

DG ENVIRONMENT

Economic Analysis of Resource Efficiency Policies

Final report

August 2011

COWI



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Executive summary

Context	<p>Natural resources are fundamental to life, and resource efficiency is on the top of the European political agenda as a key element to achieving smart sustainable and inclusive growth. Efficient use of resources contributes to growth, whereas inefficient use of resources and over-exploitation of renewable resources constitute long-term barriers to growth. Moreover, the use of resources entails significant environmental pressures, such as water consumption.</p> <p>In order to optimise resource efficiency, efforts are necessary in the industrial sector. Particular resource-intensive areas with high resource savings potentials include the agriculture, food production, electronics, construction and automotive sectors. In all of these sectors, there is a resource savings potential, and in some sectors the savings potential is up to 20 per cent. Sectors with the highest potential are construction, chemicals, metals and food. The metal, construction and food sectors were included in the study as case studies for in-depth analysis.</p>
Objective	<p>The objective of this study is to identify policies that have successfully optimised the use of resources. These policies were subsequently assessed in terms of their potential in a European context with the ultimate goal of providing inspiration to ways of improving resource efficiency in Europe.</p>
Methodology	<p>Based on a literature review and stakeholder consultations, 120 resource efficiency policies were identified in 23 countries. Most policies address either material efficiency of specific resources, such as water and aggregates, or material efficiency in industrial production at a general level. The scope of such policies ranges from improving material efficiency in SMEs through dissemination of information on best practices. A number of projects and schemes were identified in the UK, Germany, Belgium, Finland and the US. Such information-based instruments have proven to be able to generate resource savings for businesses.</p>

