in Poland is in excess of 1,000. The collection system can be set up on the basis of a contractual arrangement with a treatment operator.

11.5. POLISH POLICY WITH RESPECT TO PACKAGING WASTE

11.5.1. Regulatory context

According to the NWMP 2010, packaging waste is waste originating from sales (primary) packaging, grouped (secondary) packaging, and transport packaging placed on the market.

Poland transposed the Packaging Directive EU/94/62/EC into the Polish legal framework by adopting two new acts: the Act on Entrepreneurs' Obligations with regard to Management of Certain Waste, Product Fee and Deposit Fee and the Act on Packaging and Packaging Waste, which entered into force on 1 January 2002. This legislation imposes on Entrepreneurs - packers/fillers and importers - the obligation to ensure an adequate level of recycling of packaging.[687]

11.5.2. Recovery and recycling targets

The National Waste Management Plan 2010 includes data on the mass of packaging waste generated and undergoing recovery processes in Poland in 2004. A summary of these figures can be found in, as well as the achieved recovery and recycling levels per material group (NWMP 2010, p. 28).

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[686] Act of January 20th, 2005 on Recycling of End-of Life Vehicles OJ 2005 No. 25, item 202

[687] http://www.pro-e.org/Legal_Basis_Poland.html

Table 94: Packaging waste in Poland in 2004

		Recycling								
Material	Mass of wastes (tones)	Material recycling	Other forms of recycling	Total recycling	Energy recovery	Other forms of recovery	Incineration with energy recovery	Total recovery	Recycling level (%)	Recovery level (%)
Glass	914.700	250.000	0	250.000	0	0	0	250.000	27,3	27,3
Plastics	663.300	108.200	5.500	113.700	48.500	0	7.500	169.700	17,1	25,6
Paper / card-board	1.182.000	467.533	0	467.533	33.800	30.000	7.500	538.833	39,6	45,6
Aluminium	47.000	18.100	0	18100	0	0	0	18.100	38,5	38,5
Steel	121.000	20.000	0	20.000	0	0	0	20.000	16,5	16,5
Total metals	168.000	38.100	0	38.100	0	0	0	38.100	22,7	22,7
Wood	480.000	10.000	86.400	96.400	345.600	0	0	442.000	20,1	92,1
Other	5.000	0	0	0	0	0	0	0	0,0	0,0
Total	3.413.000	873.833	91.900	965.733	427.900	30.000	15.000	438.633	28,3	42,2

As NWMP 2010 is a renewed version of the first waste plan, new targets have also been set for recovery and recycling for all types of packaging waste (NWMP 2010, p 52):

Table 95: The annual recovery and recycling targets for packaging waste by 2014

Types of packaging	2007		2010 1)		2014	
	Recovery (%)	Recycling (%)	Recovery (%)	Recycling (%)	Recovery (%)	Recycling (%)
Packaging (total)	Min.50	Min.25	Min.60	Min.38	Min.60	55-80
Plastic packaging	-	Min.25	-	Min.18	-	Min.22,5
Aluminium packaging	-	Min.40	-	Min.45	-	Min.50
Steel packaging	-	Min.20	-	Min.35	-	Min.50
Paper and cardboard packaging	-	Min.48	-	Min.54	-	Min.60
Glass packaging	-	Min.38	-	Min.49	-	Min.60
Natural materials packaging (wooden and textiles)	-	Min.15	-	-	-	-
Wooden packaging	-	-	-	Min.15	-	Min.15

Data included in Table 95 show that, at the time NWMP2010 was drafted (December 2006), it was expected that in 2007 the national recycling level as set out in Directive 94/62/EC (i.e. 25 %) would be reached. (The reader should keep in mind that Poland has received a transition period for compliance).

As explained in the NWMP2010, taking into account the limited opportunities for energy recovery[688], achieving the mandatory recovery level of 50 % will require an increase in recycling of these groups of waste that account for a significant mass percentage and for which potential capacity does exist, i.e. : packaging cardboard, glass, plastics.

11.5.3. Packaging waste management scheme

The basic elements for the current national packaging waste management scheme, active since 2002, are the following (NWMP 2010):

- the operators' responsibility for their packaging products placed on the market is primarily determined by a legally binding commitment to achieve specified recovery and recycling levels
- entrepreneurs may perform their obligations independently or through a specialised recovery organization

[688] Limited to the waste thermal treatment plant in Warsaw and incineration of waste fuel in cement kilns.

- implementation of a monitoring system of wastes with a reporting obligation
- introduction of the environmental protection requirements on packaging

In the meaning of the Polish legislation, entrepreneurs are (1) enterprises who introduce to the market packaged products (that is domestic manufacturers and importers of goods) (2) retail outlets with a commercial space of more than 500 m2, selling products packaged by themselves (3) retail outlets with a combined commercial space of more than 5000 m2, selling good packaged by themselves (4) restaurants etc serving food in disposable dishes (Grodzinska-Jurczak et al 2004)..

There are three possible ways for entrepreneurs to fulfil their obligation to recycle:

- Delivering themselves used packaging to a processing facility
- Transfer the obligation to recycle to an agency responsible for waste collection, established in the form of joint stock companies
- Payment of a product charge to Voivodship Marshall office

The only role of the agencies created to recover wastes should be the organisation, management of implementation of actions involving recovery and recycling (Grodzinska-Jurczak et al 2004).

The costs related to both the collection and the preparation of packaging waste to its recycling are secured by specific-purpose funds, created from:

- Recycling charges collected from entrepreneurs by the agencies responsible for waste collection
- Product charges (or fee), treated as a penalty for a failure on the part of entrepreneurs to meet their recycling obligations.

The funds gathered by the agencies are used for covering the agency's overhead expenses and for direct financing of municipal companies engaged in waste collection or for subsidizing waste collection services organized directly by the municipal authority. Depending on the form of activity defined in its statute, the agency acts in consultation with:

- Municipal authorities or companies rendering municipal services; the consultations will define the amount of waste, its preparation for processing, principles of payment for the services, etc.
- Processing plants, to take an agreed amount of collected and properly prepared secondary materials.

The costs of selective collection is also covered using funds transferred to municipalities from product charges collected from entrepreneurs who do not fulfil (or fulfil unsatisfactorily) their duties (including organizational ones). The level of product charge is calculated for each type of packaging, and it is a product of the rate[689] and the difference between the expected and actual recycling levels. Product rates are to be set on an annual basis. Monies from product charges that have been calculated and collected from entrepreneurs are kept in bank accounts of Marshal Offices (local government) and then transferred to a separate account of the National Fund for Environmental Protection and Water Management, then to accounts of Provincial Funds for Environmental Protection and Water Management to be finally transferred to municipalities.

Municipalities (or their associations) receive funds from product charges in proportion to the amount of packaging waste directed to recovery and recycling, as specified in reports. The funds left in the National Fund are used to finance actions associated with waste recovery and recycling, as well as to provide instruction on selective collection and recycling of packaging waste. For the monies originating from the

[689] This rate does not reflect actual environmental risks. See Grodzinska-Jurczak et al.

product charge, municipalities are supposed to organize selective waste collection in their areas (Grodzinska-Jurczak et al 2004).

The recovery organizations, following their statutory obligation, provide financing to the municipal servicing companies who collect waste, or to the municipalities who manage for collection of waste in their respective areas.

11.5.4. Recovery organisations

The Polish system allows for the existence of several recovery organisations. In 2006, 40 recovery organisations were operating on the Polish market. Depending on the nature of the stakeholders, they can be sorted in 6 groups[690]:

- Packers-fillers
- Waste management companies
- Recyclers
- Public funds
- Collectors
- Private companies

In the rest of this section, we shall focus on the largest recovery organisation, Rekopol.

Unless stated differently, all the information in the remainder of this Section has been obtained from the Rekopol-website[691].

The organization has been founded in October 2000, by 19 Polish and international packaging manufacturers and waste management companies. In order to fulfil the obligations flowing from Polish law and Directive 94/62/EC, Rekopol concentrates on developing a selective collection system of packaging waste, covering the whole country. The organization is based on a non-profit principle, i.e. any profits made are to be used to reduce the fees for relevant packaging material in the following years.

Following a license agreement concluded on 8 February 2002 with DSD AG and PRO EUROPE, Rekopol owns the exclusive right for granting sub-licenses in order to use the Green Dot trade mark on the territory of Poland.

Rekopol services are available to any entrepreneur obligated to ensure the recycling of packaging (both household and industrial), except for packaging of hazardous substances. Currently the organization has 16 shareholders and approximately 2000 members.[692]

The key elements of the system can be described as follows:[693]

- *gminas* (municipalities) are partners in managing the collection of sales packaging from the household packaging waste stream;

[690] Tyczkowski (2006), Polish packaging waste management system – Overview, http://www.repak.ie/files/Jakub%20Tyczkowski.pdf

[691] http://www.rekopol.com.pl/english_summary/about_us

[692] http://www.greendotcompliance.eu/en/countries/poland.php

[693] http://www.pro-e.org/Organisation_Poland.html

- recycling companies are partners in ensuring the recycling of group (secondary) and transport packaging generated by industry and trade;
- co-operation with material organizations, which bring together packaging producers and recyclers, in determining methods for collection and recycling of secondary materials;
- Rekopol carries out seminars, courses and it is engaged in advising connected with effective organisation of waste packaging management system.
- producers of materials and packaging, and importers pay a recycling fee to Rekopol for the packaging they put on the market;
- Resources acquired from Entrepreneurs are appropriated to support municipal systems of selective collection of packaging waste and the development of recycling of packaging waste generated by industry, trade and services, always promoting the most effective solutions.

Recycling fees (or license fees for members) are paid by entrepreneurs according to material categories. The fees are the same for all members of the system, and are weight-based in respect to the reported amount of packaging put on the market, calculated per kg of packaging differentiated by the packaging material[694].

Table 96: Rekopol Green Dot rates 2005

Packaging	Tariffs in euros/kg for 2005 (excl. VAT)
Paper / cardboard.	0.40
Glass packaging	0.44
Plastics	0.42
Composites (excl. beverage cartons)	0.74
Beverage cartons	0.74
Steel	0.37
Aluminium packaging	0.64
Wood	0.13

The system set up by Rekopol and local authorities comprises 165 municipalities (including 4 inter-municipality associations) that are supported to realize the statutory assignment of selective waste collection. Rekopol's support in building this selective collection system in municipalities has the form of an allowance for each tonne of specific recyclable packaging material that is collected and forwarded for recycling.

In 2003, Rekopol introduced the separate collection of beverage cartons. In order to ensure collection, sorting and recycling of this material, Rekopol initiated a BC pilot project.

Since January 2004, at request of Zakład Gospodarki Komunalnej Organizacja Odzysku Biosystem, the Office of Competition and Consumer Protection (OCCP) has been conducting an investigation against Rekopol. In the opinion of the applicant, Rekopol breaches market rules since enterprises that want to use the "Green Point" marking are forced to enter into recycling contracts exclusively with that company. If they wished to make use of a competitive offer and be able to lawfully place the "Green Point" mark on packaging, they would have to pay double.

694 http://www.pro-e.org/Financing_Poland.html

In the opinion of the OCCP, the practices of Rekopol result in an inferior market situation of the other recycling organisations by loss of their clients or difficulties in obtaining new clients, thus consolidating the dominant position of the company.

The President of the OCCP ordered Rekopol to immediately discontinue the questioned practices, even before a final decision in the matter has been issued[695].

11.5.5. Market consolidation

As stated above, the market for recovery organisations was initially rather fragmented.

In most EU countries, packaging waste collection is restricted to non-profit making organizations. In Poland, however, waste recovery is open to commercial interests.[696]

The Ministry expected that this more liberal approach would lead to more competition.

The recovery organisations involved in selective collection have indeed engaged in fierce price competition.

However, some of the recovery organisations apparently claim to have recycled fractions that were landfilled without being sorted or treated (Tojo 2006).

Some recovery organisations have even never performed any actual waste recovery and/or recycling activities. Others have offered their services for extremely low prices without taking into consideration the full costs of their activities. Some companies have performed activities for years but without any permit. Regional authorities were supposed to verify accounts, but there was a huge backlog and law enforcement has been lax. Generally speaking, figures on packaging production and waste processing were extremely unreliable[697].

For instance, according to the Warsaw Business Journal, official data for 2002 report that 2.5 million tons of packaging was released onto the domestic market. However, because some firms were not required to provide data, in real terms the figure was reckoned at over 3 million tons.[698] The Journal also claims that official overall recovery figures of 44 percent for paper and cardboard and 11.4 percent for plastics were doubted by many in the industry. Finally, the Journal claims that in 2002, Poland did not have the technical facilities to recycle multi-materials while official figures claim that 6.5 percent had been recycled[699].

As pointed out above, funds distributed by the National Fund are passed on to regional Environmental Protection Funds who are responsible for handing on funds to local government for the promotion of

[695] http://www.uokik.gov.pl/en/press_office/press_releases/art28.html

[696] http://www.wbj.pl/article-358-dirty-money.html

[697] http://greenhorizon.rec.org/insight/poland-consolidating-its-waste-collection-industry.html

[698] Similarly, in 2004, according to the data of the Ministry of Environment mixed waste contained 4 million tons of packaging whereas entrepreneurs declared only 3 million tons - http://www.ekopartner.com.pl/english/page/waste.htm .

[699] http://www.wbj.pl/article-358-dirty-money.html

recycling and creation of consumer segregation bins. Some regional Environmental Protection Funds, however, have used funds as capital to set up their own commercial recovery organizations[700].

The size of the firms involved in the market also varied hugely. Polski System Recyklingu (PSR), for instance, processes some 185,000 tonnes of packaging waste annually while Flora-Impex processes approximately 150 tonnes of packaging waste per month[701].

In 2007, the main companies were Rekopol, Polski System Recyklingu, Biosystem, Ekopunkt and Branzowa Organizacja Odzysku. It was expected then that the number of recovery firms would shrink from about 40 to 10 at the most. By then, 85 percent of the market was controlled by companies whose services were not limited to particular kinds of waste or to a specific geographic area[702].

As a reaction to the problems mentioned in this Section, the Ministry claims to have improved monitoring and enforcement. Also, the NWMP 2010 foresees the introduction of minimal capital requirements for companies involved in recovery. Moreover, such companies will have to obtain EMAS certificates.

Even though the Ministry does not have an up-to-date list of recovery organisations[703], it reckons that, contrary to the forecasts mentioned above, there are still some 40 recovery organisations currently in operation. The Ministry however expects that the requirements of the NWMP 2010 should lead to a higher concentration.

11.5.6. Evaluation

The NWMP 2010 (p. 29) states that the scheme for selective collection of packaging waste originated from households is insufficiently developed. The 2004 figures show that only 132.5 thousand tonnes out of 3,413 were selectively collected by the municipalities.

The NWMP has identified the following problems:

- insufficiently developed scheme for selective collection of packaging waste originated from households – the NWMP reckons that it should have been possible to acquire about 900 thousand tonnes of packaging waste fit for recycling; the major proportion of that mass was deposited on landfills in form of mixed municipal waste[704],
- insufficient number of installations and unsatisfactory processing potential in case of certain types of waste,
- requirement to double certification of recycling practices,
- unavailability of a register of the companies that deal with processing, recovery, including recycling and disposal of packaging waste[705],

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[700] http://www.wbj.pl/article-358-dirty-money.html

[701] http://greenhorizon.rec.org/insight/poland-consolidating-its-waste-collection-industry.html

[702] http://greenhorizon.rec.org/insight/poland-consolidating-its-waste-collection-industry.html

[703] Registration takes place at the Voivodship level.

[704] It is not clear how this figure has been obtained.

[705] This is in line with the claims made by major recycling firms, as well as associations of companies that produce packaging, that there is a need for a central registry of recovery and recycling firms. See http://greenhorizon.rec.org/insight/poland-consolidating-its-waste-collection-industry.html and http://www.ekopartner.com.pl/english/page/waste.htm

- wrongly issued decisions to perform recovery processes[706]

Given the technology progress being made in manufacturing of packaging materials, the NWMP does not expect significant growth in the mass of packaging waste in the period 2007-2018. Considerable improvement is anticipated in the equipment of the packaging waste sorting plants (with equipment for shredding, compression, magnetic sorting, optical sorting, flotation, or conditioning of cullet etc.) and the increase in the number of such plants.

The plan anticipates also more opportunities for incineration with energy recovery from packaging waste unfit for recycling, by means of their incineration in municipal waste incineration plants. The following materials are specifically enumerated: plastic waste, beverage cartons, and the primary packaging of high calorific value that originates from households.

The NWMP concludes that the implementation of the following activities is required in order to achieve the objectives assumed for management of packaging waste management:

- expand sorting and recycling infrastructure,
- control the activities of those who place packaging products on the market, recovery organizations, and the operators dealing with recovery (including recycling) of packaging wastes,
- introduce instruments to monitor the packaging waste streams and the performance of the scheme,
    - establishment of the national recycling register including directory of the operators authorised to issue certification documents on recycling operations performed and those certifying the recovery processes other than recycling, and the inventory of such documents,
    - drafting more precise and specific requirements concerning bankruptcy and winding up of the recovery organisations.

11.6. POLISH POLICY WITH RESPECT TO PVC

In 2000, out of a total of 470.9 tonnes of plastics packaging waste, there were just 9.4 tonnes of PVC waste (Grodzinska-Jurczak at al 2004).

There is currently one PVC producer in Poland (Anwil in Wloclawek) with a production capacity of approximately 300,000 tonnes per year. Annual consumption lies between 340,000 and 350,000 tonnes.

No other data on PVC waste in Poland have been identified – as has been pointed out in Section 3.3.2, Recovinyl is now just starting evaluation activities in Poland.

11.7. POLISH POLICY WITH RESPECT TO BATTERIES AND ACCUMULATORS

Unless stated otherwise, all information in this section comes from the REBA website and from interviews with stakeholders who required to remain anonymous.[707]

[706] It is not clear what this point refers to.

[707] http://www.reba.com.pl/pg?id=91 . Reba Organizacja Odzysku (Recovery Organization) was registered on 28.01.2003. It is not the only, but by far the largest recovery organization for waste batteries.

11.7.1. General regulatory framework

Some (very limited) collection in scattered locations was already taking place before 2002.

The crucial step in the creation of systematic collection was the Act of 11 May 2001 (see Section 11.4), which also introduced extended producer responsibility in the battery sector. A statutory obligation of recovery and recycling of batteries has been imposed on entrepreneurs who introduce batteries and (small-dimension) accumulators, covered by the provisions of the stated Act, onto the Polish market. Recovery organizations can take over this recovery and recycling management, as well as the whole responsibility for the fulfilment of this obligation. They can act both as a profit or not-for-profit company[708].

The management of waste batteries and accumulators from WEEE is regulated by the act of July 29, 2005 on Waste of electrical and electronic equipment (Legal Journal No. 180, item 1495). This act requires batteries from collected waste electrical and electronic equipment to be removed. It also requires from treatment facilities to be equipped with containers for batteries.

The Act does not limit the number of battery recovery organisations, but the membership of the largest (REBA) covers 65 to 70% of the registered battery market.

The Ministry of the Environment does not have an exhaustive list of producers' organizations for battery recovery.

Each year by the end of March every recovery organisation is required to submit its report to the Voivodship Marshall. The regional reports are submitted to the national Ministry of the Environment. The national reports have not been made public for the last four years (2004-2007).

The act has established special recovery and recycling targets of waste batteries and portable accumulators which were increasing quickly from one year to another:

Table 97: (initial) Polish recovery and recycling targets per battery type

Battery kind	**2002**		**2003**		**2004**		**2005**		**2006**		**2007**	
	%		%		%		%		%		%	
	o*	r*	o*	r*	o*	r*	o*	r*	o*	r*	o*	r*
Small Ni-Cd accumulators	**10**	**10**	**15**	**15**	**25**	**25**	**35**	**35**	**45**	**45**	**50**	**50**

[708] EPBA and Recharge (2007), Compliance Blueprint, A guidance document for setting up a Battery Compliance Organisation; p12

Primary and other secondary batteries, excluding their parts - button cells - primary batteries (Zn-C; Zn-Mn) - other secondary batteries	**5**	**(1)**	**7**	**(1)**	**10**	**(1)**	**15**	**(1)**	**30**	**(1)**	**50**	**(1)**

o* - recovery; r* - recycling

[1] - no recycling target (only recovery one)

In the case of non-fulfilment of a given mandatory target, the battery *producers* (or the recovery organization when the obligation was transferred) are obliged to pay a product charge set by Ordinance by the Minister of Environment.

Based on the experience gained during the first two years of operation, these initial targets were later substantially adjusted by amendment on the Act on Waste and on the Ordinances of the Minister of Environment, 29 July 2005.

In the renewed targets set by the Act of July 29, 2005 (amending the Act on waste), no difference is made between recovery and recycling rates.

Table 98: (renewed) Polish recovery and recycling targets per battery type

Battery type	2005	2006	2007	2008
Ni-Cd accumulators	35 %	35 %	40%	40%
NI-MH, Li-Ion and other secondary batteries	-	15 %	20%	20%
Button cells and primary batteries, excluding their parts	15 %	15 %	25%	18%

The Polish Government has recently come up with a draft Act on batteries and accumulators, which should transpose the new version of the Battery Directive (Directive 2006/66/EC) into Polish law.

The draft foresees the introduction of a separate register for battery producers – until now, a *national* register only existed for the producers of electrical and electronical equipment.

REBA has written a position paper on certain elements in the draft law.[709] The main oppositions from REBA are firstly the proposal to introduce a fee imposed on operators placing portable batteries and

[709] http://www.reba.com.pl/x.node?id=119

accumulators on the market, and secondly the launching of a principle of exclusively individual accounting for the waste portable batteries' and accumulators' separate collection obligation.

Concerning the fee, it is argued that the proposed amounts of the fee would lead to significant price increases and that the fee must be interpreted as an additional tax visible for the end-users, which is not allowed according to Directive 2006/66/EC: "4, The costs of collection, treatment and recycling shall not be shown separately to end-users at the time of sale of new portable batteries and accumulators..."

The principle of *exclusively* using *individual* operators' responsibility (referred to in Art. 27(1), Art. 28(1) and Art. 33(1) of the draft Law), would imply the end of the current collection scheme and recovery organizations. As many uncertainties still exist, further details on the draft law are beyond the scope of this study.

11.7.2. Car and industrial batteries

For car and industrial lead batteries, a deposit refund system exists. Until today, those are the only batteries managed through such a system.

According to the NWMP, companies dealing with recycling of lead-acid accumulators have their own waste collection network which covers the entire Polish national territory. In 2004, about 79 thousand lead-acid accumulators were subject to recycling in technology process aimed at recovery of lead and sulphuric acid, including approximately 56 thousand tonnes of replacements for worn-out car batteries. This type of waste also originates from the end-of-life vehicles dismantling stations.

11.7.3. Collection of portable batteries

The collection system for batteries in Poland only started to develop as from 2003.

The largest recovery organisation, REBA, has built a collection network covering the whole territory of Poland with approximately 15,000 collection points (this corresponds to more or less 2,500 inhabitants per collection point). In those five years (2003-2007) 2,169 tonnes of waste batteries were collected and recycled (this corresponds to approximately 50 gram per inhabitant).

Currently, retailers are not required to take back batteries. However, they will be following the transposition of the new Battery Directive into Polish law.

No official data has been published on the number of batteries brought on the market in Poland for the last four years.

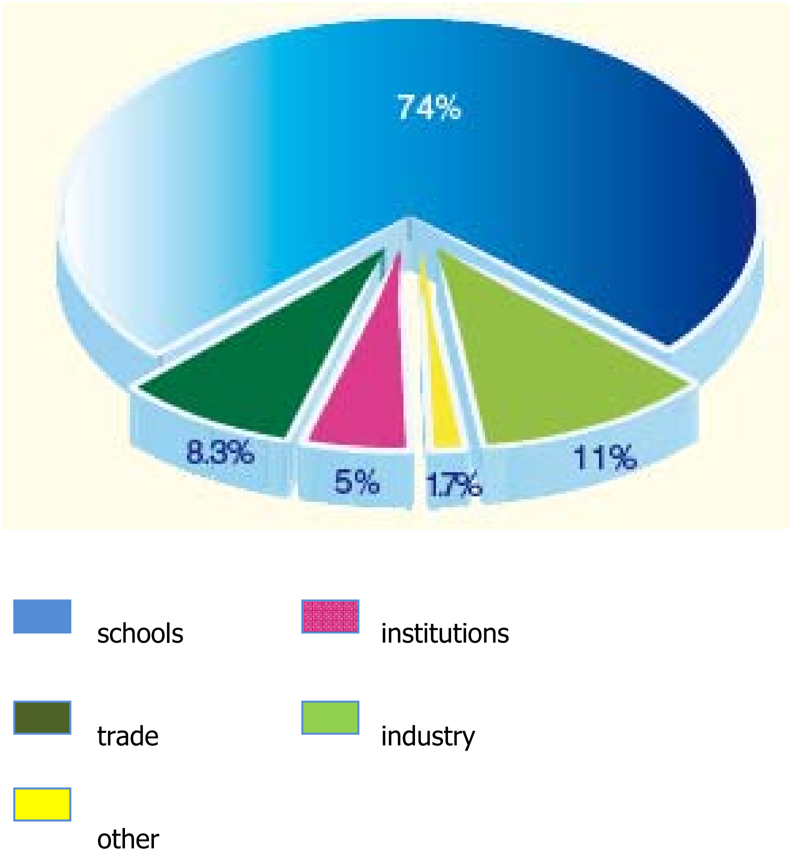
The following information has been found in the National Waste Management Plan 2010 (NWMP, p. 19).

- **Nickel-cadmium batteries and accumulators**. Both large- and small-size nickel-cadmium batteries and accumulators are currently present on the Polish market. Given their lifetime duration of 10-12 years, precise quantities of used Ni-Cd batteries and accumulators are difficult to determine. It is estimated that about 2 thousand tonnes of this type of batteries and accumulators are phased-out from operation annually.
- **Manganese-zinc batteries with alkaline and hydrochloric electrolytes (Mn – Zn), zinc-carbon (Zn), Zinc-manganese (Zn-Mn), lithium (Li), lithium-ion (Li-ion) and other.** Following the estimates, in 2004, more than 250 million batteries, mainly zinc-carbon, zinc-manganese and lithium-ion batteries were placed on the Polish market (approximately 7 thousand tonnes). Given their relatively short life-time, it is estimated that the total used annual mass of this type of batteries is comparable to that of manufactured batteries, i.e. about 7 thousand tonnes. In 2004, only about 700 tonnes of this type of batteries was collected and forwarded to specialist installations for recovery and disposal.

Based upon data collected from the members of its compliance scheme, REBA puts forward the estimate of approximately 250,000,000 pieces per year. In the year 2007, all 27 members of the REBA collection system brought in total 175,350,321 pieces of batteries and portable accumulators on the Polish market, weighing 4,658.69 tonnes. REBA and its collection partners collected 755.536 tonnes. That gives a *collection rate of 16.2* %. REBA thinks that this figure may be representative for the collection rate for the Polish market in general.

The collection network of REBA includes educational establishments, firms and public institutions. The importance of every channel is shown in Figure 66. One incentive provided by REBA to these entities is a special loyalty program rewarding all schools that participate in battery collection.

Figure 66: REBA collection channels 2007



Other entities which manage bring-back points (retailers, public institutions etc.) do not receive financial remuneration, but they are provided with collection containers and all batteries collected are picked up from them free of charge.

REBA contracts collectors to ensure the emptying of the containers and their transport to sorting plants. A competitive system for accreditation is used. An additional condition is that the companies willing to undertake battery collection from bring-back points have to obtain a special permit from their respective local public authority. These collection operators receive a fixed price per ton collected, combined with a quantity scale (the price per ton is higher for larger collectors). Most of the contracts are of unspecified duration as REBA aims at securing long-term collaboration with the collectors.

In 2004 and 2005, REBA did not reach its recycling targets and had to pay the product charges.

11.7.4. Recycling and processing

For portable batteries and accumulators, it can be stated that in Poland practically all *collected* batteries are recycled.

For recycling activities, REBA currently operates long-term contracts with two or three local Polish companies. No positive prices can be obtained from the recyclers. The small available quantities of recyclable (collected) batteries have hindered export opportunities. The first steps are however taken to transfer batteries for recycling to one other EU Member State.

Recyclers often use technology which does not meet the required recycling efficiency target of 50 %. Of the 5 battery recyclers in Poland, 2 are very small and their potential for modernisation is limited. For 2 others, battery recycling is merely a small fraction of their activities, and the investment decisions are not driven by the needs for battery recycling.

The most commonly used technologies in Poland are either Waelz kilns (recover Zn and Pb using a reducing roasting process) or mechanical recycling, the latter being the crushing of batteries with subsequent separation of the ferromagnetic fraction and the production of refuse derived fuel (RDF) from the plastic and paper fraction.

11.7.5. Evaluation

The NWMP has listed the following problems:

- data are unavailable on all the operators who deal with imports or inter-Community purchase of batteries,
- poorly functioning scheme for the collection of small-size batteries from small and medium sized enterprises and households, including retailers,
- there is a lack of environmentally and economically effective technologies for the treatment of batteries and accumulators that would provide for achievement of 50% recycling level (excluding lead-acid accumulators and nickel-cadmium batteries).

According to one interviewed stakeholder, battery collection in Poland is hampered by the following factors:

- Insufficient level of people’s awareness of the necessity of selective collection of that particular waste
- Lack of sufficient number of bring-back points and in particular relatively small number of collection containers placed in retail outlets
- High proportion of MSW send to final disposal (landfills) without prior sorting.
- The fragmentation of the Polish waste management market (over 1,500 companies, many of them very small, operating in just one municipality),
- Lack of legal obligation to collect waste batteries by the retail trade (will be introduced by means of a new Act on Batteries and Accumulators...),

The stakeholder underlined that battery collection in Poland is an element of solid waste management in general and more particularly of the municipal waste management (see Section 11.3.3). All waste management companies are legally obliged to collect waste batteries from their contract parties, if those wish to get rid of them. This automatically leads to a large proportion of waste batteries (as mixed in municipal solid waste) directly sent to final disposal (landfills) without prior sorting.

Other stakeholders have identified the following reforms as the ones that would be the most effective in order to improve recycling of batteries

- expansion of the collection scheme for waste batteries and accumulators;
- enforce regulations for recycling of waste batteries and accumulators;
- support research and encourage improvements in the overall environmental performance of batteries and accumulators throughout their entire life cycle.

According to the NWMP, implementation of the following activities is required in order to achieve the objectives assumed for management of waste batteries and accumulators:

- transpose and implement the revised Battery Directive 2006/66/EC
- improve and further develop the collection scheme for small-size waste batteries and accumulators from diffuse sources,
- modify existing installations with view of their conformity to environmental requirements, and determine potential demand of new installations, for instance to treat small-size waste batteries and accumulators,
- develop and implement innovative technologies for treatment of waste batteries and accumulators,
- expand the scope for the allocation of financial resources originating from the product charges, by financing the purchase of the elements of the collection infrastructure (including receptacles and transportation means), and of research on development of innovative recovery and recycling technologies.

11.8. FOOD WASTE

Polish policy does not specifically cover the waste stream food.

We have already described the situation with respect to municipal biodegradable waste (see Section 11.3.7), which of course includes food waste. An important point mentioned there is that policy has given priority to the selective collection of garden waste rather than food waste, mainly because of the ease of collection.

The NWMP2010 also provides data on waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing.

Table 99: Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing (2004)

	Waste generated	Waste recovered	Disposal of waste					Waste stored	Waste on landfills
			Total	Thermal	Compost	Deposition	Other		
Ktonnes	8,868.7	7,724.9	693.3	72.2	34.8	289.9	296.5	450.5	1,207.4
%		**87.1**	**7.8**	0.8	0.4	3.3	3.3	**5.1**	

The sources of this waste category ("group 02 wastes") are: slaughter-houses, meat processing plants, diaries, cold storage plants, agricultural, horticultural and breeding farms, sugar plants, breweries, alcohol distilleries and other plants dealing with food-stuff production and processing.

In 2004, about 9 million tonnes of waste other than hazardous wastes were generated within this group – this corresponds to about 7% of the total wastes generated in Poland. When compared against 2000, the quantity of group 02 wastes declined by about 17%. By the end of 2004, about 1 million tonnes of group 02 wastes were disposed off on the own landfills of the waste generating companies.

The major waste management problems within this group of waste include: the diffuse nature of their origination sources, the seasonal character of generation of large quantities of waste (campaign-mode), no economic grounds for application of any recovery processes for a part of this group waste types, and the difficulties of their shipment at longer distances.

Regulations on composts use are specified by decrees of Ministry of Agriculture and Rural Development. It is allowed to produce compost from municipal wastes. However, composts for sale as organic fertilizers must obtain ministerial approval based on chemical analyses, sanitary tests and assessment of its usefulness and environmental safety. Limit values for trace elements (zinc, chromium, cadmium, copper, nickel, lead, mercury) concentrations in organic fertilizers are specified. Sanitary test include presence of parasites and Salmonella bacteria[710].

Sewage sludge can be applied to soil for agricultural purposes (10 tonnes of dry matter per hectare during 5 year) if it meets all requirements specified in the order of the Ministry of Environment (on municipal sewage sludge use; 1.08.2002) with respect to metals concentration limits and sanitary tests. The amount of sludge applied for soil reclamation purposes might be greater. Soil might be amended with sludge if metal concentrations do not exceed limit values and soil pH is not lower than 5.6. [711]

When Poland joined the EU, the domestic standard for compost was abolished. Instead, the Ministry of Agriculture introduced a new standard for fertiliser in accordance with the EU requirement[712].

According to this act, compost is organic fertilizer and its introduction on the market requires permission of the Minister of Agriculture. Compost produced from organic waste can be qualified as a fertilizer if it fulfils the requirements described in the provisions of Act on fertilizers and fertilization. In case when the material originating from composting facility does not meet the requirements defined for organic fertilizers it should be treated as a waste and the provisions of Act on Waste should apply. Managing of this material requires then the obtention of a permit for economic activities in the field of recycling and neutralization of waste[713].

As a result, the output of some composting plants that use technology developed 20-30 years ago is now considered to be waste (Tojo 2006).

The material obtained after composting is given EWC code 19 05 03, and can be spread on the land's surface to fertilize or to improve the soil, after fulfilling the conditions listed in Regulation of Minister of Environment from 14 July 2007 concerning the process of recycling R10[714]. According to this regulation, the producer of waste with code 19 05 03 is obliged to carry out tests in certified laboratories in order to define the acceptable dose of waste that can be used for soil[715].

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[710] http://www.compostnetwork.info/index.php?id=49

[711] http://www.compostnetwork.info/index.php?id=49

[712] Act from 10 July 2007 on fertilizers and fertilization (Dz. U. Nr 147, poz. 1033, z późn. zm.) http://aktyprawne.rp.pl/aktyprawne/akty/akt.spr?id=235738

[713] Information obtained from the Ministry of the Environment.

[714] DZ. U. Nr 228, poz 1685, http://aktyprawne.rp.pl/aktyprawne/akty/akt.spr?id=248361

[715] Information obtained from the Ministry of the Environment.

In practice today there is only mixed waste composting with low qualities mainly used as landfill cover or for land restoration (Barth et al (2008)).

Animal tissue waste (EWC 02 02 02 and 02 01 02) are used to feed fur-bearing animals and pets. Food waste is also fermented for the production biogas.

Some gminas have tried to organise selective collection of food waste - with mixed results. It seems that achieving good results in selective food waste collection is linked to the type of buildings existing in a given area. In Poland, most people live in multifamily buildings, and the cover of anonymity makes it more difficult to make them selecting waste. Since the reduction of landfilling of biodegradable municipal waste is necessary, several future actions in this field are foreseen, including pilot projects in the field of selective collection of food waste.

11.9. CARDBOARD

Cardboard recycling is affected by, on the one hand, the policy on biowaste, and on the other hand, the policy on packaging waste.

From Table 25, we can see that Poland achieves a recycling rate of 41% and a recovery rate of 42.9%.

According to Rekopol, it is simple to verify the quality of the material. In Poland, cardboard waste accepted by paper mills must be of defined standards. Import and export of waste cardboard are free. The market is transparent: the price is very well known, suppliers are known and users are known. Both long term contracts and spot markets are used. Few intermediaries are used: in general, the waste management company deals directly with the recycler[716].

In 2006, 750,000 tonnes of packaging waste cardboard were recycled.

In order to stimulate the use of recycled cardboard, the NWMP foresees mainly the use of green public procurement and information campaigns.

We have not identified other information on this subject.

11.10. CONCLUDING REMARKS

Poland has clearly made a rather radical move to free markets in waste management. However, the global experience with this approach does not seem to be overly successful.

We will come back to this issue in Section 13.1. The basic lesson is that competition in the market is not a silver bullet. Competition in the market can even be dysfunctional if the core business of the industry requires undertaking actions that they will not undertake in the absence of proper supervision. We will

[716] Information provided per e-mail by Jakub Tyczkowski of REKOPOL on 29 May 2008.

argue in Section 13.1 that there exist alternative institutional arrangements that also bring the benefits of competition. It seems that Polish authorities have learned from past experiences and are taking actions that will help improve the situation.

12. CASE STUDY: SPAIN

12.1. STRUCTURE OF THIS CHAPTER

This Chapter takes a closer look at the specific situation of the four waste streams under consideration in Spain. We begin the chapter with some basic information on Spanish society (Section 12.2) and waste policy (Section 12.3). Key waste statistics are provided in Section 12.4. An overview of extended producer responsibility is given in Section 12.5. Cardboard and beverage cartons' recycling fits within the policy on packaging waste, which is described in Section 12.6. The detailed analysis for the different waste streams follow then in Section 12.7 (PVC), 12.8 (batteries), 12.910.8 (food waste) and 12.10 (cardboard).

12.2. GENERAL INFORMATION

From the following table, it is clear that Spain is a country with a relatively low population density, but with a high concentration in urban areas (EEA Country Fact Sheet).

Table 100: Geographic characteristics of Spain

Surface area	505997 km^2
Population (million inhabitants)	44.5
Population density	83 inhabitants /km^2
Average number of persons per private household	2.9
Household characteristics by urbanisation degree, distribution of households	50% in densely populated areas (at least 500 inhab./km^2) 19% in intermediate urbanised areas (100 - 499 inhab./km^2) 31% in sparsely populated areas (less than 100 inhab/km^2)

Its GDP per capita relates as follows compared to the EU average[717]:

Table 101: Spanish GDP compared to EU average

	2006 GDP per capita (PPP)	2006 GDR per capita (EUR°
Spain	24,000	22,300
EU27	23,500	23,500

In 1995 Spain started an impressive economic cycle, with growth figures around 3%, often well over this rate[718]. Between 1997 and 2007, Spain's GDP per capita expressed in PPP has moved from 94% of the EU27 average to 103%.

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[717] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-07-001-01/EN/KS-CD-07-001-01-EN.PDF

12.3. GENERAL REGULATORY CONTEXT

12.3.1. Historical background

In the 1980s, waste management planning had been transferred from the central government to the autonomous communities. The level of development of the regional waste plans was very heterogeneous, ranging from fully developed waste management plans to the absence of even a draft version. Regional attitudes towards incineration were also diverse (modern incineration facilities in Madrid and Palma, recycling in Barcelona). According to a report written in the context of the Second Cohesion Report, the situation in Spain in 1997 was characterised by poor waste management with great differences between regions and a general lack of co-ordination. Disposal of waste in landfills accounted for 70.4% of waste treatment: 12.2% of the waste was dumped illegally and 58.2% was disposed in authorised landfill sites (most of which did not meet the requirements of the Directive 99/31/EC). Recycling rates in 1996 were insignificant, with the exception of paper and glass (42% and 35%, respectively) [719].

SLR consulting (2005) confirms that, with a low population density in many parts of the country, landfill has been the prime management route for solid wastes and many continue to operate without proper environmental safeguards or, in some cases, without permits. Until the publication of the Waste Framework Directive[720] and the subsequent Landfill Directive[721], political attention to waste management was limited to some densely populated areas such as Madrid and Barcelona.

12.3.2. Packaging Waste Act

The Packaging Waste Act transposed Directive 94/62/EC into Spanish Law – see Section 12.6 for more details.

12.3.3. Waste Law of 1998

Law 10/1998 of 21 April on Wastes (the "Law on Waste") transposed the Waste Framework Directive 91/156/EEC and established a framework national legislation for waste. It introduced separate collection in municipalities above 5000 inhabitants, and established that recyclable or recoverable wastes are not allowed to be disposed.

The law did not specify whether bring systems or kerbside collection must be used. Most communities have used bring systems, as they are cheaper to operate. This is also consistent with the existing dominating practice of using bring systems for waste collection.[722]

It defines two main categories of waste (Santabaya and Castellá Hammerstein 2008):

- Urban wastes: those originating from private domiciles, shops, offices and services, and other types of waste that are not considered hazardous (e.g. wastes from cleaning the

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[718] http://www.la-moncloa.es/NR/rdonlyres/2E85E75E-E2D9-4148-B1DF-950B06696A6C/74823/Chapter_2.PDF

[719] http://europa.eu.int/comm/regional_policy/sources/docgener/studies/pdf/enviwas.pdf

[720] Requiring the preparation of a national waste management plan, see Article 7.

[721] Requiring diversion of biodegradable municipal waste from landfill, see Article 5.

[722] Barlaz M, Loughlin D and Willians J, (2002) Spain in "Strengthening Markets for Recyclables, A Worldwide Perspective", North Carolina State University.

streets, dead pets, abandoned furniture or those coming from small construction or repair works).

- Hazardous wastes: those substances or objects catalogued as such by Spanish or European Community regulations or international conventions. These wastes are subject to stricter obligations and their management, transport, collection and storage are subject to a previous authorisation.

The Law on Wastes imposes on the holder of waste the obligation, unless it is legally processing the waste itself, to give it to a waste manager or to the local authorities, and to preserve waste in adequate conditions of hygiene and safety, and, as the case may be, in special areas and duly labelled, while they are in its possession. As to the recovery and disposal of waste, producers are only entitled to carry out such activities if they hold the corresponding administrative authorisation. Nevertheless, Autonomous Regions can enact pieces of legislation that render exempt from this authorisation to companies that dispose of or recover their own non-dangerous waste in their production centres. Abandoning, dumping or uncontrolled elimination of waste is strictly forbidden (Santabaya and Castellá Hammerstein 2008).

Municipalities are expected to establish Integrated Systems of Management or ISM for solid wastes and recyclables. A municipality can either choose to negotiate the collection and waste management activities with the Green Dot organisation Eceombes (see Section 12.6.2) or to implement its own strategy (subject to the approval of the governing Autonomous Community (Barlaz et al 2002).

The Law also introduced the principle of extended producer responsibility – we refer to Section 12.5 for more details.

12.3.4. National Urban Solid Waste Management Plan 2000-06

The National Urban Solid Waste Management Plan 2000-06 had as main targets (EEA Country Fact Sheet):

- Stabilise waste amounts
- Introduce separate collections in municipalities above 5000 inhabitants by 2001, above 1000 inhabitants by 2006
- Promote packaging recycling and reuse;
- Valorisation of Biodegradable Municipal Waste (BMW), especially via composting;
- Correct disposal of waste; 17.7% incineration by 2006

The plan clearly established the waste management hierarchy, where composting is considered a form of recovery, that is, recovery of organic matter[723].

The 1998 NWMP foresaw to incinerate 9% of MSW by 2001 and 17.7% by 2006. All uncontrolled landfills were to be closed by 2006 (EEA Country Fact Sheet).

The target for 2006 was to recycle 75% of paper waste, 40% of plastic packaging waste, 90% of metal waste and 75% of glass waste.

In addition, the Spanish National Waste Plan forecasted investments in waste treatment and management in the period 2000-2006. According to the plan, these investments would be financed by the Cohesion Fund and co-financed by the Ministry of Environment ranging from 40% to 75%. However, the polluter pays principle would gradually be implemented into the tax system. Households would pay a

[723] http://europa.eu.int/comm/regional_policy/sources/docgener/studies/pdf/enviwas.pdf

tax directly derived from the costs of municipal mixed waste collection, according to the national waste plan [724].

As pointed out by SLR Consulting (2005) the targets in the Strategy were not underpinned by any kind of national fiscal mechanism and thus have been very ineffective in stimulating development of new infrastructure.

In general, landfill taxes have indeed not been implemented. In Madrid, the following values apply (EEA Country Fact Sheet):

- 10 EUR per tonne of hazardous waste
- 7 EUR per tonne of domestic waste
- 3 EUR for C&D waste

In Catalonia, the average value was 10 EUR per tonne.

The OECD has pointed out that some municipalities do not charge for waste services and that less than a third of waste collection and treatment costs are recovered countrywide[725].

12.3.5. Others

The National Plan on C&D waste 2001-2006 had as main targets (EEA Country Fact Sheet):

- 90% of amounts shall be correctly managed by 2006;
- Reuse and recycling of min 60%

The Landfill Directive 99/31 was transposed by the Royal Decree 1481/2001 on Landfill. The Incineration Directive 76/00 was transposed by the Royal Decree 653/2003 on Incineration of Waste.

12.3.6. Organisation of household waste collection[726]

Municipalities in Spain have traditionally mainly used bring systems. Mixed waste is collected in bins that are placed on the kerbside near residences and are shared by several households. "Yellow" bins are used for the selective collection of containers (metal cans, plastic bottles and beverage cartons). Green and blue igloos have been placed for the selective collection of glass and paper and cardboard (newsprint, office paper and magazines). These bins have been designed to prevent the dumping of mixed waste. Some municipalities also practice the selective collection of organic material in specifically designed containers (see Section 12.9.6.3 for examples).

A drawback of this system is that the containers crowd the streets, up to the point where some streets even had to be redesigned. In some cases, this has been tackled by the introduction of subterranean waste bins and pneumatic collection.

12.3.7. Integrated National Waste Plan (PNIR 2008-2015)

A detailed draft national waste plan (PNIR) was published by the Spanish environment ministry in March 2007.

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[724] http://europa.eu.int/comm/regional_policy/sources/docgener/studies/pdf/enviwas.pdf

[725] OECD Environmental Performance Review of Spain, Executive Summary.

[726] Barlaz M, Loughlin D and Willians J, (2002) Spain in "Strengthening Markets for Recyclables, A Worldwide Perspective", North Carolina State University.

The Environment Ministry has drawn up a draft Integrated National Waste Plan (PNIR 2008-2015) which includes 13 specific waste plans (urban, hazardous, end-of-life vehicles, end-of-life tyres, treatment plant sludge, polluted soil, etc) and three strategic documents (waste of animal origin, liquid waste or manure from livestock farming and reduced landfilling of organic waste). Each of these documents considers reinforcing or extending existing economic measures to promote the prevention and correct management of waste or implement new measures[727].

Examples *relevant for this study* include: the extension of integrated management systems, the extension and in-depth application of the principle of producer responsibility, the possibility of establishing economic discrimination in the administrative and tax treatment of materials derived from recycling, imposing an obligation to re-use (for instance packaging) and the possibility of establishing duties on final disposal or dumping (elimination) of waste[728].

The document acknowledges the failings of previous plans, most notably the urban waste plan 2001-2006. From 2001 to 2004 urban waste grew by 18.5 per cent. In 2003 88.5 per cent was landfilled or incinerated. Recycling rates remained generally stagnant. Some successes were achieved in areas such as organic waste composting[729]. New ambitious targets were set for 2015[730]:

- 20 per cent reduction in per capita urban waste generation
- 70 % reduction in non-biodegradable plastic bags
- 15 % cut in the generation of toxic waste

The document also calls for a homogeneous country-wide system of landfill taxation to cut disposal to 10-12 per cent of urban waste generated by 2012. Both the PNIR waste plan and a planned modification of the packaging and packaging waste legislation (see Section 12.6) emphasises the importance attached to voluntary agreements between consultation mechanisms to achieve set ecological objectives, particularly for those that are not compulsory under current legislation. Funding of the Plan is based on the principle of producer responsibility where waste management matters are concerned. A possible contribution from public funds will only be allocated to citizen awareness programmes, statistical monitoring and R&D&I programmes[731].

12.4. KEY WASTE STATISTICS

Table 102 shows a strong increase of municipal waste generation between 1995 and 2003 (with 37%). It also shows that, in 2003, 54% of municipal waste was still landfilled (down from 60% in 1995), including a significant fraction of biodegradable waste.

[727] Spanish Government, Comments on the 2004 OECD Environmental Performance Review of Spain, OECD, Paris (9-10 January 2008)

[728] Ibid.

[729] http://www.eco-net.ie/index.php?id=news&sub=13

[730] Ibid.

[731] http://www.eco-net.ie/index.php?id=news&sub=13

Table 102: Waste generation and treatment in 1000 tonnes

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Municipal waste generated *	20065	21135	22174	22436	24479	26513	26634	26586	27581
Municipal waste landfilled	12134	11758	12606	12577	13157	13559	14726	14723	15000
Biodegradable municipal waste generated	11685	:	:	:	:	:	:	:	:
Biodegradable waste landfilled	:	:	:	:	:	:	8852	9268	9291

Municipal waste per capita has grown by 30% in the same period:

Table 103: Waste generation in kg per capita

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Municipal waste generated	510	536	561	566	615	662	658	649	662

12.5. EXTENDED PRODUCER RESPONSIBILITY IN SPAIN

The Law on Waste, in its article 7, entitles the Government to enact legislation that obliges producers, importers or EU buyers, agents or any subject responsible for putting on the market products that become waste to choose between:

- being directly responsible for processing the waste produced by their own products;
- participating in an organised waste management system; or
- contributing to a public waste management system.

Furthermore, the Law on Waste provides that if the legislation to be enacted by the Government does not contain the previous obligation, it may oblige the same subjects to accept a system by which the final consumer, when receiving the product, deposits an amount that will be recovered when returning the package or the product (the Deposit-Return System) (Santabaya and Castellá Hammerstein 2008).

The Royal Decree 208/2005 of February 25 on WEEE transposes Directive 2002/96/EC into Spanish law and opens up the possibility of reaching objectives by means of integrated management systems[732]. It

[732] Comments from the Spanish Government on the 2004 OECD Environmental Performance, Review of Spain.

imposes on electrical and electronic equipment producers the obligation to establish systems to recover and collect waste from their products and to finance the costs of their collection and management. Producers may comply with this obligation on their own or by collaborating with other economic agents in an authorised collective management system (*Sistema Integrado de Gestión,* SIG) (Santabaya and Castellá Hammerstein 2008). Producers must also register with the competent body of the Autonomous Community in which their head office is situated. They must provide a guarantee in the case of individual compliance[733].

Another example is Royal Decree 106/2008 of 1 February, on batteries and accumulators waste – see Section 12.8.

In a similar way the Law on Packaging allows the producers to choose between a Deposit-Return System or participate on an authorised SIG that periodically collects packaging waste in the consumer's domicile or its proximities – see Section 12.6 for more details.

The National Plan for End-Of-Live-Vehicles 2001-2006 established that centres for collection and "decontamination" had to be realised by 2003 and that vehicles must be delivered to these centres from 1-1-03 (EEA Country Fact Sheet).

There have been some issues between local authorities and producer responsibility organisation, mainly because the government wants to have a service in the whole territory while the producer responsibility organisations try to focus in high-density areas. In rural areas, it takes more money to arrange the service and the PROs collect less waste[734].

12.6. PACKAGING WASTE POLICY

12.6.1. General[735]

The Spanish state has transposed the European Directive 94/62/EC into the Packaging and Packaging Waste Act 11/97.

The Act defined the following targets: to recover between 50%-65% of which 25%-45% are to be recycled, with a minimum of 15% per material. If this latter figure is not reached, taxes will be applied. It also establishes the objective to reduce waste packages by 10%.

Responsibility is on the last holders/ owners of commercial/ industrial waste. This law states that the following options are open to fillers, retailers, distributors and handlers of packaged products: a Deposit and Return System, self-compliance or join an Integrated Management System.

In a collective system, packaging companies finance the recollection of packaging by contributing a quantity of money for each packaged product they place in the market. The capital collected is reinvested in the recollection, recovery and treatment of waste.

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[733] Perchards (2005) Transposition of WEEE & RoHS Directives into national law of EU Member States and compliance activities, Summary of Perchards' Quarterly Reports.

[734] Information provided per-email by Zigor Garcia (IHOBE) on 27 June 2008.

[735] Unless stated otherwise, information in this Section has been obtained from the EEA Country Fact Sheet, Ecoembes press information package and from PRO Europe.

Ecoembes, a non-profit company, applies the Green Dot system to plastic, metal and paper-derived packaging. Glass packaging is managed in a similar way by Ecovidrio. Glass and all other packaging are usually deposited in different containers.[736]

Table 104: Ecoembes and Ecovidrio facts and figures

Inhabitants covered by selective collection	More than 43.6 million inhabitants tin paper/cardboard selective collection and more than 42.8 million inhabitants for light weight packaging (plastics, tins and beverage cardboards) selective collection.
Total packages on market	7.4 million tons (2004) included wood, "other" materials and glass.
Household packaging recovered	1.245 Ktonnes + 744.6 Ktonnes glass (2005) Ecoembes: 1.004 Ktonnes recycled; 241 Ktonnes energy recovered Ecovidrio: 744.6 Ktonnes glass recycled
Member companies	- 12.000 companies licensed to Ecoembes (2005) - 2.297 companies licensed to Ecovidrio (2005)
Turnover	- 237 million Euros Ecoembes (2005) - 49.9 million Euros Ecovidrio (2005)
Types of packaging	Household packaging. Commercial packaging is accepted under voluntary agreement

The scope of Ecoembes is limited to household packaging waste.

In the case of non-household packaging waste, the end-users have to negotiate directly with contractors. The brandholders have to report on packaging data and pay for packaging that is similar to household waste (Perchards 2005).

The Royal Decree 252/2006, of March 3 on new qualitative ecological objectives regarding management of packaging waste sets out new and more ambitious objectives for the recovery, use and recycling of packaging waste, broken down by material. It transposes Directive 2004/12/EC into Spanish national law and amends RD 782/1998, which stated previous objectives. It also includes a more precise definition of packaging waste.

The Decree transposing the Directive requires the submission of a Prevention Plan. It exempts companies that put small amounts of packaging on the market from the submission of the prevention plan. At regional and central level, financial or fiscal measures can be put in place to promote the packaging that responds to the Prevention Plan.

A new draft law on packaging and packaging waste will replace current Act 11/1997. The draft of the revision of the Law 11/1997 on Packaging and Packaging Waste takes into consideration the possibility to have the *complete* cost of the management of packaging and packaging waste assumed by the people who put the packaging on the market. In the present law the people in charge of the packaging paid the *additional* cost linked to selective collection[737].

[736] http://europa.eu.int/comm/regional_policy/sources/docgener/studies/pdf/enviwas.pdf

[737] Information provided by Carmen Tapia (Ministerio de Medio Ambiente) per e-mail on 08 July 2008.

On the other hand, those responsible for placing industrial and commercial packaging on the market (for large companies and establishments) are required to inform the competent authorities in detail of the amounts and types of packaging placed on the market and the quantity of this waste which can be recovered, exploited, reused and recycled. Provision is also made to levy duties for superfluous packaging. To determine whether a packaging is superfluous, the following factors will, amongst others, be taken into account: the size and the weight of the minimal packaging, the size and the weight of the average packaging, the standard UNE-EN 13428 regarding the specific requirements for the manufacturing of the packages; communitarian norms that could follow from the experience acquired by the countries more advanced in this matter. The new law will also impose new and stricter measures to monitor compliance with all these obligations and to determine the rigour and accuracy of the information given to the authorities by producers, and cater for integrated management systems[738].

12.6.2. Ecoembes

Ecoembalajes España, S.A. (Ecoembes) was set up as a SIG on the 22nd November, 1996. All the business sectors involved in recycling, packagers, retailers and distributors, producers of raw materials and recyclers are represented in the company. Ecoembes has 57 shareholders (55% Packagers, 20% Retail and Distribution, 20% Raw Materials and 5% Recyclers).

It currently counts 12.000 member companies and has signed agreements with 100 government authorities. It has been authorised in all the Autonomous Regions of Spain.

Ecoembalajes España is a non-profit company. Its activity is financed by the contributions made by the packaging companies belonging to the SIG, according to the number of packages put for the first time on the Spanish market and the material used to make them.

Local Councils in Spain are responsible for the implementation of the selective collection of packaging waste. Ecoembes uses these contributions to finance the *extra* cost that the selective collection, transport, classification and subsequent recycling and recovery of the packaging waste means to the local authorities[739]. Ecoembes also provides technical support for the definition, development and supervision of the selective collection system and packaging waste classification system.

[738] Ibid.

[739] 2% of the contributions is used to cover management costs.

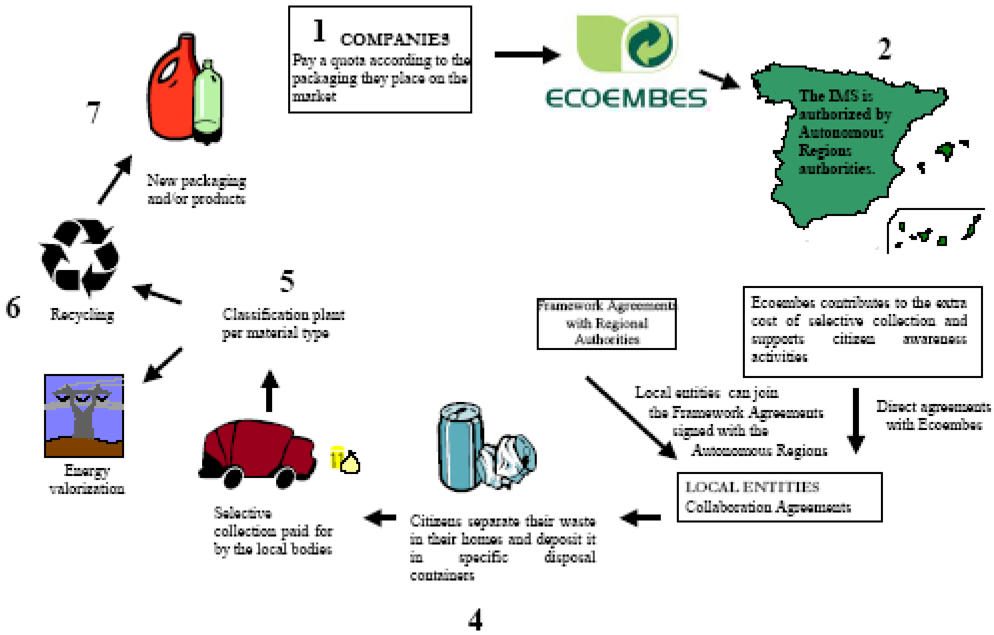


Figure 67: The Ecoembes system

The packaging companies that want to belong to Ecoembes's SIG in order to comply with the law, enter into a Membership Contract and fill in an annual return regarding the packing put on the Spanish market, from which their contribution to the SIG is deducted.

Table 105: Unit fees for Ecoembes

Packaging material	**2007**	**2008**
	Euros / Kg. (excl. VAT)	
Flexible HDPE / LDPE / Other plastics	0.28	0.329
PET / HDPE (rigid body)	0.247	0.278
Paper/cardboard	0.051	0.051
Beverage cartons	0.212	0.266
Steel	0.059	0.061
Aluminium	0.102	0.102
Wood	0.019	0.019
Ceramics	0.018	0.018
Other materials	0.261	0.329
Glass:	**Euros / unit**	
> 500 ml > 125 ml, < =500 ml	0.0078 0.0039	0.01053 0.00527

< =125 ml	0.00293	0.00396

The fees include material costs and the tonnage of all materials recovered. The fees differ for each material and the costs depend on weight (except for glass, which will have a unit cost, depending on which of 3 volume groups it falls into).

From 2003 onwards, composite packaging[740] will always contribute as if it were entirely composed of the majority material.

12.6.3. Voluntary agreements[741]

There exist agreements between industry groups and Ecoembes/Ecovidrio to guarantee producer take back for recovered materials for which no purchaser can be found.

Ecoembes/Ecovidrio can also sign voluntary agreements with producers of packaged goods to achieve source reduction goals. However, producers who sign such agreements remain subject to the legally mandated sector-wide goals.

12.6.4. Prevention plans

Companies that produce more than 350 metric tonnes of packaging annually or that exceed material-specific packaging levels have to draw packaging prevention plans. These plans are typically drawn by trade federations but are binding.

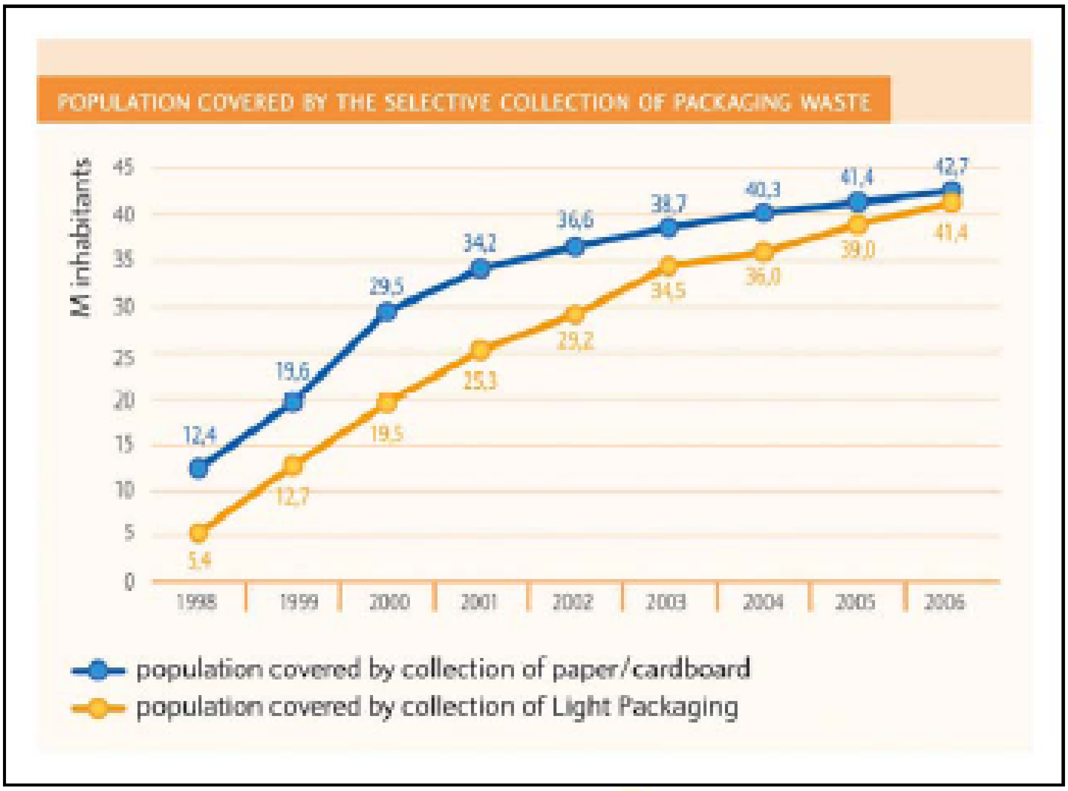
12.6.5. Results

The following figure shows how the coverage of the system evolved through time:

[740] That is, packaging made of 2 or more materials, that are originally separate but when they form the packaging are difficult for the final consumer to separate.

[741] Barlaz M, Loughlin D and Willians J, (2002) Spain in "Strengthening Markets for Recyclables, A Worldwide Perspective", North Carolina State University.

Figure 68: Population covered by Ecoembes



During 2006 (figures for 2007 are not official yet), Ecoembes recovered 1,267,029 tons of packaging, which represents 63.3% of all packaging placed on the market by the companies affiliated to the SIG (2,002,592).

Of this total recovered, 1,066,343 tons were recycled, representing over half (52.2%) of the packaging placed on the market and 62,059 tons more than during 2005. The remaining waste, 200,686 tons, was incinerated with energy recovery.

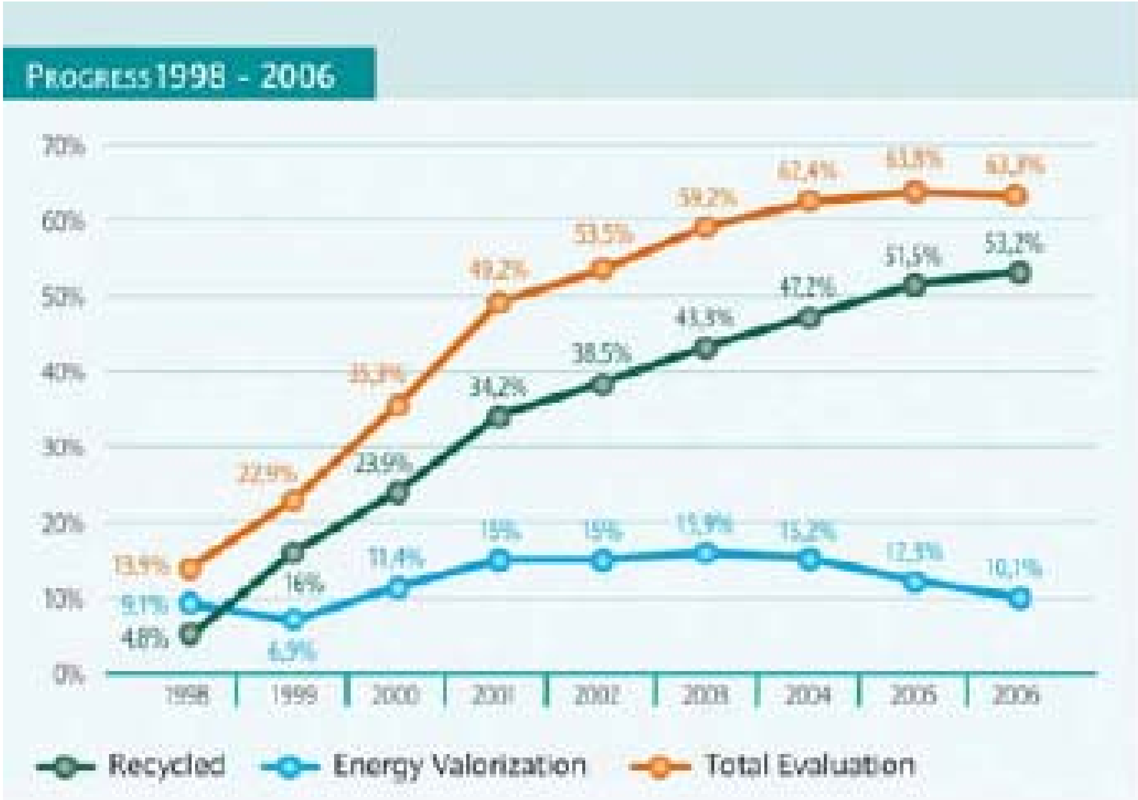
In terms of material type during 2006, 598,677 tons of paper-cardboard packaging were recycled, 11,634 more than during 2005. 223,251 tons of plastic packaging were also recycled, which is an increase of 20.3% over 2005.

The recovery and recycling results of the SIG during 2006 exceeded the objectives defined by the Packaging and Packaging Waste Act. It was 1.8 points away from achieving the global recycling objective set by European Directive 2004/12/CE.

Table 106: Progress of recycled objects by type of materials (%) / 2004-2006

Materials	2004	Increase	2005	Increase	2006	Objective
Paper/Cardboard	63%	5.6 points	68.60%	0.9 points	69.50%	60%
Plastics	22.30%	3.6 points	25.90%	4 points	29.90%	22.50%
Metals	58.10%	3.6 points	61.70%	1.5 points	63.20%	50%
	47%	2.2	49.20%	9	58.20%	15% **

Figure 69: Ecoembes progress 1998-2006



Since 1998, Ecoembes has been carrying out awareness campaigns among the business community in order to provide information regarding the obligations that have arisen from the Packaging and Packaging Waste Act 11/97.

Besides this informative work, Ecoembes has three systems for the detection of fraud committed by companies: control at points of sale, research using databases that enables the detection of companies whose products are difficult to be located at the points of sale and, finally, research into those companies that leave Ecoembes without a justified reason.

As a result, Ecoembes detected 150 companies in breach of the law during 2006.

Ecoembes informs the Autonomous Regions as regards those companies that may be in breach of the Packaging and Waste Packaging Act. Using this information, the Autonomous Regions initiate inspection procedures that may result in the application of fines. At the end of 2006, Ecoembes had sent information on 1,059 companies that may be in breach of the Packaging and Waste Packaging Act to the Autonomous Regions.

In total, 1,278 companies have become affiliated to Ecoembes as a consequence of the work carried out to control fraud by both Ecoembes and by the Autonomous Regions. This represents over 10% of the collaborating companies at the end of the year.

12.7. PVC

The information provided by the Iberian PVC Forum did not contain additional information compared to what we have obtained from Vinyl2010.

12.8. BATTERIES[742]

12.8.1. Current situation

Currently, about 1 billion batteries are used per year in Spain. 15% of those that are thrown away are actually collected. According to the Spanish Association of Battery, Accumulator and Mobile Collection Companies (AERPAM), only 8% of the collected fraction is actually recycled (this corresponds to 1.2% of the total). AERPAM expects that the implementation of the new Battery Directive will lead to an increase of collection by 25%[743].

12.8.2. Transposition of the new Battery Directive

The Spanish Royal Decree 106/2008, of 1 February, on the management of batteries and accumulators and of waste batteries and accumulators[744] has established a new legal framework for the batteries sector.

The Royal Decree will effectively enter into force on 26th September 2008. It applies to all types of batteries, accumulators and battery packs, irrespective of their shape, volume, weight, composition or use (with the only exception of those of military use or used in equipment designed to be sent into space). It affects both batteries sold separately and batteries incorporated into electrical and electronic equipment.

Under the new legislation "batteries producer" is any natural or legal entity who, irrespective of the selling technique used (including distant selling), places batteries or accumulators, including those incorporated into appliances or vehicles, in the Spanish market for the first time on a professional basis.

A Register of Batteries Producers will be constituted at a national level and producers will report periodically figures of batteries placed in the Spanish market.

According to Article 5 of the Royal Decree, four different types of schemes are foreseen for producers' compliance:

- Contributing financially to public management systems
- Implementing an individual compliance scheme (not for "hazardous" batteries (Ni-Cd, lead and mercury-containing))
- Participating in an integrated management system
- Creating a deposit scheme (can be managed within a public or collective scheme)

Thus, in places where Public Management Systems duly authorised by the competent government bodies have been set up, producers of batteries, accumulators or battery packs may participate in these systems by assuming, in each case, their share of responsibility for the quantities which they place on the market within the territory in which these Public Management Systems operate. Public Management Systems must have separate collection points, equipped by the local authorities or Autonomous Communities organising such systems. Holders and end-users of used batteries, accumulators and battery packs must be able to deposit these items free of charge so that they can then be managed in accordance with the Royal Decree.

Producers of batteries, accumulators or battery packs may meet their obligations by setting up their own Individual Management System which must be duly authorised by the competent body of the

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[742] All information in this Section has been obtained from the Ecopilas website and through e-mail correspondence from Ecopilas .

[743] http://www.aerpam.org/principal.htm

[744] Spanish Official Journal on 12nd February 2008.

Autonomous Community in which this system is set up. Using this Individual Management System, the producer shall directly organise, at his cost, the corresponding management operations for the waste batteries and accumulators which he has placed on the market. When the producer opts to contribute to Public Management Systems set up within his area of operation by meeting the relevant cost, he must, however, organise, at his cost, the other operations which are not provided by the public system.

Integrated Management Systems must be authorised by the Autonomous Communities in which they operate. The authorisations are granted to Integrated Management Systems for a maximum period of five years but may be renewed for successive periods. Integrated Management Systems are required to establish collaboration agreements with local authorities and Autonomous Communities. In order to achieve the targets, Integrated Management Systems are financed through fees or contributions paid by producers of batteries, accumulators and battery packs. Their financial solvency must be guaranteed.

Producers of batteries, accumulators or battery packs may also meet their obligations by setting up their own Deposit, Return and Refund System which shall be duly authorised by the competent body of the relevant Autonomous Community. This Deposit, Return and Refund System may be organised and operated within an Integrated Management System.

Producers or managers of the system must provide the establishments of sellers or distributors with special and appropriate containers which allow the used batteries and accumulators returned by consumers to be deposited and duly sorted.

The sum of money paid as a deposit shall be set by an order of the Environment Ministry.

Producers who set up their own Deposit, Return and Refund System must apply for authorisation.

12.8.3. Ecopilas

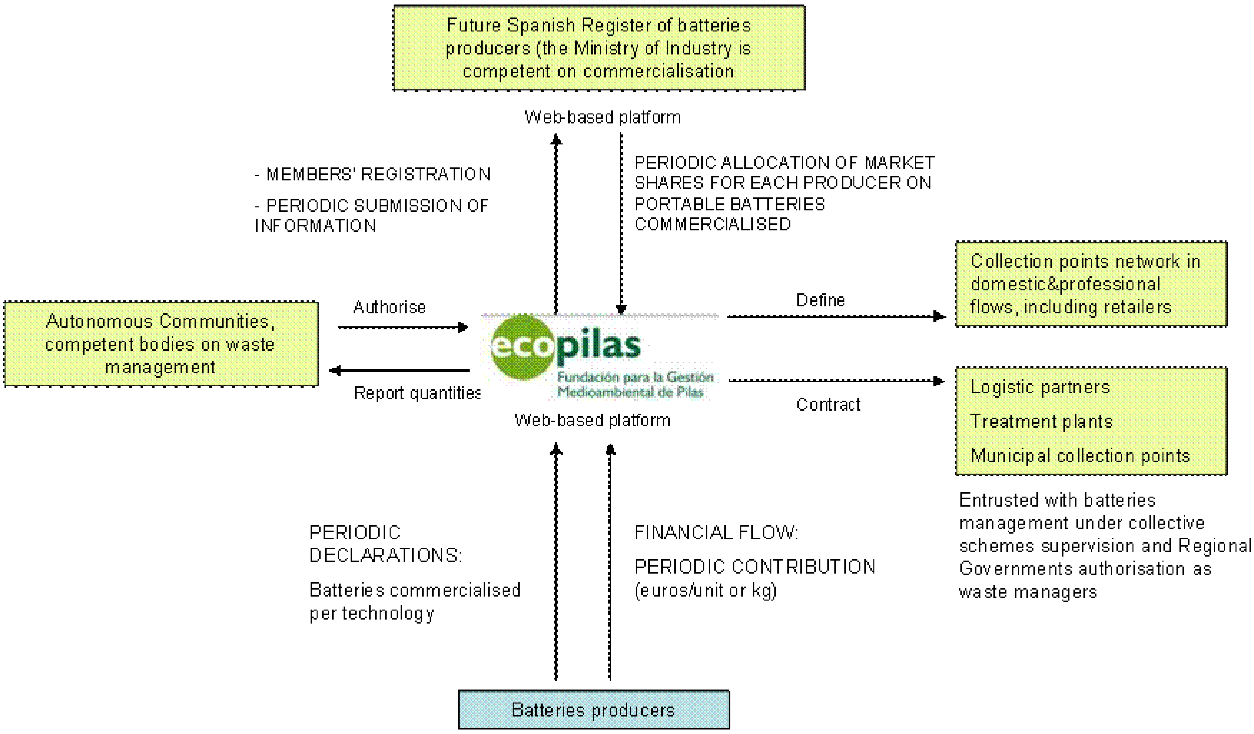
The Foundation ECOPILAS, integrated in ASIMELEC and created by the main batteries manufacturers, was constituted in 2000 as a batteries compliance scheme. The Board of Trustees of ECOPILAS comprises the different sectors involved in batteries life cycle: producers, retailing chains and end-users.

The founding members of ECOPILAS represent 70% of the sector in Spain.

ECOPILAS covers all types of batteries and accumulators. It is implementing collaboration with the relevant WEEE schemes in Spain.

ECOPILAS will cover domestic and retailing collection points as well as public institutions and industries. No economic incentives are foreseen to fight hoarding. It is not clear yet what type of contract will be used for the logistical partners and the recyclers.

Figure 70: Ecopilas scheme



12.8.4. Existing schemes

In the past, some Spanish Regions and Municipalities have taken initiatives for the selective collection of batteries, without a harmonised approach and without the involvement of batteries producers. It is not clear yet how the existing systems will coordinate with the integrated management systems.

For instance, Seville has selectively collected batteries since at least 1991[745].

The selective collection of batteries through shops was launched in Catalonia in 1991[746]. The Junta de Residus[747] provided special containers so people could drop off their used batteries. There are currently over 16,000 battery collection points in Catalonia.

The collection process depends on the source of the batteries[748]:

- Domestic batteries can be left in special battery containers in shops selling electrical appliances, toys, cameras, clocks and watches, etc. and at collection centres. These shops are known as collection points. Each collection point has a place assigned that centralises management: distribution of containers, removal of full containers, delivery of information leaflets, and so on. These are the so-called "centralising points": town councils, regional councils or shops centralising distribution chains.

[745] http://habitat.aq.upm.es/bpes/onu98/bp444.en.html

[746] http://www.arc-cat.net/en/municipals/canon/index.html

[747] Since 2003 Agència de Residus de Catalunya or Waste Agency of Catalonia

[748] http://www.arc-cat.net/en/municipals/recollidaselectiva/rmespecials/piles/pilesrecoll.html

- Batteries from industry must be stored by companies, segregated from other waste and without being mixed with paper, plastic or cardboard wrapping. In any case, large batteries must be separated from button cell batteries.

The established management model consists in collection through shops from where batteries are transported to the treatment and recycling centre at Pont de Vilomara (Bages).

Law 6/1993, of 15th July, regulating waste, establishes that the treatment of batteries is a public service to be rendered by the Government of Catalonia. In this respect, the Waste Agency of Catalonia is responsible for their management. PILAGEST S.L was licensed through public tender, for the collection, transport and treatment of waste batteries in Catalonia.

Interestingly, PILAGEST is an example of an integrated collector-sorter-recycler.

12.9. FOOD

12.9.1. Policy

Mixed biological municipal solid waste (BMW) is defined in the National Decree (1481/2001) as any waste capable of anaerobic/aerobic degradation and that are contained inside municipal (or urban) waste; hence the materials considered are (EEA Country Fact Sheet):

- Food waste
- Garden waste
- Paper and cardboard

According to Barth et al (2008, p.151), the National Waste Management Plan 2000-2006 sets the following objectives for treatment by composting or anaerobic digestion: minimum 40% of total BMW arising by 2001 and 50% by 2006.

With respect to energy recovery by means of anaerobic digestion it sets the objectives of 2% of BMW by 2001 and 5% by 2006.

The 2000-2006 National Plan on Waste also stated a general target for green waste to be separately collected and recycled: 50% by 2002 and 80% by 2006. The plan imposed the separate collection for *food* waste starting from big producers (restaurants, canteens, etc) for all municipalities with more than 5000 inhabitants.

The main goals for composting were outlined in the section dedicated to the National Plan for Composting: the development of an agricultural quality standard for compost; the foundation of a National Centre for Compost; creation of incentives for research programs and promotion of compost; and promotion of voluntary agreements so to increase the demand for and use of compost[749].

The new National Plan for Waste aims at further promoting the source separation schemes for biowaste and green waste in cities. Until now, source separation of biodegradable waste has only been implemented in some towns and regions like Catalonia. This Plan also includes a National Strategy for reduction of biodegradable waste in landfills, to comply with European legislation.

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[749] http://www.compostnetwork.info/index.php?id=44

If selective collection takes place, it is the municipality that decides whether food waste is separated from the green fraction[750].

According to SLR Consulting (2005), recent moves to divert biodegradable waste from landfill in Spain have led to the development of composting schemes for municipal waste in sparsely populated regions, such as Estamadura, where the benefits of applying organic matter to agricultural land, to prevent desertification, has had widespread political support. Desertification is a key driver for compost-based solutions in many parts of Spain, such that the Government has adopted a National Action Plan under the UN Convention to Combat Desertification (UN-CCD). As a result, the use of material derived from mixed, i.e. non-source separated wastes on agricultural land receives far greater acceptance than in other Member States.

For instance, SLR Consulting points out that as far back as 1996, a high proportion (13.9%) of urban waste stream was being composted and almost 12% recycled – even though a high proportion (perhaps as much as 50%) of the material sent to composting plants was not suitable for use on land and either required disposal at landfill or was detrimentally employed in agricultural applications.

Spanish regions have a significant degree of autonomy from central government. According to SLR Consulting (2005), only the Basque Region and Catalonia have in place plans to exceed the first Landfill Directive target in 2010 – we will treat these examples in a separate Section.

12.9.2. Quality requirements

Compost is regulated by the Law on Waste and in the Royal Decree 1310/1990 regarding the use of waste water treatment sludge in the agrarian sector [751].

Compost quality is also briefly discussed in the Royal Decree on fertilizers[752] where, for the first time, different kinds of compost are established according to their quality in terms of heavy metals concentrations (class A, B and C).

In Spain no compost can be sold without having it registered in the "Official Register on Fertilisers Products". Once a product is included in the Register it can be sold – the Decree thus establishes when compost ceases to be waste. The registration period is 10 years. Depending on the heavy metal content, three classes of compost exist with application limits depending on the quality of compost (see Barth et al 2008 p 31):

- Class A compost which is very near to Ecolabel requirements[753]
- Class B compost: this corresponds to compost produced from clean organic wastes (included biowaste from separate collection)
- Class C compost : this corresponds to compost obtained from "less clean" organic wastes (including waste considered "compost" or "stabilised organic waste" obtained from composting of residual waste)

The Decree restricts the use of Class C compost (mixed waste compost) to 5 tonnes of dry matter per hectare per year. For some types of fertiliser, it is only allowed to use raw materials from organic (animal

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[750] Information provided by Carmen Tapia (Ministerio de Medio Ambiente) per e-mail on 08 July 2008.

[751] http://www.compostnetwork.info/index.php?id=44

[752] Royal Decree 824/2005 on Fertiliser Products

[753] http://www.eco-label.com/

or vegetal) source, included explicitly in the list of biodegradable organic waste of Annex IV to the Law. No input materials are specifically excluded (Barth et al 2008).

There exists a draft statutory Spanish standard on compost legislation, laying down standardised, nationwide rules concerning the production, marketing and labelling of compost as a product prepared by the Ministry of Environment (Barth et al p. 99).

12.9.3. Market situation

In 2006, only around 58% of the compost produced has been sold, mainly for agricultural uses. Commercialization of the product is still an issue in Spain, mainly due to poor quality or to a bad image of compost among the agricultural sector. The new regulations of the Environment Ministry (law on fertilizers, new National Plan on Waste) and some studies are trying to palliate this problem, and effort needs to be made to ensure a good quality of compost[754].

According to Barth et al (2008, p 160), a study of the Spanish Ministry of Environment has reached the conclusion that the market need corresponds to twice the supply of all compostable residues (mixed MSW, sludge, farming residues).

On the one hand, the study has produced the following estimates for *potential* compost production:

- Organic fraction of mixed municipal solid waste: 1.07 million tonnes
- Processed sludge: 0.62 million tonnes
- Residues from farms/food residues, farming industry: 1.79 million tonnes

This corresponds to a total of 3.48 million tonnes.

On the other hand, the study has estimated that demand[755] corresponds to 7.34 million tonnes.

Potential supply of compost is mostly situated in the northern regions, while the deficit areas are mainly in the south. .

According to Barth et al (2008, p. 177) no import or export activities to France are recorded at the Agencia de Residus in Catalonia. On the one hand, for the low compost qualities made from mixed waste compost, transportation costs are too high compared to the prices that can be obtained abroad. On the other hand, for good quality compost made from separately collected biowaste, Barth et al think there is sufficient demand in Catalonia.

Barth et al reckon that the same reasons may explain why there is no compost trade detectable with Portugal. In addition there are only four Spanish plants located in an acceptable distance to the Portuguese border.

12.9.4. Infrastructure[756]

The number of composting plants in Spain has started to grow steadily since the end of last decade.

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[754] http://www.compostnetwork.info/index.php?id=44

[755] In the areas of agriculture, horticulture and green areas and other ranges combined with infrastructural projects establishing arable land.

[756] http://www.compostnetwork.info/index.php?id=44

In 2006, there were at least 91 MSW composting plants working in the whole country, most of them big, centralized plants (the average capacity of composting plants in Spain is 100,000 tons/year).

Only 9% of the waste entering the composting plants comes from separate collection of biowaste, most of the input material being mixed MSW. A number of composting plants are also in the process of modernisation.

Anaerobic digestion is growing strongly in Spain. The first plant was built in A Coruña in 1999; in 2006 there were 11 plants operating, 4 were closed and were being rebuilt and at least 6 more plants were planned for the forthcoming years.

Around 8 million tons of waste has entered MSW biological treatment plants in 2006, thus obtaining more than 1.2 million tons of compost.

12.9.5. LIFE project in Andalusia[757]

A LIFE demonstration project[758] brought together a group of participants from Andalusia and the Algarve (Portugal) to disseminate and demonstrate the efficacy of co-composting municipal waste as a source of organic slow-release fertiliser.

The LIFE project showed that 'co-composting' - joint composting of organic waste, such as household rubbish, bio-solids from urban wastewater treatment plants and plant remains from parks and gardens - is technically feasible and worthwhile both from an economic and an environmental point-of-view.

In the first phase, compost was processed at two plants that initially did not carry out co-composting. In the second phase the compost obtained was tested as humus for its use as an organic fertiliser in forests and agricultural cultivation. In the third and closing phase the results were disseminated.

Additionally, a 'LIFE Compost Office' was created in Andalusia to provide a permanent feed-back point and information about co-composting technology and the application of compost. The project successfully mixed different ratios of organic waste to manufacture three compost types using an open, simple and cost-effective system.

Based on the result of the project, the Regional Ministry of Environment of Andalusia has designed and registered a trademark "Environmental Accreditation of Compost" that allows - on a voluntary basis - companies producing compost to show its quality. Compost should fulfil some limits according to the Royal Decree 824/2005 (8/7/05) about fertilisers. The Regional Ministry of Environment of Andalusia will control the label use and define accredited laboratories to analyse compost samples. There is no independent sample taking (Barth et al 2008 p. 99).

[757] http://www.biomatnet.org/secure/Life/S1910.htm

[758] Contract No LIFE 00 ENV/E/000543

12.9.6. Catalonia[759]

12.9.6.1. Regulatory framework

Catalonia is one of the three autonomous communities in Spain. It has its own waste management policy within the frame of the European Union and the Spanish State. Catalonian waste policy follows the waste hierarchy.

The Law 6/93 of 1993 imposed separate collection of biowaste on municipalities of more than 5000 inhabitants by 1999. This requirement applied to 19% of Catalan municipalities, corresponding to 80 % of the population. The remaining municipalities are not required to comply, although they may participate on a voluntary basis. The 2001 Catalan Municipal Waste Management Programme (PROGREMIC) contains also a Regional Strategy for BMW management (Catalan Decree 1/1997). It set the objective that by 2003 40% of biowaste must be collected seperately, and 55% by 2006. [760]

As the result of Municipal Waste Management Programme in Catalonia (2001-2006), a waste disposal tax was introduced that helps finance the implementation of sustainable waste management and aims to discourage the sending of waste to disposal facilities. The tax rate is €10 per tonne of waste sent of landfill (adjusted annually by means of the Catalan Finance Act). At least 50% of the funds generated must be applied to the treatment of selectively collected organic fraction of municipal solid waste (OFMSW). The rest should be allocated to the selective collection of OFMSW, the recovery of other types of material, treatments that reduce the amount or improve the quality of the final waste sent to landfill, and to awareness-raising, environmental education or dissemination campaigns[761].

The Catalan Government is actually working in the direction of implementing the law on waste and the municipal waste management programme (PROGREMIC) in order to:

- extend the obligation of bio-waste separate collection to all municipalities of Catalonia (not only those municipalities with more than 5000 inhabitants)
- to make pre-treatment of residual waste compulsory in order to reduce the amount (and to improve the quality) of the residual/rest waste before it goes to landfill (or to incineration)
- improve the management of landfills, trough the disposal of stabilized residual/rest waste by means of plastic packs.
- extend the landfill tax (10 EUR/T) to an incineration tax (5 EUR/T) and to a debris tax (3 EUR/T)

In Catalonia, the Junta de Residus had drawn up a Decree on the quality of compost, but it has not yet been approved.

12.9.6.2. Experiences

After some poor experiences with bad quality mixed waste compost, the implementation of the new regulation on waste and the development of source separation of biowaste have led to significant development of source separation and biological treatment capacity[762].

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[759] http://www.compostnetwork.info/index.php?id=44

[760] Gelabert, E (2003), The successful separate collection experiences in Catalonia. The Door to Door collection. International ECN Workshop, Barcelona, Spain.

[761] http://www.arc-cat.net/en/municipals/canon/index.html

[762] http://www.compostnetwork.info/index.php?id=44

Nevertheless, in 2001, 63.8 % of total MSW was still landfilled, mainly without any pre-treatment, while source separation and recycling averaged 17.0 % of MSW generation (3.6 million tonnes). Some 100 municipalities in Catalonia had by then implemented, partially or totally, the separate collection for the food waste; the source separation of biowaste affected about 1.000.000 inhabitants[763].

Since the implementation of biowaste separated collection, several schemes were used with unequal outcomes. In some Catalan municipalities, the door-to-door separate collection (for at least biowaste and residual waste) resulted in the collection of large quantities of high-quality biowaste; in addition to this, it allowed to get the highest recycling rates, between 60 to 80 %.

The development of source-separation schemes was further fostered in 2003 by granting about EUR 2.8 Mio to 47 municipal and "supra-municipal" authorities to allow investments for buckets, biodegradable bags, containers, information campaigns and other activities strictly linked to encouraging separate collection of bio-waste, such as the realisation of organic waste transfer points or the equipment with specific vehicles for separate collection. By 2003, 144 municipalities had introduced separate collection schemes for bio-waste, collecting about 150.336 tonnes of materials. About 2.2 million inhabitants are connected to the separate collection scheme. At the end of 2003, the state of the infrastructure to recover organic matter was as follows: 15 plants for composting, 1 for anaerobic digestion; 7 plants were under construction[764].

12.9.6.3. Door to door collection: an example

In 2000, the municipality of Tiana (Barcelona, Spain) implemented as first a door to door selective collection system for organic waste. This pilot project was followed by others in the next few years.

These door to door collection schemes have obtained participation levels of up to 80%. They have allowed to remove containers from the street and led to higher participation.

The financial cost of these schemes did not turn out to be more elevated than that of container collection. While the collection cost of biowaste has gone up, the collection cost of residual waste and the treatment costs for landfilling and composting have gone down. The first experiences in Catalonia have lead to the conclusions that door to door collection is applicable for small or medium sized municipalities, with an average or low population density. It is supposedly also applicable to narrow high density city centres (Gelabert 2003).

The selective collection of organic waste has now been generalized to almost all municipalities with positive results. The selective collection has been stimulated by the creation of a list of wastes that are subject to the landfill tax. Part of these tax revenues are used for the treatment of the selectively collected organic fraction[765].

In Tiana, food waste is collected in a door-to-door selective system. The domestic food waste is collected 4 days per week, by night. The domestic non-selective waste is collected just 1 day per week.

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[763] http://www.compostnetwork.info/index.php?id=44

[764] EEA Country Fact Sheet. Although legislation prohibits the landfilling of waste without pre-treatment, no MBT facilities exist in Catalonia. Only the combined composting and anaerobic digestion plants are allowed to treat biowaste and mixed municipal waste. Depending on the quality of the material produced, it could be used as a "MSW-compost" for land reclamation or should be landfilled – see http://www.compostnetwork.info/index.php?id=44 .

[765] Information provided by Carmen Tapia (Ministerio de Medio Ambiente) per e-mail on 08 July 2008.

Household paper, glass, plastic, envelopes and cans are collected in igloo containers in the street. Paper, glass, plastic, envelopes and cans of commercial sources are collected in a specific door-to-door collection service.

Households receive free baskets: one 10 litres basket to use in the kitchen to separate the food waste, and one 25 litres basket to take the waste in the street to be collected.

In the old town centre and the narrow streets, a little collector truck (7m3) with one driver and two workers, is used to collect the waste. This truck is used as a satellite. Larger trucks (16m3) are used to collect all the waste collected in the little ones and to collect the waste in the wide streets in the town.

The number of commercial food waste producers in Tiana is limited: 10 bars and restaurants, 5 schools, and 10 others food waste producers (little supermarkets, bread shop, fish shop…). Commercial producers also receive free containers to separate and collect the food waste: 120, 240, 360 or 600 litres containers[766].

In the implantation phase, the municipality encountered typical communication problems. However, once the system was operational, citizens could see that the selective collection was not that difficult. Currently, most problems are minor (mostly littering near to the igloo containers).

12.9.7. Basque country

The Integrated Urban Waste Management Plan for Gipuzkoa lays the groundwork for developing sustainable urban waste management in the Basque Region. The Plan aims to significantly increase composting from the current level of 1500 tonnes/year from green and wood waste to 22,500 tonnes year in 2016. This increase will be achieved through the selective collection and treatment of the organic waste from large-scale producers (markets, large shopping centres, cafeterias etc). Once these minimisation recycling and composting strategies have been applied it is envisaged that the remaining part of MSW will undergo mechanical biological treatment and be used to produce energy or a combination of both techniques (EEA Country Fact Sheet).

In practice, there is no systematic separate collection for food waste until now. However there are some plans to start kerbside collection programs. Gipuzkoa region for instance has just started with a pilot project. In order to avoid contamination of food waste, people who want to participate in the program need to ask for a key to lock the container. The early results seem to be good, with little contamination.[767]

12.10. CARDBOARD[768]

12.10.1. Basic statistical data

Spanish pulp and paper industry is the 5th pulp and 7th paper producer of the European Union. There are a total of 124 industrial plants: 15 for pulp production and 109 for paper and board production.

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[766] Keep in mind that commercial waste management is the responsibility of the producer. However, the local administration can choose to offer the collection service, and has to charge all the costs of the service to the commercial producer. In Tiana, all the commercial producers use the services of the Municipality because it is cheaper than a private service. However, the situation in the medium and big cities is different.

[767] Information provided per-email by Zigor Garcia (IHOBE) on 27 June 2008.

[768] Unless stated otherwise, this section is based on Miranda and Blanco (2007).

Basic statistic data of the Spanish pulp and paper industry are summarized in Table 107 and

Table **108**.

Table 107: 2006 Basic statistic data for the pulp and paper industry[769].

	'000 tons	**% 06/05**
Pulp		
Production	2037.7	+3.3
Consumption	1991.7	+3.4
Imports	923.9	+4.6
Exports	969.9	+4.3
Raw materials		
Wood consumption ('000 m3)	6317.6	+3.4
Recovered paper consumption	5370.8	+16.3
Total turnover (million €)	4700	+7.04

Table 108: Paper and cardboard production in Spain[770]

Paper and cardbaord (2006)	**Production (T)**	**Exports (T)**	**Imports (T)**	**Consumption (T)**
Press and printed matter	1.973.000	1.276.400	2.340.100	3.036.900
Hygienic and sanitary paper	606.900	137.200	161.000	630.600
Corrugated cardbaord:	2.711.900	770.800	1.036.500	2.977.600
Kraft bags	147.500	94.800	66.300	119.000
Paperboard	356.500	226.600	415.700	545.600
Others	557.300	291.700	292.700	558.300
Total	6.353.300	2.797.500	4.312.200	7.868.000
% change compared to 2005	+ 11.5	+6.5	+14.1	+34

[769] Source: National Association of Pulp and Paper Manufacturers (ASPAPEL), quoted in Miranda and Blanco.

[770] ASPAPEL data supplied by Margarita Riuz Sainz-Aja of the Spanish Ministry of the Environment.

Table 109 shows the most relevant statistics to collection and utilisation of recovered paper as raw material during the last years (2000-2006).

Table 109 Evolution of collection and utilisation of recovered paper in Spain during the period 2000-2006[771]

	2000	2001	2002	2003	2004	2005	2006	2007	06/00 (% change)
Collection ('000 t)	3318.5	3496.2	3618.8	3642.9	3926.5	4322.5	4637.7	4900	39.8
Imports ('000 t)	660.0	771.5	860.1	911.3	822.4	808.3	1115.8	1200	69.1
Exports ('000 t)	103.6	70.8	106.6	111.6	274.6	512.1	382.7	492	269.4
Utilisation ('000 t)	3874.9	4196.9	4370.3	4442.7	4474.3	4618.8	5370.8	5700	38.6
Collection rate (%)	48.6	54.6	52.0	50.5	54.6	58.5	58.9	63.7	21.2
Utilisation rate (%)	81.3	81.8	81.5	81.7	81.0	81.1	84.5	84.6	3.9
Recycling rate (%)	56.8	65.6	62.9	61.6	62.2	62.5	68.3		20.2

During the years 1985-1994, the collection of recovered paper was very low (1300-1800 Ktonnes) but the average annual increase was 4.0%.

In 1994, after a framework for selective collection was signed, a lot of efforts were carried out for providing enough "blue containers" (see Section 12.3.6) for promoting the selective collection of recovered paper across Spain. As a result, the average annual increase in the collection of recovered paper was 10% during the period 1994-2000, reaching 3318 Ktonnes collected in 2000.

After 2000, the collection of recovered paper initially remained nearly constant, e.g. 3643 Ktonnes collected in 2003 versus 3619 Ktonnes in 2002 and 3496 Ktonnes in 2001, although the paper consumption increased significantly. The result was a decrease in the collection rate of paper: 54.6% in 2001, 52.0% in 2002 and 50.5% in 2003.

[771] Sources: ASPAPEL (quoted in Miranda and Blanco), e-mail correspondence of Lucas Gonzalez (REPACAR) of 07 July 2008 and e-mail correspondence by Angeles Blanco of 23 July 2008.

In order to reverse this situation, ASPAPEL launched the initiative "Your paper/role is important" in 2003 – see Section 12.10.2.

Following significant increases in collection after 2004, the total increase in collection between 2000 and 2006 reached approximately 40%. Total consumption increased by the same rate during that period, which suggests that the Spanish industry has completely absorbed the increases in recovery rates.

From 2000 to 2007, the collection *rate* has increased by 20%, reaching a 63.7%. This value now exceeds the CEPI average (63.6%). The recycling rate has also increased by a 20%. The recycling rate, 68.3% in 2006, is also higher than the CEPI average (56.3%).

The utilisation rate has remained almost constant in the last years, at around 81%. In 2006, a significant increase has been observed, reaching an 85%. This value is the highest of the CEPI countries (with an average of 47.8% in 2006) and one of the highest at world-wide level.

This increase is the result of an important increase in the production capacity of the paper industry (nearly a 25% during the period 2005-2007) and the fact that the new lines are based on 100% recovered paper as raw material.

The demand for recovered paper is so high that, in 2007, net imports of recovered paper from other European countries (mainly Portugal, France and Germany) reached 708 Ktonnes[772].

At the same time, exports of recovered paper have increased from around 100,000 tonnes per year in the period 2000-2003, to 400,000-500,000 tonnes per year during 2005-2006. The reason of this behaviour is the strong demand for recovered paper by the Far East countries, especially China. As a consequence of the increase in the exports of recovered paper, imports of recovered paper have also increased. The imports, mainly coming from other European countries, compensate the lost raw material for the paper recycling industry due to the exports.

According to Blanco, there are no significant differences in grade between imported and exported recovered paper. It is difficult to understand that a country simultaneously imports and exports a homogeneous product. Blanco explains this phenomenon by referring to strategic behaviour by Spanish paper mills, who import recovered paper in order to affect the bargaining position of Spanish recovered paper merchants.

12.10.2. ASPAPEL initiative "Tu Papel Es Importante"[773]

The programme "Tu Papel Es Importante", launched by ASPAPEL in 2003, had as objective to increase the collection of recovered paper in Spain.

The programme has been developed in three different stages.

First, in 2003, a detailed diagnostic of the situation of the recovery of paper and board and Spain was carried out. The main conclusions were:

- In the industrial channel, the recovery ratio was already high (> 90%). The only recovered paper not collected was coming from small industrial parks and from the graphic papers of their offices. As a consequence of the already high recovery of paper collected from industrial channel, ASPAPEL estimated that no specific actions were required.
- In the municipal channel, the recovery ratio was rather low (42.4%). The following possible causes of the low recovery of paper in the municipal channel were identified:

[772] Corresponding to a 13.6% of the recovered paper utilised in the paper industry.

[773] Literally, "Your paper/role is important".

a) The number of blue containers was still relatively low and more containers were thought to be needed, especially in big cities. Due to a lack of maintenance, the containers had also deteriorated.
b) There was an important quantity of board from small shops not collected or collected with the municipal solid waste due to a low implementation of "door-to-door" collection systems for small shops.
c) Office recovery rates were still low. Amongst the reasons mentioned were the difficult coordination with the collection services. The role of municipalities was considered to be key because of the possibility of establishing mandatory collection of recovered paper in office buildings.
d) The landfilling taxes were still relatively low providing little incentives for selective collection as an alternative to landfilling (see Section 12.3.4).
e) Environmental consciousness campaigns are key for improving the situation, but are not enough.

Second, in 2004, some pilot experiences were carried out for determining the most suitable collection systems for improving the recovery of paper. As result, four technical manuals were edited, suggesting how to implement different collection schemes in different locations. The following technical manuals were edited:

- Improvement of the collection in blue containers (2004).
- How to recycle paper in the office (2005).
- "Door-to-door" collection systems for the board of the small shops (2005).
- Implementation of "door-to-door" systems for households (2005).

Third, in 2005, the "Big Cities Framework" was launched, focusing on the improvement of the recovery of paper in the biggest cities on the country (more than 150,000 inhabitants), where the potential for increasing the recovery of paper is higher – see Section 12.10.5.

According to Miranda and Blanco, "Tu Papel Es Importante" programme has reversed completely the tendency of the first years of '00[774]. This programme has been awarded with the First Annual European Paper Recycling Award promoted by the European Recovered Paper Council (ERPC) in the category "with communities"[775].

12.10.3. Sources of recovered paper

According to the estimations of the Spanish Recovered Paper Association (REPACAR), the importance of each source of recovered paper in Spain in 2006 was: 55% trade & industry, 17% printing and converting, 18% households and 10% offices.

The share of recovered paper from household collection is still very low compared to other European countries. To put this in perspective, according to CEPI, roughly 50% of the collected volumes in Europe come from trade and industry, 40% from household and 10% from offices[776].

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[774] This claim is consistent with the figures discussed in Section 12.10.1 .

.[775] http://www.paperrecovery.org/award/erpc_award.asp

[776] CEPI (2006), Special recycling 2005 Statistics.

According to the 2003 study by ASPAPEL[777], in 2001, for a total consumption of paper and board of 6,275 Ktonnes, the total recoverable paper and board was estimated in 4,799 Ktonnes (76.5% of the total consumption). According to this study, the differences between consumption of paper and recoverable paper correspond to:

- Non-recoverable or non-recyclable products such as tissue paper, special products such as smoke paper, etc. (equivalent to 876 Ktonnes, a 14% of the apparent consumption of paper).
- Residues from the converting and finishing of paper (511 Ktonnes, an 8.1% of the consumption of paper).
- The net trade of packaged products in terms of packaging weight (89 Ktonnes, equivalent to 1.4% of the consumption of paper). Although there is a significant importation of electric and electronic equipments, the weight of the packaging of the exports of fruits and vegetables is higher.

12.10.4. Collection systems

12.10.4.1. Recovered paper with industrial origin (pre- and post-consumer)

The origin of pre-consumer recovered paper is in the graphic, converting and finishing industries. It mainly consists in converting residues such as shavings and cuttings and over-issues of newspapers and magazines. The origin of the post-consumer recovered paper is in the locations where unwrapping occurs (supermarkets, shopping centres, etc.).

For at least 50 years, there has been a single collection system for both categories of recovered paper: “pick-up” systems traditionally organized via the recovered paper dealers using containers at individual points of generation.

Miranda and Blanco refer to the existence of initiatives for a further improvement of these collection systems, e.g. the technical manual edited by the National Association of Corrugated Cardboards’ Manufacturers (AFCO).

12.10.4.2. Recovered paper from small business and catering

In Spain, the board from small business is collected mainly with the municipal solid waste and with the “drop-off” blue containers.

One of the objectives of “Tu Papel Es Importante” has been the implementation of specific collection systems for this type of commercial board as complementary systems to the traditional “drop-off” blue containers.

This system is starting at present in some big cities. The board from small business is located at certain hours in the pavement for collection by municipal operators. The introduction of such systems is preceded by an information campaign.

Miranda and Blanco claim that with this type of collection systems the quality of the recovered paper is better: because of the separation at source, the amounts of board refused are lower and the overflowing of the blue containers is avoided.

12.10.4.3. Recovered paper from households

In Spain, the most practised collection system for households is based on the “drop-off” blue containers. In fact, in 2005, an 89.5% of the recovered paper from households was collected in blue containers or recycling centres (although recycling centres are only in a low proportion). Only a 10.5% of this recovered paper was collected by kerbside.

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[777] As referenced in Miranda and Blanco.

As already mentioned in Section 12.6, the extra cost for the selective collection of paper and cardboard packaging waste is carried by Ecoembes. For non-packaging paper waste, the municipalities are paid according to the market value of the recovered products. The quality of the paper is assessed according to the European standards for recovered paper quality (Barlaz et al 2002).

There are new initiatives starting at present for the improvement of the collection system of blue containers as the basic collection mode for recovered paper in the frame of the ASPAPEL programme "Tu Papel Es Importante".

a) "Drop-off" blue container

In 2006, the total number of blue containers was 116,500, which means a ratio of 1 container per 360 inhabitants. Paper recovered collected by this system was 934,062 tons, equivalent to 21 kg per capita per year. There are different collection systems depending on the container type:

- The "igloo" type of 3 m³ is the most common (102,500 units)[778], covering a 76.3% of the population. It is collected by trucks with hooked lifters and upper loading;
- The second more important are the side loading containers (10,500 units) covering a 19.6% of the population. The use of this system is growing, especially in big cities, due to its lower collection costs;
- In third place, the containers for rear loading (3,500 units), covering a 2.7% of the population and usually used in small municipalities.

There are also buried containers, used for aesthetic reasons in the historical centres of some cities, collected by hooked lifters trucks. These only cover the needs of 0.6% population.

b) "Pick-up" systems

Apart from the basic "drop-off" containers, a 0.8% population has access to kerbside systems for the collection of recovered paper from household.

Some initiatives are starting at present.

For example, Oviedo has implemented a "door-to-door" collection for multimaterials, based on bags, not only for recovered paper but also for glass and light packaging. In this city, the recovered paper and the light packaging are collected 3 times per week. One year after the implementation of the system, a 77% increase in the collection of paper and board was obtained, a 241% for light packaging and a 119% for glass.

Another initiative, in the frame of "Tu Papel Es Importante" is the "door-to-door" collection from household by the installation of "eco-litter bins" of board installed in the entrance hall of the buildings. These "eco-litter bins" are used with bags that are emptied regularly and collected by municipal operators with vans or small tracks.

Pilot experiences of this system, e.g. Tres Cantos (Madrid), have increased the amount of recovered paper collected in a 30%. This system is only complementary to the basic "drop-off" system based on blue containers.

c) Recovered paper collected in container parks and others

The main disadvantages of container parks are the limited opening hours and the distance from the household where the used paper is generated. However, Miranda and Blanco point out that the possibility to dispose difficult materials such as paints, varnishes, used batteries, or motor oils can compensate for this disadvantage.

[778] Miranda and Blanco point out that in other European countries, large multicompartment containers above 5 m3 are frequently used.

The collection at schools, sport clubs, churches, etc. and other locations where high volume of paper is generated is also possible. Although the recovered paper collected by these centres is usually of low quantity, Miranda and Blanco think that the school collection promotes the environmental consciousness of the children.

12.10.4.4. Recovered paper from offices and administration

The recovery of paper from this source is still low.

The use of "eco-litter bins" in the same way as those used in "door-to-door" collection system for households is now being promoted. Paper collected in these "eco-litter" bins is stored before being collected by a recovered paper dealer. Depending on the volume of recovered paper generated, the storage can be very simple (cages or bins with wheels) or more complex, , with bigger containers similar to those for industrial collection of recovered paper (with or without compaction systems).

ASPAPEL, in the frame of "Tu Papel Es Importante" programme has also published a technical manual for the implementation of these types of collection systems in the office.

12.10.5. ASPAPEL Big Cities Framework Programme (2005-2008)

The objective of this programme was the evaluation of the collection systems of recovered paper in the 130 biggest municipalities in Spain (more than 150,000 inhabitants) and the development of individual improvement plans. It also offered support for the implementation of these plans by ASPAPEL and Ecoembes.

The improvement plans are focused on two different areas:

- The improvement of the basic "drop-off" system based on blue containers, and
- The establishment of other municipal complementary collection systems e.g. in small shops, schools, offices, etc.

a) Improvement of the traditional "drop-off" system

The implementation of the selective collection of recovered paper already covers 96% of the population. Therefore, it was thought more important to increase the amounts collected in the places in which selective collection is implanted, rather than to increase the coverage. This is carried out by: a higher number[779] and better location[780] of the blue containers and a better service (collection frequency, state of the containers and the surroundings).

We should specifically mention here the use of the GIS methodology to optimize the location of the "blue containers" in terms of number of persons using the container and distances to walk to the closest container.

b) Establishment of "door-to-door" collection systems of the board of small shops

The main problems associated with the board of small business are:

- Blue containers are not designed for the board from small shops.
- Packaging material lying next to the container is not collected, leading to dirty streets and a poor image of the blue container.

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[779] 7,500 new containers will be installed during 2006-09.

[780] By geographic information systems, GIS.

- The containers are filled with packaging of low density compared to recovered paper from households.

The advantages of implementing "door-to-door" collection are:

- Board is collected where it is more generated.
- Complementary collection to the blue container.
- Significant improvement of the cleaning of the streets and decrease of the associated costs for the cleaning of the streets.
- Relocation of the blue containers.

The most advanced methodology for the analysis and implementation of these types of collection systems is also based on GIS. For example, the design of the collection system in Leganes (Madrid) is based on:

- A survey was carried out for determining the interest of the merchants in the collection system (and their preference for the collection hours) and to determine the inventory of board generated (type of commerce and the board generated in terms of number of boxes and frequency).
- The geographic location of the businesses and their generation volumes were introduced into the GIS. This task allows the identification of the commercial areas with a higher density of businesses and the potential streets for the establishment of the optimal collection route.

12.10.6. Sorting

Despite the new technological developments, manual sorting is still the most important in Spain. The combination of manual and automatic sorting or the fully automatic sorting is starting in some new installations.

One of the most modern sorting plant, very close to automatic sorting of paper, is the plant of Carpa (owned by Holmen Paper) located in Fuenlabrada (Madrid). It was inaugurated by the end of 2007 with the aim of sorting the recovered paper coming from selective collection ("blue containers") to produce deinking grades. The investment of this plant is 8 M€ and its capacity of treatment is 200,000 tons/years. This installation is based mainly on mechanical screening but new optical technologies have been incorporated (Vis/IR).

The major companies in recovered paper collection and sorting are owned by the biggest paper and board producers as shown in Table 110.

Table 110 Volume of recovered paper collected by companies in 2006

RP dealers	Recovered paper collected (tons)
Grupo Saica Recuperación	2,100,000
CARPA	450,000 (+200,000 in 2008)
MAREPA	380,000
VILAR VITA	200,000
S. Solis	160,000
Irmasol	160,000
Reciclajes Dolaf	100,000

12.10.7. Prices[781]

Statistics on prices for recovered paper in Spain are drafted according to two standards of the Spanish standardization organization AENOR:

- AE 0007:20002: Requirements of the System for the Monitoring and Aggregation of the Prices of Recovered Paper
- AENOR Regulation for the Certification of the Service of Monitoring and Aggregation of Prices of Recovered Paper

This registration of prices should not include the transportation costs. Material will be considered once cleaned, classified and baled according to the norm UNE-EN 643.

Prices for recovered paper are available on the websites of REPACAR and ASPAPEL.

12.11. SOME GENERAL ASSESSMENTS

According to Barlaz et al (2002), the crucial factor in explaining Spanish recycling rates is the lack of public participation. This can be explained in large part by the fact that an important part of the Spanish population live in multi-family dwellings and share waste containers (which, in turns, makes it difficult to introduce use-based charges). The introduction of kerbside collection systems would require significant changes in existing infrastructure.

In their 2002 report, Barlaz et el recommended, inter alia:

- Increase participation through citizen awareness and information campaigns
- Make the results of R&D efforts easily available to the public and decision makers
- Publicize success stories
- Consider kerbside collection in areas not limited by high-density dwellings with limited street space
- Provide collection bins to aid with the in-home separation of recyclables
- Allow participation of waste management companies in the design of new infrastructure
- Introduce a landfill ban on recyclable paper
- Combine voluntary agreements and government procurement

In a personal communication, Zigor Garcia of IHOBE has emphasized the importance of recycling targets such as the landfill diversion target of biodegradable municipal waste in the Landfill Directive. Green public procurement could also have an impact in recycling.

With respect to collection systems, Zigor Garcia thinks that there is already a good network of containers for the separate collection of glass, paper, and packaging. There are also collection points for other waste. Food waste collection has yet room to improve. Waste similar as household waste from companies, offices, shops and so on has still some potential for improvement. Trucks with separate space for 2, 3 or 4 kinds of waste (for instance, paper, packaging, glass and food waste) could allow collection costs and nuisance to go down in not very densely populated areas, and would increase the efficiency of selective collection.

According to the paper recovery organisation REPACAR, the following policy reforms would have the highest positive impact on separate collection[782]:

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[781] ASPAPEL data supplied by Margarita Riuz Sainz-At of the Spanish Ministry of the Environment

- Supporting sensitisation campaigns.
- An increase in the number of paper and board containers available for citizens.
- School education on the importance of waste separation at the source.

[782] E-mail by Cristina Afán of REPACAR on 04 June 2008.

13. ANALYSIS AND POLICY CONCLUSIONS

13.1. INTRODUCTION

The spontaneous attitude with respect to waste in modern developed countries is to consider it as an undesirable side-product of our consumption. In this respect, it is hardly surprising that the pre-dominant attitude with respect to waste management is to find ways to get rid of waste in such a way that this minimizes, or at least reduces, the harmful side-effects of disposal. Relatively limited thought is being given to finding valuable applications for recycled waste instead.

However, waste could also be considered in the first place as just another raw natural resource that needs some further processing before it can be made suitable for human use (in consumption or in production processes). In such an approach, waste collection and processing is regarded as an industry producing valuable products. Of course, this does not imply that we should downplay the environmental hazards, but rather that we should recognize that environmental hazards are present in almost all industrial processes, and that they are not specific to waste.

Actually, in some circumstances, a vibrant market in recycled products can be observed – just think of recycled paper where recycling rates of up to 86% can be achieved. However, other extremes exist as well. For instance, in the United Kingdom, less than 3% of portable batteries are collected for recycling.

This quite naturally raises the question under what conditions a market in recycled products will develop.

Economic theory tells us that, in a market without government intervention, recycling will take place up to the point where the price of the recycled product equals the cost of producing an additional recycled product – in economic jargon, up to the point where price equals marginal cost.

This implies that recycling will increase whenever:

- The price customers are willing to pay for a recycled product increases – this is, whenever demand increases.
- The cost of producing additional units of recycled products decreases – this is, whenever supply increases.

Although this framework is very simple, it provides a useful starting point to understand why actual recycling rates are not always as high as they could, or should, be and to understand why they vary over time and space.

Whenever actual market outcomes differ from the market outcomes that would lead to the highest benefits for society as a whole, it is said that market failures occur.

In the case of waste recycling, market failures occur both at the demand and the supply side. Section 2.2 and 2.3 of this report provide, respectively, an overview of market failures in general and of market failures in resource use. Let us briefly summarize the main points here.

At the demand side we find market failures in recycling occur mainly for the following reasons:

- Collected waste is often contaminated by other waste streams. Whenever it is difficult for a buyer to verify the quality of the recycled product, demand will be lower than for a primary product.

- If the buyers of recycled products have some market power, they use that power to push down prices (which restricts volumes recycled).

At the supply side, the following market failures in recycling occur:

- The producers of primary products do not design products with their eventual "recyclability" in mind. Therefore, it is often expensive to prepare waste for recycling. If this is the case, a "technological externality" is said to occur.

- If collection or recycling firms have some market power, they push up prices for the recycled products (which restricts volumes recycled).

Finally, due to transaction and search costs[783], demand and supply will not always be "matched" in their most valuable application.

However, the most obvious market failures in the field of waste management are related to the environmental impacts of the alternatives to recycling (illegal dumping, landfilling and incineration): health impacts from air pollution, landfill leaching, exposure to hazardous substances, disamenity effects, methane emissions from landfills, litter, pests, excessive use of virgin materials etc (see Section 2.3 for more details).

As these costs are in general not internalised[784], the costs of the alternative treatment or disposal methods are too low compared to the cost of recycling. Or, in other words, the costs of recycling are too high compared to the cost of the alternatives. This implies that any measure that better internalises the environmental effects of the alternatives to recycling will lead to higher recycling rates as well.

This brings us to the purpose of this study: on the one hand, *understanding how dealing with the market imperfections in recycling markets can help overcome the lack of internalisation of the environmental side-effects of the alternatives*, and, on the other hand, *understanding how a better internalisation of the environmental side-effects of the alternative can improve the market prospects of recycled products*.

We have therefore, for 4 waste streams and 6 countries, examined both the demand and the supply side of the recycling market.

We have found that, when analysing the supply side, it is useful to distinguish between the collection and the recycling phases. In its essence, waste collection is a transport service characterised by economies of density (see in Section 13.2 for a definition), and it faces very specific issues of market organisation - one way to deal with these issues could be to have collection being organised by the government (which does not imply that the government should finance collection or should take care of day-to-day operations).

For each waste stream, the following questions need to be asked:

- Does the price of the recycled product cover the costs of collection and recycling? In this case, a market will often develop without government intervention.

- Does the price of the recycled products cover the cost of recycling, even if it does not cover the cost of collection? In this case, a market will develop if the government carries the burden of collection, if it *imposes* the collection on private actors[785] or if it finds other ways to reduce the

[783] These are the costs related to price deocvery, administrative costs, negotiation and bargaining costs.

[784] This is, they are not borne by those who cause them, but by society at large.

[785] This is essentially what Extended Producer Responsibility requires – see Section 2.3.

burden of collection – this could be justifiable if market failures occur in the collection phase that the government can solve.

In both cases, tackling the other market failures could help (1) create a market where there is none (2) further develop the market where there already is one. This applies both to the market failures in the recycling market and those related to imperfect internalisation of environmental externalities. Thus, market failures can explain why it could be optimal to have recycling, even if the price of the recycled product does not cover the operational costs of recycling. In these cases, there is a need for active policy intervention.

In some countries and for some waste streams, the value of the recycled product will always be lower than the cost of collection and recycling, even if all market failures have been solved. In these cases, the optimal solution from the point of view of society is that no recycling takes place.

Throughout what follows, the reader should always keep in mind that the answer to the questions listed above depends on a lot of factors that cannot directly be influenced by policy makers:

- The existence of competing primary products puts an upper bound on the price that can be asked for a recycled product. Therefore, the following questions need to be addressed: What are the primary products the recycled products will be competing with? Are recycled and primary products close substitutes? What factors influence these substitution possibilities?

- The costs of collection depend on the cost of labour, but also on energy prices. As has clearly been exemplified in the recent past, the latter can fluctuate a lot, even in the short term. Such price changes also affect the price of the competing primary products, but possibly in different ways.

- Sometimes, recycling requires investment that cannot be recovered if the recycling activity is stopped. It is then said that the investment is "sunk". In this case there can be an important difference between the optimal ex ante decision (this is, the decision before the costs are sunk) and the optimal ex post decision (this is, after the costs have been sunk). In other words, once a given recycling technology has been put in place, it may be optimal to keep it, even if it would not stand a cost-benefit analysis to acquire one. This implies that optimal waste policies can be path-dependent.

It follows from this that the optimal approach to recycling can vary substantially through time and space – this study contains several examples of waste streams where the profitability of recycling has fluctuated substantially in the last decade.

An additional constraint in the actual design of policies is that much of the information listed above is not currently available, particularly on future prices. In Task 1 of this project, we have set out to identify the ten markets which offered the greatest potential for environmental and economic benefits thanks to an improved market operation. A rough assessment has been made, based upon the information that is publicly available in the EU, but we have to acknowledge that a lot of information is fragmentary, outdated, inconsistent across countries or simply missing. Even the information we have identified for our detailed case studies suffers from these flaws.

Therefore, our objective has been to seek policy conclusions that are robust to changes in factors outside the influence of policy makers, and to avoid recommending policies that are dependent upon the existence of information that is currently not being collected.

This Chapter provides a summary of lessons learned from this study. First, we have a look at those aspects of waste collection that are common to all waste streams under consideration. Next, we tackle the individual waste streams considered in this study. Finally, we provide a general conclusion and some tentative policy conclusions.

13.2. ORGANISATION OF COLLECTION

We refer to the literature survey of Sections 2.4, 2.5 and 2.6 for the state of the art on collection to which this Section is a complement. Let us just briefly summarize the main findings here.

The organisation of collection makes a great difference to the economics facing collectors. If those economics are not favourable, less selective collection will take place – or it will take place at greater expense to whoever is paying.

13.2.1. The organisation of municipal waste management

As explained in detail in Section 2.4, waste collection for residences and small enterprises is generally characterised by economies of density: the average costs of waste collection decrease as the volume of waste collected from a fixed length of network increases. If this is the case, competition in the market is not naturally sustainable. In general, this issue does not arise in the provision of collection services to large waste producers. However, selective collection of recyclable material exacerbates this problem.

If competition in the market is not the optimal approach, in-house collection services by the public authorities could be a solution. Alternatively, the collection could be left in the hands of the private sector, but regulated by the public authorities. The two fundamental options are then to either negotiate a contract with a private waste operator or to create "competition for the market" through competitive tendering. An important advantage of privatisation is that, due to the homogeneity of waste management services, experiences acquired in other markets (e.g. other regions) can quite easily be transposed to new situations. Therefore, multinational companies can play an important role in the diffusion of innovative approaches to waste collection.

It has been argued that the management of municipal waste management is a candidate for regulation at the local level because the public good issues (e.g., public hygiene concerns) only arise at the local level, there are minor (if any) spillover effects with neighbouring regions and the efficient scale of solid waste collection firms is no larger than small municipalities (OECD 2000).

This argument however overlooks one specific point: it is not sure that the necessary competences and resources exist at the local level.

In the cases of Poland and Estonia, several elements suggest that this problem significantly contributes to the relatively low performance of the waste management system.

Privatisation of municipal waste management is not necessarily a solution to this specific problem: a privatised system requires high quality supervision.

Indeed, if the market is allocated periodically, writing service specifications requires a high level of technical expertise. Two specific problems arise:

- If the market is allocated as the result of negotiations, the problem of writing sound specifications will be compounded if the private firm is a large multinational with ample experience in negotiating this type of contract.
- If the market is tendered, prevention of collusion is a central concern and also requires a high level of competence.

It can even be argued that managing a contract with private companies requires even more planning skills from the authority than organising services in house. Indeed, with in house services, there is less need for contingency planning: if waste management is governed by a hierarchical relation, it is easier to modify task contents following changed external circumstances than if waste management is governed by an external contract. It may well be that the costs linked to the management of the contract outweigh the benefits of competition.

In practice, most European countries choose one of the options described above and do not allow competition in the market for municipal waste collection – Poland is one notable exception.

If the market is left free, then the municipal authorities still need to supervise whether all individual households are indeed served by a waste collection service and whether these collection services comply with the relevant regulations. The costs linked to supervision and enforcement may well exceed the capabilities of a local authority (see Section 11.3.3).

The following policy options could be considered:

- Centralising waste management at the next higher level of government (provinces for instance). It can be expected that such a move would meet fierce opposition from the local authorities. Moreover, a higher level of government may be less informed of the specific local needs and may be less responsive to these needs.
- Creating voluntary associations of municipalities and pooling their resources. This solution is used in several countries[786]. It allows for economies of scale to be realised whilst also preserving the autonomy of local authorities.
- Creating national knowledge centres on municipal waste management who could assist municipalities in some of their tasks. For instance, the knowledge centres could create a common methodology for drafting waste management contracts, and leave it to the local authorities to adapt these contracts to their local circumstances. The systematic exchange of good practices would also be helpful.

13.2.2. The organisation of PROs

As explained in Section 2.3, extended producer responsibility (EPR) imposes accountability over the life cycle of products and packaging introduced on the market. This means that firms, which manufacture, import and/or sell products and packaging, are required to be financially or physically responsible for such products after their useful life. They must either take back spent products and manage them through reuse, recycling or in energy production, or delegate this responsibility to a third party, a so-called producer responsibility organization (PRO), which is paid by the producer for spent-product management. In this way, EPR shifts responsibility for waste from government to private industry, obliging producers, importers and/or sellers to internalise waste management costs in their product prices, leading to better allocation of resources in society.

We have found a wide diversity of practices in the organisation of PRO, not only across countries but also across waste streams within one country.

In this Section, we will limit ourselves to the discussion of points that are not specific to one waste stream, and that have not already been discussed elsewhere – we refer to Section 2.6 for a generic discussion of the issues raised by the organisation of PROs.

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[786] A recent overview is given in a recent (2004) study by DEXIA, "Local public companies in the 25 countries of the European Union".

A central question we would like to see answered is: what is the relative efficiency of the PRO systems we have investigated and how can the differences be attributed to differences in the design of the systems? The answer, unfortunately, is that with the data at hand, relatively little can be said. The cost and collection data of the recovery organisations are not sufficient to compare systems: one would have to look at *all* relevant costs, including those borne by the local authorities, those borne by the households, those of recovery organisations that are not covered by a collective system and of course all external costs. It is not surprising that no data on this issue are in the open domain if we take into account the following factors:

- For some waste streams, competing systems exist. If this is the case, data on costs are sensitive commercial information.
- One of the main points of controversy lies in the distribution of costs between the local authorities, the companies that are required to discharge obligations under producer responsibility and the households. In this case as well, actual costs are strategic information.

Therefore, with the current set of information, we think it would not be acceptable to make any bold claims on whether the higher collection and recycling rates obtained in some countries justify the additional costs linked to the collection system. The fact remains that comparative studies of PROs typically fail to capture all costs relevant to making such a comparison.

One interesting idea to pursue, however, would be to create a confidential European benchmarking system with a standardized reporting methodology that would allow countries to compare the efficiency of their PROs with those of other countries. This system would of course have to be managed by an organisation that has no private interest in any of the collection systems involved and that would subject to stringent confidentiality clauses. Even here, different systems could claim to be more or less efficient depending upon the costs of disposal which are being avoided in a given situation. This would allow PROs and regulators to compare structures and improve the efficiency of arrangements.

In our sample of case studies, Poland clearly stood out as an outlier in the functioning of its recovery organisations, for two reasons: the extraordinary high number of PROs operating in parallel and the possibility to create PROs as for-profit companies[787].

Let us have a look at these issues.

13.2.2.1. The number of PROs

A high number of recovery organisations does not necessarily imply that recovery is technically inefficient. For instance, it could be that the recovery organisations operate in different geographical or technical segments of the market. Moreover, in areas dominated by apartment blocks with bring systems[788], economies of density are lower than with house-to-house collection.

As explained in Section 2.4.1, one would expect selective collection to increase the relative importance of economies of density. Moreover, if economies of density or scale are important and if capital markets function well, mergers will take place in order to share fixed costs. The fact that this consolidation of the market does not take place suggests that, in the specific case of Poland, economies of scope and scale are limited.

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[787] This possibility also exists in the UK.

[788] This refers to systems where the waste holder brings his waste to some collection point.

However, it is true that the number of organisations in a given area does impact on the total costs of supervision for the government. Moreover, there is some circularity in this problem. Indeed, lack of supervision reduces the costs of waste management companies. Therefore, more companies will be able to operate under a regime of lax supervision than under a regime of strict supervision, and this will exacerbate the supervision problems.

One way to break this vicious circle could be to determine the maximum number of recovery organisations per municipality (or per province, if there are economies of scale) and to auction the right to operate.

This would raise the interesting question as to what this number might be. Furthermore, there is a degree of 'path dependence' to the issue. Existing players in the market might need to be compensated if assets became stranded as a result of a reduction in the number of market players, making such an approach less attractive to public authorities.

13.2.2.2. The legal status of the PRO

Concerning the second point, we should keep in mind that the fundamental objective of an EPR system is always to bring producers to do something that they would not otherwise do: collecting and recovering waste products in a way that they would not choose in an unregulated situation (or to finance this activity where they themselves do not carry out the activity).

Therefore, we would expect PROs to try to circumvent their obligations in whatever way is available and whatever their legal form. In the case of for-profit companies, the benefit would be obvious. Illegal disposal combined with fraudulent declarations allows companies to cut costs, and thus to reduce membership fees in order to obtain new member companies and to increase profits.

However, the incentives facing a not-for-profit organisation are not that fundamentally different. Indeed, cost cutting through illegal disposal probably requires less managerial effort than cost cutting through more efficient management, and is thus always in the interest of the PRO's manager, whatever its legal form. Moreover, unless the PRO has a legal monopoly, increasing membership also brings benefits to the managers of the organisation, as more money would be available for managerial perks[789].

Hence, we do not think that the for-profit nature of the PRO is fundamental.

The real issue is that PROs can only be expected to act in the public interest if they are properly supervised. At the minimum, this would require independent auditing of the collection and recovery figures. If fraud is detected, it is also essential that the PRO can be held liable for this. Thus, minimal capital requirements would be essential – it should be noted that this is precisely the direction in which Polish regulations are moving (see Section 11.5.5). It is also possible to require directors to put a deposit on a blocked bank account or to require representatives of the regulating authority to attend without voting rights meetings of the board of directors of the PRO – these approaches are for instance used in Flanders (see Section 7.6.1.6). Creating one single regulator supervising PROs could contribute to the building up of expertise on the government's side.

Another, arguably more justified, concern could be that the lure of profit would lead to the establishment of a PRO with the only aim to collect membership fees from participating companies. But, again, if proper supervision is put in place, the authorities will find out that the companies in such a system do not reach the imposed targets. Such schemes could thus never be long lived. Requiring deposits from the directors limit the risks of a "take the money and run" strategy.

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[789] Notwithstanding its not-for-profit status, DSD has for instance been the object of anti-trust procedures.

13.2.3. The selective collection of waste from SMEs

We have repeatedly pointed to problems with the selective collection of waste from SMEs.

In order to understand this, one needs to keep in mind that, with respect to economies of density, SMEs take an intermediate position between households and large industrial waste producers (see Section 2.4.1). This leads to a lack of competition in this market and puts SMEs in a weak bargaining position with professional waste management companies, certainly for those market segments for which they do not have the fall-back option of municipal waste services. The price SMEs pay for waste disposal will thus be higher than what they would pay in a competitive market, which increases the benefits of illegal disposal. All other things being equal, this also implies that the price they will receive for sorted waste will be lower. This reduces the incentives for sorting waste at the source.

Another issue is that, for SMEs, the private benefits of improved waste management are often small (or at least perceived to be small). However, understanding legislation and searching for interesting disposal options imposes costs that are not necessarily smaller than for large companies.

At the other side of the market, for waste collectors, identifying SMEs with collection needs is less lucrative than securing contracts with large retailers.

Although the specific needs of SMEs are mentioned several times in this study as an area for concern[790], the study has not revealed many specific suggestions for improvement from stakeholders or examples of successful policies.

Suppose for instance that sorting at the source would be *imposed* on SMEs. If relatively high economies of density exist, this could lead to local monopolies in unregulated commercial waste services. Moreover, monitoring and enforcement could be difficult.

Developing shared collection in industrial or commercial zones could reduce the abuse of market power by the waste collectors but can create problems with respect to the monitoring of the waste that is brought to the collective collection points.

Paying subsidies for sorted waste could be a preferable option – this is basically the approach taken in Flanders for industrial packaging waste (see Section 7.6.3). This would not have negative effects on competition and would reduce the incentives for non-compliance.

Providing SMEs with market information could also put them in a better bargaining position.

13.3. PVC

Probably the most striking finding in our analysis of PVC is how little governmental action is undertaken to monitor what is going on in this waste stream. None of the countries covered in our case studies collects systematically specific data on waste arising. In the light of the controversies that have surrounded this material, this was very surprising indeed.

Therefore, with the exceptions of the UK and France, almost all information on this issue was obtained from European trade associations.

[790] In the case of France, for instance, SMEs were an area of focus for the 2004 National Action Plan for Waste Prevention (see Section 9.3.4). Information and awareness campaigns targeted at SMEs were part of the priority measures proposed by the "Grenelle Environnement" (see Section 9.11).

Let us first note that all sources agreed that post-industrial PVC waste does not really raise any fundamental issues: as it is uncontaminated, it is an almost perfect substitute for virgin PVC and recyclers are willing to pay high price. It is moreover very easy to collect this waste, as it arises at the production sit itself. The combination of high demand and cheap supply explains why recycling rates are very high.

The situation is completely different in the case of post-consumer waste where the waste collected often does not meet the required criteria for recycling (absence of contamination by other materials, cleanliness).

According to the industry sources, the technologies to deal with contamination are available but recyclers are reluctant to invest because of the uncertainties that surround the future availability of secondary raw material.

This, in turn, is not due to the low quantities of PVC waste becoming available, but rather to low collection rates (see Section 4.2.1).

Several factors on the supply side explain these low collection rates:

- In many countries, prices for landfilling and incineration remain low. In the UK, a landfill tax exists but it is applied by weight, therefore plastics are often not considered for recycling. Therefore, public policy provides insufficient incentives to divert PVC away from landfilling and incineration.

- Part of the very low collection rates can be explained by the longer than expected life span of PVC products. The long life time also leads to a discrepancy between the needs of the recyclers and the characteristics of the PVC waste that comes available.

- The main issue is however the lack of pre-sorting in the C&D sector[791]. This can be explained by the public good characteristics of selective sorting. Because of increasing returns to scale, all potential investors of PVC technology would gain if they could be assured of the supply of relatively clean and uncontaminated PVC waste. This steady supply however requires creating a system of sorting that companies involved in C&D do not find worthwhile doing with current market prices. If a single recycler would provide incentives to C&D companies for creating a steady supply, all recyclers would gain because this stability has a value in itself. However, as no single recycler can reap all the benefits of increased sorting, supply remains at too low a level if no coordination takes place.

In order to understand why pre-sorting is not taking place on a larger scale, we must however also turn to the demand side for the recycled products: after all, if these prices were higher compared to the cost of pre-sorting, recyclers would be willing to invest and would confront the C&D sector with incentives for better sorting.

The following issues certainly affect the prices of recycled PVC negatively:

- There are important perception problems with respect to the quality of recycled PVC, certainly in dealing with SMEs. There is thus a problem of asymmetric information that needs to be overcome.
- Recycled PVC is subject to strong competition from a wide variety of products, not just from virgin PVC: wood, steel, aluminium, other plastics… This creates downwards pressure on the price that can be obtained.

[791] In the case of WEEE and ELV, the high levels of landfilling and incineration follow more directly from technological constraints.

- Some existing standards prevent the use of recycled materials. For instance, waste bins cannot be made in recycled plastic[792]!

Other possible market failures (market power, lack of price transparency) do not seem to pose major problems[793]. For instance, web based exchanges already exist and prices are quoted in the professional magazines. This suggests that, even if actual market transaction are far from a frictionless ideal, new institutions emerge when a better functioning of the market leads to higher private profits.

If raw material prices increase, the demand for post-consumer PVC waste will also increase, and thus also the incentives for prior sorting on C&D waste. Of course, taking into account the recent economic turmoil, policy should not be based upon the assumption that such an increase will soon take place. However, in the long run, increased demand must inevitably lead to a more rapid depletion of non-renewable resources, and thus accelerated price increases.

However, as the long run can sometimes turn out to be the very long run indeed, there is clearly scope for both demand and supply side measures to improve current PVC recycling rates.

13.3.1. Demand sides measures

On the demand side, the following measures are suggested:

- Public procurement could play an important role, taking into account the importance of government in construction markets. Governments could also help overcome the perception problems by demonstration projects. It is noteworthy that recent initiatives of the Commission go exactly in that direction (see Section 3.7).
- Clear end-of-waste criteria could help develop the market. However, in the draft of the revised Waste Framework Directive that was approved in second reading by the European Parliament, plastics were not mentioned as one of the waste streams for which the definition of end-of-waste criteria should be considered.
- Contractual specifications for materials should be independent from the origin of the material and should be targeted at performance. This is in line with recent initiatives taken by the Commission (see Section 3.7).
- Landfilling and incineration should be further discouraged. Complete bans may be too blunt an instrument (though some countries apply these for PVC). Indeed, in some countries, recycling facilities are underdeveloped and, in the short run, little alternatives are available. The use of economic instruments (taxes, tradable permits) would be a more cost-effective approach. This would still provide the right incentives (including for investments in recycling facilities) but leave some flexibility. As the draft revision of the Waste Framework Directive requires the separate collection of plastics, it would even be possible to differentiate landfill and incineration taxes to take into account the specific externalities of this material.

13.3.2. Supply side measures

Mandatory sorting of C&D waste before demolition would be a, maybe radical, solution to overcome the barriers to higher recycling. However, it would be difficult to monitor whether this sorting really takes place. Moreover, imposing uniform requirements would not be cost-effective. The cost of sorting depends on the initial design of the building, and this is something the demolition company can hardly be held

[792] Information provided during an interview with stakeholders.

[793] which does not mean that they are absent!

accountable for. Thus, uniform requirements would impose widely divergent demolition costs, but without affecting incentives for eco-design.

If the financial incentives for waste collectors were determined by an association of recyclers, this could help overcome the coordination problem we have described above – this is precisely what the PVC industry in Europe is doing (see Section 3.3). The fact that Vinyl2010 and its collection projects have obtained a significant increase in the collected amounts shows that incentives do work. Of course, collected amounts are still extremely low compared to the estimates of the INFU/Prognos study (see Section 4.2.1). Collecting larger quantities would require an increase in the financial incentives provided by Vinyl2010. The fact that the amounts paid are not higher in this stage, could be an indication that (a) further increases do not stand a cost benefit analysis or that (b) the industry initiatives have not been able to overcome all market failures.

As Vinyl 2010 does not bear the externalities linked to PVC landfilling and incineration[794], it is clear that hypothesis (a) must be rejected and that increasing sorting *compared to current levels* will indeed stand a cost-benefit analysis.

Thus, there is still some room for further improvement. One possible approach would be to introduce extended producer responsibility and to transform the voluntary agreement into a PRO. In order to meet its targets, the PRO would have to significantly increase its payments to the C&D sector, which would in turn require much larger contributions from its members.

This approach would certainly offer some advantages. In general, it is easier to verify that a waste stream has indeed been submitted for recycling than to verify whether it has *not* been included in a waste stream that was submitted for landfilling. Therefore, having the PRO subsidizing waste collectors for collecting PVC would be more effective than compulsory sorting – note that this is precisely what VAL-I-PAC is doing for industrial packaging waste in Belgium (see Section 7.6.3).

However, we should ask ourselves whether introducing EPR for a product with such a long time span makes sense. Every EPR scheme is somehow confronted with "orphans"[795]; however in the case of PVC, this would take extreme forms. Industry could rightly question the fairness of such scheme. It is also difficult to imagine how EPR could affect design for recycling: one can barely predict what the needs will be of recyclers in decades from now. Therefore, the incentives provided by the scheme would be very weak. All in all, transferring responsibility to the industry would then just be a way to transfer financial burdens from taxpayers to producers.

In a first best world (see Section 2.2.5), one could also argue that the responsibility of the collective scheme should be limited to overcoming the coordination problem of the industry and that appropriate landfill and incinerations taxes should do the job of internalising externalities.

In practice, there are some constraints on the design of such instruments. Besides the obvious difficulties linked to raising taxes in general, one should keep in mind that the landfill or incineration tax will never be targeted at the specific externalities linked to PVC, even if plastics in general are collected seperately: the externalities linked to disposal of PVC and PET are not the same.

Alternatively, one could think of a "mixed" EPR scheme where part of the burden is carried by industry, but where the scheme is supported by the public authorities. For instance, governments could contribute

[794] It could however be argued that the threat of coercive regulatory measures does at least partially lead Vinyl2010 to take into account the external costs of disposal – after all, it was this threat that lead to its creation in the first place.

[795] Products put on the market by firms that have by now ceased operations.

to every EUR paid to the waste collectors. Such a scheme would be relatively easy to monitor and could be tailor made for the waste stream under consideration.

Finally, besides overcoming the coordination problems discussed above, Vinyl 2010 and Recovinyl also play an active role in dealing with other markets failures. For instance, they help reducing transaction costs (identification of collection points, recovery and recycling facilities; organisation of independent auditing) and spreading innovation (funding and coordination of R&D, dissemination of best practices, guidelines for sorting etc). The latter point shows that government funding for R&D can also be complemented by support from the industry.

13.3.3. Other issues

A final, but according to the industry vital, issue is the relation with the REACH regulation. If recycled PVC is treated according to the same rules as virgin PVC, this will lead to significant costs increases for recyclers. Even if one does not believe the concrete cost figures put forward by the industry (see Section 6.2.1), it is clear that these costs increases will lead to further market consolidation and, all other things being equal, less recycling. There is an important policy trade-off here to be made between, on the one hand, the benefits of recycling and, on the other hand, the external costs linked to additives that were used 30 years ago but that have been banned since. If one thinks that these additives should be put out of circulation at any price, then recycling PVC is probably no longer a viable option. We have no knowledge of independent analysis tackling this issue in depth. However, such studies as do exist appear to suggest that where PVC is concerned, environmental impacts may be greatest in the disposal phase, and that if high quality recycling of PVC takes place, the avoided externalities may be of the order hundreds of Euro per tonne of material diverted from disposal.[796]

Other needs for further action include the gathering of better data. The INFU/Prognos study that we have referred to as major source of information had to cope with important data gaps and inconsistencies. It is difficult to imagine how one could design sensible policy targets or instruments while it is scarcely known what is actually going on.

13.4. BATTERIES

In an economic analysis of battery recycling, it is essential to distinguish the analysis of lead acid batteries from the analysis of the other types.

13.4.1. Lead-acid batteries

The current high prices of lead[797] cover the costs of the selective collection and recycling of lead acid batteries by the private sector. Therefore, one could say that, with current prices, the targets of the Batteries Directive do not “bite” for lead-acid batteries.

An important factor on the supply side is that collection naturally takes place through garages. This saves the expense of a separate collection network.

The only real concern raised with respect to this category is whether recycling takes place using technologies and procedures that do not harm the environment. At least one stakeholder interviewed during the study pointed to the existence of a black market in waste lead batteries as a way to

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[796] AEA (2000) *Economic Evaluation of PVC Waste Management*, Report for the European Commission Environment Directorate, June 2000.

[797] The price for lead has quadrupled since 2003.

circumvent the environmental requirements – unfortunately, the extent of this problem is not known. This stakeholder called therefore for a better enforcement of the relevant regulations on transboundary shipments.

One should however keep in mind that commodity markets can be very volatile - there is no certainty that high collection and recycling rates will last if the price of lead would drop. Taking into account the long time lags that would be needed for policy changes in case this market would become unprofitable, there certainly is no scope for a laissez-faire approach.

One possible approach would be to follow the position that is currently adopted in Belgium:

- Leave the collection of lead acid batteries to the market, but
- Require systematic reporting from the industry and
- Commit to more active intervention should lead prices fall below the threshold where selective collection and recycling is viable.

The main advantage of this approach is that it would leave it up to the market to find the most efficient logistical channels and the most valuable applications of the recycled material, while at the same time monitoring whether these applications do not lead to harmful side-effects.

13.4.2. Portable batteries

In the case of portable batteries, the situation is rather different. The table below shows collection rates for the countries covered in our study.

Table 111: Portable battery collection rates in countries covered by case studies

Group	Country	Most recently available collection rate (+ year)	Producer responsibility	Selective collection
High collection rates (higher than imposed by new Battery Directive)	Flanders (Belgium)	88,5% (2005)	Legal monopoly of PRO since 1996; single collection system allocated by competitive tender	Very strongly developed
	France	30% (2006)	Since 1999; 2 dominant PRO and 14 individual recovery systems; collection contracts negotiated and partitioned geographically	Strongly developed
Medium collection rates	Poland (REBA network only)	16.2% (2007)	Since 2001; 1 dominant recovery organisation and (unknown) multitude of small ones	Developed but important issues of enforcement and monitoring; has not covered retail sector until

				now
	Spain	15%	Is now being implemented	Some local and municipal initiatives
Low collection rates	Estonia	5.7% (2006)	Is now being implemented; 3 PROs	Nothing systematic
	United Kingdom	2-3% (2007)	Nothing at this stage; unclear how they intend to proceed	Pilot projects, including with kerbside collection

This table clearly suggests that the introduction of producer responsibility and the existence of a network for selective collection strongly affect collection rates.

It is important to understand the mechanisms behind this observation - with, according to the most recent industry figures, 164,000 tonnes of portable batteries put on the European market each year, this is indeed a significant issue.

A first point that can be drawn from our case studies is that there is an analogy between battery recycling and PVC recycling.

There are important sunk costs[798] in battery recycling from investments in recycling equipment (see Section 6.3.2). Due to the existence of economies of scale, a minimum supply of used batteries is necessary to maintain the viability of recycling plants and to make investments in new technologies profitable. However, this supply is not materialising because collection costs are too high compared to current prices.

The introduction of producer responsibility is thus essential in overcoming the market failures related to this coordination problem[799].

However, as in the case of PVC, it would be an error to analyse problems on the supply side in isolation of what is going on at the demand side. After all, if demand for the metals recovered from recycled batteries were high enough, battery recyclers would certainly be willing to pay individual households for their waste batteries. Thus, all other things being equal, demand side measures could be useful complements to supply side measures.

In most countries, the current metal prices cover the operational costs of recycling for the following battery types: Nickel Cadmium, Nickel Metal Hydride and Lithium Ion. Thus, for these battery types, imposing selective collection is a necessary but also sufficient condition to create a viable market for recycling. This is economically justified if the external costs linked to incineration and landfilling of these battery types[800] are higher than the cost of selective collection.

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[798] These are costs that cannot be recovered upon exit from the market.

[799] Other measures could include support for R&D.

[800] Essentially, athmospheric emissions of heavy metals from incinerators and leaching into ground water of heavy metals from landfills.

The revenues from sales of zinc and manganese however do not cover the *operational* costs of recycling these battery types. Thus, imposing selective collection does not suffice to make recycling financially viable: explicit and binding recycling objectives are necessary on top of collection targets. This is economically justified if the external costs linked to incineration and landfilling of these battery types are higher than the cost of selective collection *and* of recycling.

Let us now analyse in turn the demand and the supply side of the market to understand where the market could be improved to bring about greater recycling.

13.4.2.1. Imperfections in demand for used portable batteries

Due to economies of scale at the firm level (see Section 2.2.1), the market for batteries for recycling is very concentrated, based on battery type. Indeed, as long as the average cost of recycling batteries decreases as the numbers of batteries recycled in a firm increases, recycling firms will always find it profitable to merge.

This might be expected to allow these plants to then abuse that control – by cutting the price that they offer to battery collectors. Compared to competitive levels, one would expect that battery recyclers will play off waste collectors against each other in order to push prices lower for waste batteries (or in order to extract high payments from waste collectors). This in turn reduces the incentives for collection and the levels of collection.

The main reason why abuse of market power seems to have been limited[801] is that until recently the portable battery recycling capacity was higher than the actual amounts collected. This situation is likely to change as implementation of the revised Battery Directive progresses and higher amounts are collected.

One could argue that market power abuse is a case for competition authorities and that this falls outside the scope of environmental policy.

However, economics teaches us that one of the main sources of market power lies in high transportation costs, which effectively create local monopolies.

In this case, transportation costs are affected by existing provisions on the transportation of waste. The relative unimportance of international movements in waste batteries is at least partially due to the higher transportation costs that follow from restrictions on transborder shipments and from the application of the proximity principle. There is clearly a policy trade-off here. Regulations that have been devised with the protection of the environment in mind can actually lead to lower recycling rates because they restrict the outlets which are readily available to collectors and thereby create local market power. This does not imply that regulatory restrictions on the transportation of waste batteries should be abolished or that batteries should be put on the "green list" for transfrontier shipments. However, it could be worthwhile to re-examine these requirements and to verify whether the same objectives could not be obtained with regulations that do not affect recycling rates negatively.

A second issue has been raised by an interviewed stakeholder: some materials recovered from battery recycling are forbidden in some applications whilst they are allowed in others. This type of discrimination delimits the market. Standardisation of regulations could help create a level playing field.

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[801] Only one stakeholder pointed to this as a specific problem - see Section 6.3.2.

13.4.2.2. Imperfections in supply of used portable batteries

13.4.2.2.1. Hoarding and illegal disposal by the households limits supply of batteries for recycling.

Hoarding and illegal disposal by households are currently the central constraints on the expansion of batteries recycling. Most households either throw away portable batteries into the mixed domestic waste, or keep them around in the house (usually for many years) – 'hoarding'. Either way, the batteries are not available for recycling.

The central issue here are the opportunity costs linked to hoarding; these are the benefits lost for a household because it stores batteries at home. As long as collectors are not willing to pay for waste portable batteries, there is essentially no opportunity cost from hoarding – it is limited to the very small amounts of space taken by these batteries. In other words, there is no reason not to hoard those batteries.

We can make the following observations with respect to the incentives that can be provided to households in order to bring back their batteries:

- For households, the main cost linked to selective collection of waste batteries is the opportunity costs of their time[802]. Therefore, the convenience of the collection system is an essential issue. The collection system should be dense and should use as many channels as possible in order to best meet individual households' specific needs[803]. Of course, there is also a cost to this, and the collection system can become too dense as well. However, with the possible exception of Belgium, there is no indication that this stage has been reached yet in any of the countries covered in our case studies.
- Almost all consulted stakeholders have pointed to the central role played by awareness campaigns. These campaigns are not only essential in order to appeal to citizens' sense of civic duty, but also to inform them of disposal channels[804]. Such information campaigns would need to be organised on a quasi-permanent basis in order not to lose the attention of the public. This implies that the cost of information campaigns can become rather high. Contrary to the costs linked to an expansion of the collection network, these costs are not very sensitive to the density and the size of the network that needs to be served. Several stakeholders have pointed to the essential role of cultural attitudes and have pointed to the specific difficulty of reaching some groups in urban areas.
- It can be doubted that the first two factors will suffice to obtain high collection rates on a permanent basis – they should rather be seen as necessary conditions that need to be complemented by financial incentives. Deposit refund systems are the typical financial instrument to increase collection rates of waste product if it is difficult to observe undesirable behaviour (hoarding and illegal disposal). The industry stakeholders have strongly opposed this type of instrument, claiming that its application would be impractical. Essentially, the point of industry is that end of life batteries will be brought to a few retailers but will have been bought anywhere and anytime (see Section 6.3). We have not been convinced by their argument that such an instrument would be unfeasible. However, administration costs linked to a "clearing system" could indeed turn out to be high. Therefore an alternative approach could consist in using the

[802] This refers to the lost benefit of the next best alternative uses of their time.

[803] In this perspective, it is difficult to understand why Poland had initially prohibited the use of the retail sector in the collection network. This will change with the transposition of the new Battery Directive.

[804] We remind the reader that the case study of the UK has shown that even public authorities could benefit from information campaigns.

introduction of a deposit refund system as a threat should some stated collection targets not be met. It would then be left to the industry to use its expert knowledge of the market to devise more cost-effective financial incentives. One potentially interesting option would be to give away lottery tickets to those bringing back their used batteries.

It is somehow surprising that, despite the recognized importance of hoarding, Bebat is the only PRO interviewed that actually provides financial incentives. Although the actual collection rates of Bebat are exceptionally high, none of the countries covered in the case studies indicated any plans to use such incentives in the future.

13.4.2.2.2. Cheap alternatives to recycling - the low cost of landfilling and incineration.

A second issue on the supply side is that the alternative to separate collection and recycling is too cheap and easy compared to the alternatives. Disposal through landfilling and incineration is easy for batteries in mixed waste and externalities from this disposal route are often not internalised, so it remains relatively cheap and attractive. As the externalities linked to these options vary from country to country, this does however not imply that a one-size-fits-all solution would be appropriate.

13.4.2.2.3. Free-riding in producer responsibility reducing separate collection.

Free-riding in EPR schemes is an important problem because it directly affects the financial resources that are available for the PROs for collection (and thus also the density of the network and the intensity of the communication campaigns). In Belgium, free-riding has been limited because there is a legal requirement to participate in the unique PRO and because this PRO is allowed to denounce any free riding to the relevant authorities.

Where several PROs exist, recovery organisations are less likely to vigorously chase free riders: verifying whether producers comply with legislation has public good aspects (all PROs benefit from higher participation, but the cost of monitoring falls upon the individual PRO). Alternatively, competing PROs could collaborate in the fight against free riding. Some stakeholders have argued that firms competing in product markets would not be able to set up joint strategies. This is not completely convincing. Competitors are known to collaborate efficiently on issues that are much more delicate than this.[805]

In the absence of collaboration between PROs, enforcement will be mainly the task of public authorities, who do not face strong incentives for strict enforcement. The existence of a national registry of producers and of recovery organisations seems an absolute pre-requisite in the fight against free-riding.

13.4.2.2.4. Relation with the WEEE Directive.

WEEE legislation requires batteries to be removed (see Annex II of the WEEE Directive) but does no specify how and when. Apparently, in the UK, it is not common to remove them at the pre-shredding phase. It is beyond the scope of this work whether this interpretation of the Directive is legally correct. However, in more general terms, several stakeholders have pointed to the lack of enforcement of the WEEE Directive as a problem.

Batteries contained in small household appliances constitute a specific problem.

First, the separate collection rate of these appliances is significantly smaller than for other categories of WEEE, for several reasons:

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[805] For recent examples of "co-opetition" as a business concept, see "Dealing with the downturn" in The Economist, 7 August 2008.

- hoarding which is often due to the financial or emotional value of the product
- ignorance of the private user with respect to the presence of batteries or accumulators
- their small size which makes it more attractive to dump them with mixed household waste

Second, often, batteries are not separated from the equipment before shredding. As 25% of batteries and accumulators put on the market are integrated in electronic and electronical equipment, this is a significant problem.

One instrument that has been proposed to deal with this is the establishment of a link between the WEEE and the battery registry – this would at least affect free-riding. However, this is a task the Member States have to take care off in the implementation.

13.4.2.2.5. The organisation of PROs and its impact on collection rates.

We have discussed general competition issues linked to waste collection in Section 2.4 and those specifically linked to PROs in Sections 2.6 and 3.2.3 . We will therefore limit ourselves here to the specific issues we have identified in the case of portable battery recovery.

As we have noted above, the existence of one unique PRO with a monopoly imposed by law has certainly contributed to the extremely high collection rates in Belgium: it has reduced the scope for free riding and has led to important financial resources for the scheme, thus allowing for a dense network and extensive and coherent communication to the public.

An important advantage of having one single organism is that this avoids duplication of fixed costs, such as those linked to information campaigns and the fight against free riders. However, as we have argued above while discussing free riders, alternative arrangements are possible that do not require merging PROs. After all, authorities can require competing recovery organisms to have a single communication campaign.

Having a single organism would be more efficient if there were economies of density or scale in used battery collection.

Let us therefore look at the situation in France and Poland where several PROs operate[806].

- In France, several parallel collection systems exist and seem to function rather well compared to the other systems we have looked at – the fact that they do not merge suggests that there are no significant economies of scale and/or density in France beyond those already achieved by the PROs.

- In Poland, the situation is different, but the problems seem to be more related to issues of regulatory supervision than to the existence of several parallel systems as such – we refer to Section 13.2.2. It is not clear, however, how the Polish government's intentions to move to purely individual producer responsibility would solve these problems – to us, it rather seems that it would further complicate supervision.

Does the French experience imply that the Belgian system with just one PRO is inefficient? Not necessarily. First, some French stakeholders think that the communication efforts undertaken by the battery PROs have been insufficient. Increased efforts could well push fixed costs beyond the threshold

[806] In the other three countries covered by the case studies, things have not progressed enough at this stage to draw any useful lessons.

where a merger becomes profitable. Secondly, the Belgian system does leave room for competition in the collection phase through periodic tendering of the market.

An alternative arrangement could be to have a single PRO but to divide the market regionally amongst collection companies. Even in the presence of economies of scope, the use of "yardstick competition" would provide strong incentives for technical efficiency (see Section 2.2.1).

However, tendering is a relatively cumbersome procedure. For a small country like Belgium, the transaction costs of organising several tenders for each regional submarket may well outweigh the gains in technical efficiency. However, taking into account the legal monopoly of Bebat, the use of tenders is probably unavoidable for reasons of accountability.

Unfortunately, there are no publicly available data on the cost price of the different collection systems. Several stakeholders have claimed that the Belgian system is excessively expensive compared to others, but we cannot validate nor deny this claim.

In conclusion, we do not see a case for a legal monopoly but we do think that a monopoly could well be the natural outcome if communication and enforcement costs are high enough. This outcome should be left to market forces, not be imposed by law. However, if monopoly is indeed the outcome, competition in the collection phase can still be obtained through periodic tendering or "yardstick competition".

13.4.3. Economics under the new Batteries Directive

The new Battery Directive imposes collection targets and recycling efficiencies for all batteries and introduces EPR as a regulatory instrument. It can therefore be expected that the transposition of the new Battery Directive will have a radical impact in the countries that have not been forerunners in this field.

Our analysis has shown that there are several instruments available that could have a direct impact on collection rates. Increasing recycling efficiencies would rather require incentives for technical innovation – we refer to the relevant chapters in this report (see Section 2.7).

The current Battery Directive requires Member States to report on waste prevention, but does not suggest possible ways to achieve this. One approach in the field of prevention that is worthwhile investigating lies in the stimulation of the demand for rechargeable batteries and for electricity taken from the grid, while recognizing that these are not perfect substitutes for primary batteries. A second option would be to have the financial contribution to PROs depend on the expected life time of batteries. Taking into account the long life spans of batteries, none of these proposals could be expected to yield immediate results.

13.5. FOOD WASTE

Based upon previous work of one of the project partners, we have put forward the estimate that 52 million tonnes of food waste is either being composted, digested, spread on land or used as animal feed, while the remaining food waste is of the order of 113 million tonnes.

In general, our report for Task 1 of the current project had pointed to the inconsistency of data on quantities of food waste throughout the European Union. The more detailed analysis undertaken in Task 2 and 3 basically confirms this first impression.

Our research also suggests why this is so. Indeed, none of the countries covered by our analysis has a policy on food waste "as such". What happens with food waste depends on a series of policies that are often uncoordinated or whose primary objective is not to increase useful applications of food waste. Taking into account the size of this waste fraction, this is surprising, to say the least. In the absence of a well-defined policy, it is of course not clear what should be monitored, and this is reflected in the quality and the amount of information that is available.

Due to the absence of more specific policies, our analysis has often covered biodegradable waste in general – this includes garden and park waste on the one hand, and paper and cardboard on the other hand. The only exception here is the UK, where a relatively detailed analysis has been possible according to the origin of food waste (households, commercial, industrial).

There also exist a wide variety of potential markets for recycled food: compost, technical applications, livestock feed, pet food, biogas production, energy recovery in cement kilns etc. In practice, the information we have found is almost entirely focused on compost.

In the case of Flanders, though, we have also been able to conduct an analysis of the system for selective collection of frying fats and oils, of the uses of industrial organic waste and of animal by-products. As these cases clearly show that, in specific circumstances, both waste collection and recycling can be commercially viable, we shall briefly summarize them here before discussing compost.

13.5.1. An example of the changing economics of collection: Frying fats and oils in Belgium

After the Belgian dioxin food crisis in 1999 which was due to dioxins in oils entering the food chain, one common recycling option for waste frying fats and oils (putting them back in the food chain) was no longer open. Because, at that time, the price for the alternatives did not cover collection and recycling costs, the Belgian government imposed an acceptance obligation on producers for waste frying fats and oils in order to shift the financial burden of waste disposal from the municipalities to the producers.

However, due to current high demand from the biodiesel and "green stream" sectors, the collection of frying fats and oils is now commercially viable. This leads to the parallel existence of, on the one hand, an "official" circuit that is monitored by the PRO Valorfrit, and, on the other hand, an "informal" sector that follows less stringent quality standards.

Thanks to high market prices for biodiesel and co-incineration, there is, currently, no risk that these waste streams will get back into the food chain. Therefore, the "informal" sector is not a source of major environmental concern – this could change if the price for biodiesel and co-incineration would drop again compared to the (prohibited) application in the food chain.

In the case of the catering sector, a collection system is commercially viable because the logistics are simple: there is a largely predictable supply at known collection points (the restaurants).

The main constraint lies in the collection from the household sector, where significant amounts of illegal disposal still take place. An important barrier here is that, due to Flemish regulations on hazardous waste, frying fats and oils cannot be left on the kerbside. The current bring system[807] apparently imposes time costs on most households that are too high to obtain their cooperation.

Of course, if biodiesel and coincineration prices continue to increase, collection from households on appointment outside working hours could become commercially viable as well.

We refer to Section 7.9.3 for more details.

13.5.2. Examples of the impact of high alternative disposal costs and of economic support for collection: Fallen stock in Flanders

As all waste from animals that are slaughtered in a slaughterhouse are considered fit for human consumption after inspection by the Food Agency (see Section 7.9.5), *market conditions* determine whether this waste will be used for human consumption, for technical applications or as a Category 3

[807] Requiring householders to take their oils to collection sites.

waste. For that Category 3 waste disposal costs are high, because the disposal is regulated and so slaughterhouses and boning plants constantly search for new markets (like recycling) to avoid those costs.

In the case of "other" animal by-products (see Section 7.9.5), the prices paid to the waste collectors (or received from the waste collectors) depend on the material on offer, the yields obtained in processing the material and the costs linked to the destruction of meal and fat. The transport costs linked to collection are highly variable depending on the material.

The prices for the possible application also depend on market conditions outside the waste market. For instance: fuel prices will determine the returns to incineration, the prices for vegetable fats will determine the price for technical applications etc.

The collection of fallen stock provides one interesting illustration of how varying market conditions throughout time can affect collection and recycling. In the unregulated market for animal by-products until 1993, world market prices for meal and fats were high, and collection and processing were profitable businesses. This changed in the 1990s, mainly due to a drop in the value of the US dollar, leading to lower prices for Belgian recyclers. More stringent environmental requirements increased financial pressure even more. In order to maintain the financial viability of collection – and so keep fallen stock from being disposed of illegally - the Flemish government provided a guaranteed turnover for one specific company (Rendac), thereby creating a de facto monopoly.

The collection system is now financed jointly by the Flemish Government and the cattle industry. Cattle holders can choose between paying an annual contribution or a contribution per animal that needs to be collected.

The collection of fallen stock also nicely illustrates an important dilemma in the regulation of monopolists we had mentioned in Section 2.2.1.

Initially, the Flemish government guaranteed Rendac's return on capital on top of the reimbursement of all costs – however, this had led to an important increase of the equity capital of Rendac at the expense of the Flemish taxpayer. The collector now receives a fixed sum per ton on top of the cost of collection, treatment and disposal of fallen stock. While this system limits the transfers from the taxpayer to the regulated companies, its drawback is that it does not provide incentives for cost efficiency.

13.5.3. Compost

In the case of compost, the recent study undertaken by Barth et al on behalf of the JRC has provided an invaluable overview of the current situation on the European market.

The main message of the study is also clear: even though Barth et al reckon that the market potential in Europe is twice the size of the maximum production potential, 95% of composting plants depend upon a gate fee to make a profit. Demand for compost is too low to make a profitable supply possible.

Although the factors affecting demand and supply can vary significantly between countries, one common factor across countries is that the main motivation behind their policies is to comply with the Landfill Directive by reducing the amounts of biodegradable waste going to landfill (see Section 3.5.2). Therefore, compost policy is mainly supply-driven and measures that could contribute to the further development of the market potential are not a priority. This leads to the paradoxical situation that even where the level of recycling is high, the actual use of the recycled product remains limited.

We shall now proceed with a more detailed discussion of the individual factors affecting supply and demand.

13.5.3.1. Supply –side issues

Barth et al identify the low quality of compost in some countries as the main obstacle to further market development. Of course, this cannot be accepted as the final explanation for the general lack of profitability. After all, quality is not an exogenous variable, but is determined by the actions of the relevant players in the market. We need therefore to have a closer look at the product chain in order to understand what is going on.

According to Barth et al, mixed waste composting is generally of low quality. Therefore, it is mainly used in relatively low-end applications such as agriculture, land restoration and landfill covers.

The question is then whether selective collection of biodegradable waste would lead to better quality of the compost that would be able to meet other demands.

SELECTIVE COLLECTION *CAN* IMPROVE QUALITY OF SUPPLY

Selective collection has led to mixed results in improving the quality of supply. Surprisingly, in some cases[808], the schemes seemed to have performed quite well, even where people mainly live in collective housing. Contamination appears to be relatively limited but effective collection rates can differ widely. In the case of Flanders, the *selective* collection of vegetable, fruit and garden waste (VFG) performs even better than incineration from a purely financial point of view because the treatment of selectively collected green waste is cheaper than *incineration*[809] (see Section 7.9.2.8). A more widespread dissemination of good practices in this regard could a fruitful idea area for public intervention. For instance, the relative low effort required from households in door to door collection in Tiana (Barcelona) probably contributes to the success of the scheme (see Section 12.9.6.3). Although the logistical details are linked to the specific situation of Spanish towns (narrow streets for instance), some lessons could be transferred to other situations.

We need to specify here that selective collection of biodegradable waste does not imply that food waste is included in this stream. In the case of Poland, for instance, priority is given to the selective collection of garden waste, because it is deemed easier than the selective collection of food waste (see Section 11.3.7).

LEGISLATIVE BARRIERS (PERCEIVED AND REAL) NEGATIVELY IMPACT ON THE ECONOMICS OF COLLECTION

In Flanders, some inter-municipal associations have explicitly excluded catering waste for composting because they do not have a permit for processing animal by-products (see however the critical remarks in Section 3.5.6.5). In this case, households have no choice but throwing kitchen waste away with residual waste. This policy option can have some important side-effects. Indeed, in the case of commercial sources (such as canteens), refusing catering waste also affects the potential for the selective collection of vegetable waste: commercial sources who may consider separating their kitchen waste (because the volumes would warrant daily collection) may not consider separating vegetable waste (because the collection frequency would go down if cooked waste and meat were excluded) – see for instance the pilot project for restaurant kitchen waste organised by OVAM (Section 7.9.4.3).

[808] Notably in Tallinn and Catalonia.

[809] It is thus important to keep in mind that landfilling has not been considered as an alternative.

An important constraint on the supply side lies in the application of the Animal By-Products Regulations (ABPR). Compliance with ABPR imposes additional costs if Category 2 or Category 3 animal by-products are included. Unfortunately, no reliable estimates of the magnitude of these costs exist.

Taking into account the food crises of the two last decades, a relaxation of the ABPR is difficult to conceive politically, even if cost-benefit analysis would suggest otherwise[810].

We should however remind here the point raised in Section 3.5.6.5: *catering* waste is exempted from the special requirements for collection, transportation and storage as well from the requirements for composting and biogas plants. It is not clear whether the strict position taken, for instance by some intermunicipal associations in Flanders, is due to a misunderstanding of the APBR or to deliberate policy choices. According to OVAM, the ABPR is an important source of confusion that acts as a disincentive for investors. Similarly, the UK ABPR has been found to be an important impediment to food waste collection.

CO-ORDINATION PROBLEMS IN COLLECTION, MARKET POWER, ECONOMICS OVERCOMING CONTAMINATION

The case study of the UK has also identified some problems linked to the collection from commercial and industrial sources (see Sections 8.2.4.2 and 8.2.4.3):

- Companies producing food waste find it difficult to identify appropriate providers of treatment capacity while potential developers of treatment capacity face difficulties in identifying waste producers.
- Economies of density and network externalities: Cost is an important reason not to collect food waste seperately but, the more companies would participate in the separate collection of food waste, the lower the unit costs would be thanks to improved logistics.
- In some areas, facility operators enjoy market power

In Flanders, initiatives to reduce transaction costs in this market segment include standard setting and web-based applications. The experience of Tiana mentioned above has also shown that selective collection of food waste from commercial sources is feasible in small or medium sized municipalities with an average or low population density.

Another specific issue that was identified in the UK are the technological externalities linked to food packaging as some food waste is contaminated with plastic packaging. It is noteworthy that, under the pressure of higher gate fees for contaminated waste, new processes are on the way to tackle these issues (see Section 8.2.4.3.4). This suggests that what appears at first glance to be a market failure (the design of packaging does not internalise the cost of recycling) finds a commercial solution when the gate fees do reflect the full costs of processing.

13.5.3.2. Demand side issues

However, most problems in the market for compost occur downstream of collection.

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[810] It should be noted though that there is little information to demonstrate whether a relaxation in the ABPR, and any attendant increase in risk which this might generate, would stand a cost-benefit analysis. Some work in the UK suggests that the ABPR, as it was initially conceived in the UK, imposed costs on industry which were not justified by the benefits (see Eunomia (2003) *Proposed Amendments to the Animal By-products Order – Compliance Costs and Related Issues*, Report to the Composting Association.

A prominent issue here is clearly the distrust of potential end users with respect to the quality of compost – which can wrongly dissuade them from buying high quality compost –a typical example of asymmetric information as a market failure (see Section 2.2.4).

The existence of credible systems of quality assurance and certification is crucial in order to overcome these problems. Some countries have now established such systems, but others have a long way to go. Pilot and demonstration projects could also play an important role in overcoming distrust and showing the benefits of compost. Where established and trusted quality control systems are absent, this is an important reason why compost is mainly used in low-end applications.

Moreover, a credible system of quality control is probably just a *necessary* condition for creating a viable market for compost. After all, Flanders does have such a system, but it nevertheless faces significant marketing problems: the treatment costs of the composting plants in Flanders are still completely covered by the waste suppliers.

On top of the issues of asymmetric information, we have identified the following barriers as being significant:

- Because the application of nitrogen and phosphorous loads on farmland is limited, applications in agriculture are constrained by the competition from other fertilizers in general, and manure in particular. Because of these limitations, demand in regions with important manure production can be very limited.
- Sewage sludges and soil from construction works can act as additional competitors to organic waste compost.

However, high transportation costs compared to the market value of compost limit trade to regions where there is no issue of excessive manure supply or where there is a high potential use for compost (for instance, to fight soil erosion).

It is clear that these factors can be highly country-specific.

13.5.3.3. Policy recommendations

Thus, while demand for compost is generally too low compared to production costs to make the market for compost commercially viable, the underlying reasons can vary significantly from country to country.

Inasmuch as selective collection of biodegradable waste could contribute to a better quality of biodegradable waste, it would lead to better market prospects for compost. However, not everyone shares this view. As we have seen in Section 9.9.2, the French environment agency ADEME favours the development of mechanical sorting followed by biogas recovery. Others concluded however that MBT does not allow for the production of compost of sufficiently high quality (Section 9.9.5).

Determining "end of waste" criteria at the European level would certainly be a significant step forward compared to the current situation, as it would allow overcoming problems of asymmetric information and transaction costs. In this perspective, it is encouraging to see that the new Framework Directive has created a regulatory framework for "end-of-waste" criteria and that compost is covered by one of the case studies undertaken by the JRC. However, as Barth et al point out, setting European "end of waste" criteria would require overcoming the widely divergent existing requirements in the Member States. The cost of quality monitoring could also lead to consolidation in the sector, certainly if additional requirements would result from REACH.

The following policy instruments could also be envisaged:

- As written above, support for demonstration and pilot projects, both in the collection and application of products. As a LIFE project in Andalusia has shown (section 12.9.5), this is clearly a point where public funding could play a useful role.

- Due to the competition from manure as a fertilizer, stimulating demand for compost could also require modifications in agricultural policy, including the Cross Compliance requirements.
- The supply of manure is directly affected by the size of the livestock. Taking into account the recent fluctuations in world food prices and issues of food scarcity, reductions in livestock would be difficult to imagine as a policy instrument that would indirectly stimulate the demand for compost.
- The market value of compost does not do justice to its external benefits (prevention of soil erosion, carbon sink, humus reproduction, disease suppressing properties, reduction of methane gas production by avoiding landfills etc). Although existing studies have been unable to quantify all such benefits[811], this could justify subsidising use, and synergies with the EU Soil Strategy and the European Climate Change Programme should be investigated.
- Italy does make use of agri-environmental measures to support the use of compost by farmers.[812]
- Review the CAP, the Nitrate Directive and the APBR in the light of their impact on food waste.
- Public procurement could be used to stimulate demand (for instance in public parks).

The extension of EPR to food waste, as proposed by the French association AMORCE, is an interesting idea to explore. It could well be that food producers, confronted with the cost of food waste, would take more measures to reduce the amounts thrown away by households: smaller quantities per unit of packaging for instance[813].

The new Waste Framework Directive also requires Member States to promote selective collection with a view to composting and digestion.

Finally, we should keep in mind that high energy prices and the increasing number of government schemes stimulating the demand for renewable energy provide strong incentives for energy recovery from bio-mass (including manure), which will certainly lead to a degree of stronger demand for compost in the future.

13.6. CARDBOARD

The aim of this case study was to look at the specific issues related to cardboard. However, due to limitations in data availability, we often had to analyse cardboard in combination with paper recycling.

The most salient feature of this specific waste streams are the high levels of recycling that are obtained in comparison with other waste streams. This success can be attributed to the combination of high rates of selective collection, high recycling efficiencies and a high demand for recovered fibres.

However, we should avoid jumping to the conclusion that there is no room for improvement.

Taking into account the global nature of the demand for recovered paper, it is clear that the very low levels of recycling that are obtained in some countries are due in the first place to differences in collection rates.

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[811] Eunomia (2007) *Managing Biowastes from Households in the UK: Applying Life-cycle Thinking in the Framework of Cost-benefit Anaylsis, Final report for WRAP*, May 2007, http://www.wrap.org.uk/downloads/Biowaste_CBA_Final_Report_May_2007.522f9261.pdf

[812] Favoino and Hogg (2008) The potential role of compost in reducing greenhouse gases, *Waste Management & Research 2008; Vol 26; 61*

[813] Even though, as a side-effect, this could lead to increases in packaging waste!

It is also quite clear that differences in the collection rates can be almost entirely attributed to the differences in the organisation of *selective* collection. This follows from three observations. First, the countries in our case studies with high recycling and recovery rates are those who have put in place the most intense systems of selective collection. Second, the Packaging Waste Directive imposes the introduction of systems for the return or collection of used packaging, and it is for this waste stream that the highest recycling and collection rates are obtained. Third, in Spain, recent improvements in the collection system have almost immediately led to spectacular improvements in collection rates.

Moreover, the importance of selective collection and sorting at the source has been confirmed in most stakeholder interviews.

We will now first give a short survey of exogenous factors[814] that affect both supply and demand. This is followed by a brief description of the demand side and an extensive discussion of market failures on the supply side. The specific market for beverage cartons is treated in Section 13.6.6. We limit our discussion of demand to the text below.

13.6.1. Exogenous factors

In Section 6.5.2, we have referred to a study on the determinants of collection rates.

Unfortunately, these statistical results are purely descriptive, and do not assess issues of causality.

For instance, it could be that affluence affects collection rates through the supply side (richer countries can afford more expensive selective collection systems) or through the demand side (people become more environmentally conscious when they become more affluent). Moreover, this demand side effect can operate through numerous (not mutually exclusive) channels: affluent people attach more importance to luxury goods such as environmental amenities; affluent people have better access to capital markets and will thus discount the future less than poor people (and thus also attach higher value to long term health impacts of pollution etc).

The inconclusive results with respect to the effect of population density may appear surprising. Indeed, due to economies of density (see Section 2.4.1), separated collection would appear to be more viable in urban areas. Moreover, high population densities will drive up land prices, and thus also the cost of disposal[815]. This mystery is resolved once one realises that these effects have been calculated at the *country* level. A sparsely populated country where population is concentrated in a few cities may have higher economies of density than a densely populated country where the population is spread uniformly across the country.

A high population density can moreover work against high collection rate if this leads people to live in apartment blocks. Because of the typically limited social control in these dwelling, people can become more negligent in the source separation of waste, and this can lead to contamination of paper waste - in France and in Belgium, this has been referred to as one of the main areas of concern.

Other exogenous influences include:

- the abundance of forest resources in a country, which of course reduces the economic pressure for paper recovery (such as in Estonia)
- the inherited recycling and recovery infrastructures

[814] This refers to factors that are independent of waste policy.

[815] Berglund, C. and Söderholm P (2003), An Econometric Analysis of Global Waste Paper Recovery and Utilization, Environmental and Resource Economics, 26:429-456.

13.6.2. Strong demand for recycled paper and cardboard drives the market

There is currently strong demand for material for recycling, particularly from the Far East. However, we have also indicated that we cannot take for granted that demand and prices will remain high: changes in transportation costs may have an impact on future demand from the Far East. Moreover, other sources of fibre are being explored as potential substitutes.

And there is scope for improvements in demand: all other things being equal, the higher market prices for recovered paper, the more market segments become suitable for commercially viable selective collection. Public procurement can also lead to further improvements in the market position of recovered paper.

The mutual recognition of brokers and transporters could lead to more intra-European trade, and would increase the likelihood that recovered paper ends up in the most valuable applications. The same argument of course applies to "end of waste" criteria – paper is amongst the materials that are explicitly covered by Article 6 of the new Waste Framework Directive.

The merit of some other policy proposals is less clear. For instance, some stakeholders have argued in favour of export restrictions. It is not clear what environmental objective could be attained through such restrictions. They could certainly contribute to the realization of recycled content standards. However, recycled content standards impose additional monitoring costs on the industry without clear environmental benefits – on the contrary, such targets could induce trade in recovered paper in order to allow a country to meet its targets (see Section 6.5.7 for more details on this issue)!

13.6.3. Market Failures in the Supply Side

13.6.3.1. Organisation of paper waste collection and recovery

The Packaging and Packaging Waste Directive requires Member States to introduce systems for the return or collection of used packaging in order to attain specific targets. Taking into account the amounts of paper and cardboard that are used in packaging, this requirement has a direct effect on the amounts of paper and card that are being collected seperately.

With respect to the organization of paper waste collection and recovery, we have observed a wide diversity of institutional arrangements. According to 2005 data (see Table 25), Belgium, France, Spain and the UK all comfortably meet the targets the Packaging Waste Directive imposes by the end of the current year. However, as explained in Section 13.2.2, the data available prevent us from making strong claims with respect to the relative cost efficiency of the different recovery systems.

Poland does not meet the targets in Table 25, but is subject to a later deadline (31 December 2012) for the amended Directive anyway. According to the latest data we have obtained (see Table 88)[816], Estonia meets the global targets for packaging waste in general but not for paper.

We have already discussed the general problems related to the organisation of the Polish and Estonian municipal waste management systems elsewhere (see Sections 10.3, 10.12, 11.3 and 11.5). In the case of packaging waste, specific problems are the duplication of costs (in the case of Estonia) and, in the beginning of the decade, illegal activities by recovery organisations (in the case of Poland).

The low observed low rates of recycling and recovery in these countries can certainly not be attributed entirely to the ill-functioning of the collection systems. Indeed, increasing selective collection makes little sense if there is no appropriate infrastructure to deal with the collected materials. Both countries have a waste management heritage based upon landfilling that cannot be shaken off lightly. Moving away from landfilling requires important investments, and, with limited resources, priorities need to be set that can

[816] These data refer to 2004 and 2005, so one has to be careful in their interpretation.

be highly country-dependent. Moreover, in the case of Estonia, oil shale waste constitutes an important country-specific additional burden for waste policy (see Section 10.3.1). It should also be noted that, contrary to the usual practice of compensating local authorities for the operations of selective collection schemes, Estonian PROs actually *organise* the network for separate collection themselves. This approach has been chosen as a way to deal with the limited capabilities of the Estonian municipalities.

Belgium is the only country where financial incentives are provided to stimulate selective collection, but this is limited to industrial packaging waste. In France, the packaging industry provides (non-financial) assistance to industrial waste holders.

The system used in the UK is somewhat idiosyncratic. In order to meet the targets of the Packaging Waste Directive (see Section 3.6), the UK works with tradable Packaging Waste Recovery Notes (PRNs) rather than with a Green Dot System. These PRNs are issued by accredited reprocessors when packaging waste is recycled or recovered. They are put unto the open market to be purchased by obligated companies and are tradable. As actual recovery rates have exceeded the targets of the Packaging Directive, supply of PRNs is relatively large compared to demand and the prices of PRNs are very low. The low price of PRNs and the lack of full financial responsibility provide little incentives for changing product design. The low price of the PRN also provides a clear indication that, in the case of the UK, the Packaging Directive does not "bite". This also suggests that, once the collection system to reach the recovery and recycling targets of the Packaging Waste Directive has been put in place, the marginal costs of exceeding this target is relatively low.

Finally, only 2 countries (Belgium and France) have introduced a (limited) system of producer responsibility for the advertisement sector and the printed press. This is remarkable, taking into account that the contribution of these sectors to paper production can hardly be qualified as negligible.

13.6.3.2. Technological externalities

The ALCIMED study quoted in Section 5.5 has shown that the cost of paper and board recycling depends on decisions that have been made in the production phase (use of "stickies", ink choice etc). As these costs are borne by the recyclers but not by the companies that made the technological choices, we can conclude that there exist significant technological externalities in paper and board production.

The interesting point to note here is that our case study of France has shown that industry has found ways to set up structural collaboration to deal with these issues. Thus, after a transition period during which these technological interdependencies were not internalised, different sectors are now working together because they understand that there is a potential mutual benefit from collaboration.

13.6.3.3. Information failures

Generally speaking, the market for recovered paper appears to be quite transparent. There exist well established grades that are used as the basis for contracts and traders reduce search costs.

Things are a bit different in the collection phase.

Actually, one of the remaining areas of concern is the decreasing quality of recovered paper that follows from the increased collection rates. Some have argued that this could be a particular issue with apartment blocks where the lack of social control leads to higher levels of contamination.

However, it seems to us that these claims are overblown. Experience in Estonia has shown that the lids of containers for selective collection can be devised so as to minimize the risk of contamination by mixed waste (see Section 10.9.2). The use of magnetic cards with an identification system could further limit this risk. The question of course remains open whether this investment is justified by the benefits of increased collection this could induce. As the answer to this question depend on a lot of local factors (such as the basis to start with), we think it is best left to the local authorities to take this decision.

13.6.4. Interaction with other policies

At the European level, the "Food contact" regulation imposes some restrictions on the use of recycled board. However, stakeholder interviews have indicated that this does not constitute a constraint in practice (even though some confusion still exists amongst practitioners).

In the UK, local authorities tend to withdraw from the market for collecting non-household waste because this allows them to decrease the amounts of biodegradable waste that is collected and so to meet their obligations under Landfill Allowances Schemes (LAS). A side effect of this is that SMEs, who are often not aware of their obligations, have to turn to commercial waste collection. This can lead to significant transaction costs, while SMEs are already the most problematic segment of the market for selective collection.

Still in the UK, card is composted when it is collected together with garden or food waste. The inclusion of board in composting helps to meet LAS targets, which has led the authorities to prioritize the biodegradable waste fraction. The paper industry worries that such an approach contributes to perceptions that recycled board is of "poor quality".

13.6.5. Policy instruments

We have argued above that differences in cardboard recycling through time and space can almost entirely be attributed to differences in the organisation of supply.

In countries where recycling rates are low, it would be therefore a natural step to focus on supply side measures.

- As in most other cases, the most effective policy instrument to stimulate recycling would be to increase landfill and incineration taxes, and thus to divert paper from these landfill and incineration.
- If these instruments are not available, for instance for reasons of political feasibility, imposing selective collection or financing selective collection by ERP schemes are of course valuable second best solutions.
- At the collection side, the significant recent increase of collection rates in Spain (see Section 12.10) has also shown the crucial importance of a dense, customer oriented collection system combined with active information campaigns.

13.6.6. Beverage cartons

Beverage cartons merit a separate discussion.

Indeed, recycling and recovery rates are substantially lower than for other types of carton. Moreover, with the exception of France, Green Dot rates for beverage cartons are substantially higher than for other carton types. Finally, in the countries where we have obtained data on the subject, the market value of waste beverage cartons is low or even negative.

Table 112: Green Dot fees of drink cartons versus other paper and cardboard (cent/kg)

Country	Drink cartons	Other paper and cardboard
Belgium	26.62	1.74
France (Eco-Emballages)	12.21	12.21

Estonia (ERO)	41	11[817]
Poland (Rekopol)	74	40
Spain (EcoEmbes)	26.6	5.1

The main reason underlying these differences are the significant technological externalities in beverage cartons. Mixed recycling is possible but then the polyethylene and aluminium fractions are lost. It is technically feasible to recover the non-fibre components as well, but this comes at an additional cost: the cartons must be separated from other waste streams.

Depending on the specificities of a country's collection system, this separation either takes place at the source by households or at sorting plants.

It is not clear whether this additional effort is justified by the environmental benefits of recovering the polyethylene and aluminium fractions - the separate collection and recycling of beverage cartons is indeed very expensive as they are only a very small part of total waste[818].

The industry however points out that higher collection rates can lead to large scale recycling solutions and thus also higher quality recycled products.

There are also some issues on the demand side.

Indeed, there is significant market concentration on the side of the paper mills. Moreover, the recycling capacity is higher than the offer, which acts as a barrier to entry. Other barriers to entry are the important investment outlays and vertical integration.

Also, the industry claims that the reluctance of some paper mills to use beverage cartons is due at least partially to the lack of familiarity with the product – there is thus a "learning by using" issue.

What are the policy conclusions to draw from this?

If recovery organisation are left free to determine their rates, these rates will reflect, on the one hand, the gate fees obtained from (or paid to) the mills (or landfills and incinerators), and, on the other hand, the costs of collection and sorting. If beverage carton producers turn out to be willing to pay higher fees, this suggests that the benefits of this packaging solution outweigh the environmental costs linked to their disposal.

No specific regulatory action therefore appears to be necessary, except confronting every actor in the chain with the external costs linked to his actions. If, for some reason, this turns out not to be possible, the next decision is to decide what disposal option is required (incineration, recycling in a mill with recycled paper grade, recycling without recovery of the polyethylene and aluminium fractions, recycling with recovery of these fractions). However, the answer to this question depends largely on local factors, such as the logistics of the collection system, that do not need a uniform answer across the Community.

[817] This includes beverage cartons for milk.

[818] Ibenholt, K. and H. Lindhjem (2003) "Cost and benefits of recycling liquid board containers", Journal of Consumer Policy 26(3): 301-325.

13.7. RECOMMENDATIONS FROM THE USE OF ECONOMIC ANALYSIS

This study aimed at using economic analysis of market failures in recycling markets to identify the policy options that would be most effective at increasing rates of recycling in the EU, where appropriate.

We have analysed in some depth 4 waste streams in 6 member states with very diverse levels of per capita income, geographical structure and histories of waste management. The quality and the relevance of the data we have obtained were also very heterogeneous. The actual recycling outcomes turned out to widely divergent across countries and waste streams.

Our study has shown that economic analysis provides a powerful tool to understand how apparently small differences in institutional and policy contexts can sometimes have an important effect on outcomes. The in-depth investigations provide examples of the way in which economic analysis can provide insight. By investigating the blocks to high levels of supply or of demand of recycled products, we can see where removing market failures would be likely to lead to higher levels of recycling. This analysis should allow us to identify where policy will be efficient in increasing recycling – and where it may be ineffective, because another remaining market failure will still hold back recycling.

The analysis starts from the consideration that the recycled material is a valuable resource and asks the question "Why isn't that value being realised?". Often, that is for reasons that are due to failures in the economic functioning of the market – issues which may be independent of the environmental problem being tackled. Assessing these market failures using economics identifies the stakeholders' behaviour in terms of the incentives they face, the constraints to which they are subjected (including the technological ones) and the information that is available when they make decisions. This points to appropriate policy action.

For instance, we find that on the supply side, the organisation of collection makes a great difference to outcomes (whatever the policy) and that analysis of the collection market and issues of market power by recycling plants can suggest policy options.

The economic framework helps us identifying unanticipated or counterproductive behavioural responses from policy and points out that even where markets appear to be failing or policy does not exist, private parties can often, but not always, find alternative arrangements for mutually beneficial exchange. It warns us against designing policies that are not robust to changes in market conditions, that overlook the idiosyncrasies of a given situation or that require superhuman skills from those who have to implement these policies. Last but not least, the questions asked by economics can assist us in drafting an inventory of the data that authorities would need to collect in order to take informed decisions.

Maybe a few words should be added on the specific issue of data availability. We have repeatedly pointed to important deficiencies in the data that are available, and we certainly think that better thought should be given on what data needs to be collected in order to support policy. However, a lot of information can be gathered from indirect information.

For instance, suppose that an informal collection network develops in parallel with official collection services. This is only possible, if, for the waste stream in question, there are no economies of density or because there are important costs of environmental and safety compliance that can be avoided in the informal network. We cannot say on prior grounds which hypothesis is correct – it could well be that both are true. However, the lesson from this example is that economics allows to quickly identify the relevant questions to ask.

Another example of indirect evidence is how the low price of the Packaging Recovery Notes is an indicator of the low marginal costs of exceeding the target of the Packaging Waste Directive in the UK.

13.8. RECOMMENDATIONS FOR POLICY ACTION

Drawing any common lessons for the use of specific policy instruments from these experiences of different waste streams is challenging, as each situation has its own specifics. Extrapolating to other waste streams on the basis of our analysis is even more so. If we would have to draw a shortlist of measures that are common to all waste streams and countries we have covered, we would propose:

- **Stimulate optimisation of the logistics in the collection phase**. In order to avoid contamination and high sorting costs, selective collection is almost a conditio sine qua non for successful recycling. However, selective collection can be expensive. Moreover, if collection is subject to economies of density, selective collection is almost surely incompatible with competition in the market. This does not imply that selective collection needs to be put in public hands and lose the incentive of competition. There exist several way to "simulate" competition, such as competitive tendering and yardstick competition. However, organising and supervising this requires strong and competent authorities. Exchanges of good practice can play an important role in improving the quality of supervision. This should of course not lead to uniformity in practices. Even in household waste collection, the logistics can be highly idiosyncratic (think of city centres with narrow streets versus residential areas with broad avenues). An important limitation of our current knowledge is that we can only guess at the extent to which the marginal costs of selective collection are justified by the environmental benefits. This is mainly due to a lack of data that would allow a meaningful comparison. The European Union could contribute to our understanding by stimulating the creation of international benchmarking schemes.

- **Rethink the approach to trade**. It is a fundamental insight of economics that division of labour is the basis of all prosperity. If waste were a "normal" product, there would be an unambiguous case for letting the market decide where it could be put to its most productive use. In reality, trade in waste is governed by strict rules. These rules are justified inasmuch as trade imposes risks and costs on other parties than those who have agreed voluntarily to trade the waste. In reality, it has been suggested by some stakeholders that some national authorities use the rules on imports and exports in order to protect their own recycling industry. Potential gains to trade are therefore lost, even when there are no clear environmental benefits. A worthwhile idea to pursue would be to rethink rules on imports and exports from the assumption that free trade should be the rule and to leave the burden of proof to those who want to restrict it. Probably, for most waste streams, the outcome of this process will be the same as what we observe now. But some unjustified barriers, or alternative approaches to dealing with the hazards linked to transportation, may well be identified.

- **Recycled materials should not be discriminated against**. A recurring theme during our stakeholder consultations is that recycled materials sometimes are being discriminated against for reasons that are very hard to understand. Why should compost be subject to regulations in heavy metals and the ABPR, and manure not? Why should tenders impose the use of some specific materials or products, rather than describe the functional requirements? Defining clear end of waste criteria could make an important contribution in this area. Avoiding discrimination does however not imply that the specificity of recycled materials should not be recognized – this is a specific concern with respect to the implications of REACH.

- **Disseminate good practices**. We have already mentioned this with respect to good practices in regulation and organisation, but it could also refer to the adoption of new collection and recycling technologies. Of course, large cities are often already involved in European networks. However, European support could be especially helpful for small towns. As there already exists a multitude of European initiatives to promote innovation, it is important that additional initiatives do not lead to an increase in search costs.

- **Make sure that landfill and incineration taxes correctly represent the external costs of landfilling and incineration**: Our stated objective was to look at the policy options that would lead to a better functioning of recycling markets even in the absence of a correct internalisation of the environmental impacts of resource use. However, our stakeholder consultation has shown that these are the favourite instruments of most stakeholders. This does not imply that uniform landfill or incineration taxes should be promoted at the European level. Several environmental impacts (most notably those related to disamenities) are very local in nature - therefore landfill taxes may very well depend on the population density and the geographical structure of a country. To the best of our knowledge, there is also no reason why landfills and incinerators should be subject to other environmental requirements with respect to their emissions than other sources of pollution.

- **Investigate the possibility to introduce producer responsibility in other waste streams, especially if this could help promote design for the environment**. Where producer responsibility has been introduced, it has turned out to be a very powerful tool. Our study has shown the importance of avoiding a "one size fits all" approach. We have observed a wide variety of EPR systems and have found no model to be clearly superior to all others. Diversity can be a powerful source of learning lessons. However, some schemes clearly did not function very well – the underlying causes were mostly related to poor surveillance of the system, and we have suggested some policy changes that could improve upon the current situation.

- **Ensure that pricing of services for waste holders[819] reflects marginal costs.** If disposal costs reflect externalities, and if producer responsibility schemes are in place, then passing on these (dis)incentives for waste holders to make proper use of selective collection schemes can play an important role in maximising the capture of material for recycling. Such pricing schemes – widely applied in Flanders (and many other countries not included in the case studies) at the household level – can have a powerful incentive effect. However, exchanges of good practice should also consider that such schemes can also – where the selective collection system is not so well designed – generate problems of contamination of the selectively collected fraction. This will for instance be the case if the authorities apply a "pay as you throw" policy and the price for the residual fraction is high compared to the price for the selectively collected fraction – this provides incentives for mixing residual waste with selectively collected waste.

[819] According to the Waste Framework Directive, "waste holder" means the waste producer or the natural or legal person who is in possession of the waste.

14. LITERATURE

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14.2. PRESENTATIONS

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14.3. WEBARTICLES AND RELEVANT WEBPAGES

APPRICOD: http://www.appricod.org

http://www.autovinyle.com

http://www.compostnetwork.info

EPCOAT project: http://www.eupc.org/epcoat

Recovinyl project: http://uk.recovinyl.com

Roofcollect system: http://www.roofcollect.com

Tetra Pak : http:///www.tetrapak.com

http ://www.valorbin.be

Vinyl 2010 : http ://www.vinyl2010.org

Vinyloop : http ://www.vinyloop.com

http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=217&listitemid=9987

http://www.letsrecycle.com/prices/paperPrices.jsp

http://www.paper.org.uk/news/2008/pr1903ukpaperpackagingrecoverylevelssmash.htm

http://www.ecometal.ee

http://www.envir.ee

http ://www.actu-environnement.com/ae/news/premier_bilan_ecofolio_5115.php4

http://mi.emu.ee/kompost

http://waste.environmental-expert.com/resultEachPressRelease.aspx?cid=6725&codi=28996&idproducttype=8&level=0

http://www.greendotcompliance.eu/en/countries/poland.php http://www.wbj.pl/article-358-dirty-money.html

http://greenhorizon.rec.org/insight/poland-consolidating-its-waste-collection-industry.html

http://www.ekopartner.com.pl/english/page/waste.htm

http://www.aerpam.org/principal.htm

http://www.arc-cat.net/en/municipals/canon/index.html

http://www.biomatnet.org/secure/Life/S1910.htm

http://europa.eu.int/comm/regional_policy/sources/docgener/studies/pdf/enviwas.pdf

http://www.eco-net.ie/index.php?id=news&sub=13

http://habitat.aq.upm.es/bpes/onu98/bp444.en.html

14.4. GOVERNMENT WEBSITES

European Commission	DG Env, waste	http://ec.europa.eu/environment/waste
European Commission	Summaries of legilsation	http://europa.eu/scadplus/scad_en.htm
European Environment Agency	Country Fact Sheets on waste management in EU countries	http://waste.eionet.europa.eu/etcwmf/publications/factsheet
IVCIE	Interregionale verpakkingscommissie – Commission interrégionale de l'emballage	http://www.ivcie.be
OVAM	Public Waste Agency for the Flanders Region	www.ovam.be
OVOCOM	Belgian consultative body for animal food	http://www.ovocom.be
ADEME	Agence De L'Environnement et de la Maîtrise d'Energie	http ://www2.ademe.fr
AMORCE	French Association of local authorities for waste management	http://www.amorce.asso.fr
IFEN	Institut Français de l'environnement	http://www.ifen.fr/

OCCP (UOKIK)	Office of Competition and Consumer Protection (Poland)	http://www.uokik.gov.pl/

14.5. INTERNATIONAL TRADE FEDERATIONS AND ASSOCIATIONS

ACE	Alliance for Beverage Cartons and the Environment	http://www.beveragecarton.eu/
ACR+	Association of Cities and regions for recycling and sustainable resource management	http://www.acrplus.org/
BIR	Bureau of International Recycling	http://www.bir.org/
CEPI	Confederation of European Paper Industries	http://www.cepi.org/
CEPI Cartonboard	European Association of Cartonboard Manufacturers	http://www.cepicartonboard.com/
EAA	European Aluminium Association	http://www.eaa.net/
EBRA	European Battery Recycling Association	http://www.ebrarecycling.org/
ECMA	European Carton Makers Association	http://www.ecma.org/
ECN	European Compost Network	http://www.compostnetwork.info/
ECPI	European Council for Plasticisers and Intermediates	http://www.ecpi.org/
ECVM	European Council of Vinyl Manufacturers	http://www.ecvm.org/
EERA	European Economic Recyclers	http://www.eera-recyclers.com/
EMCEF	European Mine, Chemical and Energy Worker's Federation	http://www.emcef.org
EPBA	European Portable Batteries Association	http://www.epbaeurope.net/
EPFLOOR	European PVC Flooring Manufacturers	http://www.epfloor.eu/
EPPA	European PVC Window Profile and related building products Association	http://www.eppa-profiles.org/
ERC	European Recycling Coalition	http://www.recycling-coalition.eu/
ERP	European Recycling Platform	http://www.erp-recycling.org/
ERPC	European Recovered Paper Council	See website CEPI

ESPA	European Stabilisers Producers Association	http://www.stabilisers.org/
ESWA	European Single Ply Waterproofing Association	http://www.eswa.be/start.cfm
EuPC	European Plastic Converters	http://www.plasticsconverters.eu/
EuPR	European Plastics Recyclers	http://www.plasticsrecyclers.eu/
Eurobat	Association of European Storage Battery Manufacturers	http://www.eurobat.org/
FBE	Flexible Packaging Europe	http://www.flexpack-europe.org
FEAD	European Federation of Waste Management and Environmental Services	http://www.fead.be/
FEFCO	European Federation of Corrugated Board Manufacturers	http://www.fefco.org/
FEICA	Fédération Européenne des Industries de Colles et Adhésifs	http ://www.feica.com
FIR	Fédération Internationale du Recyclage	http://www.fir-recycling.nl/
Intergraf	International confederation for printing and allies industries	http://www.intergraf.eu
PlasticsEurope		http://www.plasticseurope.org/
PRO-E(urope)	Packaging Recovery Organisation Europe	http://www.pro-e.org
Recharge		http://www.rechargebatteries.org/
TEPPFA	European Plastic Pipes and Fittings Association	http://www.teppfa.com/index.asp

14.6. BELGIAN TRADE BODIES

BBRI	Belgian Building Research Institute	www.bbri.be
COBELPA	Association des Fabricants de Pates, Papiers et Cartons de Belgique	http://www.cobelpa.be/
COBEREC	Confédération belge de la Récupération	http://www.coberec.be/
FEBEM	Fédération des Entreprises de Gestion de l'Environnement	http ://www.febem-fege.be/

FEDIS	Belgische federatie van de Distributie	http ://www.fedis.be
FETRA	Fédération des industries transformatrices de papier et carton	http://www.fetra.be/
FEVIA	Federatie voedingsindustrie	http://www.fevia.be
PVC Info		http ://www.pvcinfo.be/home.asp

14.7. BELGIAN PROS

Bebat	Batteries	http://www.bebat.be/ASP/homepage.asp
Febelauto	ELV	http://www.febelauto.be/
Fost Plus	Household packaging waste	http://www.fostplus.be/tpl/main.cfm
Recupel	WEEE	www.recupel.be
RECYBAT	Accumulators	
VAL-I-PAC	Industrial packaging waste	http://www.valipac.be/
VALORFRIT	Fried fats and oils	http://www.valorfrit.be/

14.8. FRENCH ASSOCIATIONS

ACN	Alliance Carton Nature	http://www.alliance-carton-nature.org
CNR	Cercle Nationale du Recyclage	http://www.cercle-recyclage.asso.fr/
CTP	Centre Technique du papier	http://www.webctp.com
FEDEREC	Fédération de la Récupération, du recyclage et de la Valorisation	http://www.federec.com
FNADE	Fédération Nationale des Activités de la Dépollution et de l'Environnement	http://www.fnade.com
IFEN	Institut Français de l'environnement	http://www.ifen.fr/
SYPREA	Syndicat des Professionnels du Recyclage en Agriculture	http://www.syprea.org

14.9. FRENCH PROS

Adelphe	Household Packaging Waste	http://www.adelphe-recyclage.com/
Corepile	Batteries	http://www.corepile.fr
CSEMP	Industrial Packaging Waste (plastics)	http://www.packplast.org/
Eco-Emballages	Household Packaging Waste	http://www.ecoemballages.fr/
Ecofut	Industrial Packaging Waste (plastics)	http://www.ecofut.org
EcoPSE	Industrial Packaging Waste (plastics)	http://www.ecopse.fr
France Aluminium Recyclage	Industrial Packaging Waste (metals)	http://www.france-alu-recyclage.com/
Grow	Industrial Packaging Waste (Wood)	http://www.emballage-leger-bois.fr/page00010003.html
Recyclacier	Industrial Packaging Waste (Metals)	http://www.recyclacier.com/
Revipac	Industrial Packaging Waste (paper and cardboard)	http://www.revipac.com/
Screlec	WEEE	http://www.screlec.fr
Synarep	Industrial Packaging Waste (wood)	

14.10. ESTONIAN PROS

Eesti Elektroonikaromu	WEEE	http://www.elektroonikaromu.ee
EES-Ringlus	WEEE	http://www.eesringlus.ee
EPC	Estonian PackCycling (Pakendiringlus)	http://www.pakendiringlus.ee/web2/
ERO	Estonian Recovery Organisation	http://www.eto.ee/?setlang=eng

14.11. POLISH PROS

Rekopol	packaging	http://www.rekopol.com.pl
REBA	Batteries and accumulators	http://www.reba.com.pl

14.12. SPANISH TRADE BODIES AND PROS

AERPAM	Asociación Española de Recogedores de Pilas, Acumuladores y Móviles	http://www.aerpa.org/
AFCO	Asociación Española de Fabricantes de Envases y Embalajes de Cartón Ondulado	http://www.afco.es
ASPAPEL	Asociación Española de Fabricantes de Pasta, Papel y Cartón	www.aspapel.es
Ecoembes	Metal and paper-derived packaging	http://www.ecoembes.com
Ecovidrio	Glass packaging	http://www.ecovidrio.es
ECOPILAS	Fundación para la Gestión Medioambiental de Pilas	http://www.ecopilas.es
REPACAR	Asociación Española de Fabricantes de Envases, Embalajes y Transformados de Cartón.	www.repacar.org
PILAGEST	Collection and Recycling Organisation	http://www.pilagest.es

14.13. BODIES FROM NON-COVERED MEMBER STATES

AgPR	Association for PVC floor coverings recycling (Germany)	http://www.agpr.de
PYR	The Environmental Register of Packaging (Finalnd)	http://www.pyr.fi/en/
CONAI	National Packaging Consortium (Italy)	http://www.conai.org
SEPA	Scottish Environment Protection Agency	http://www.sepa.org.uk/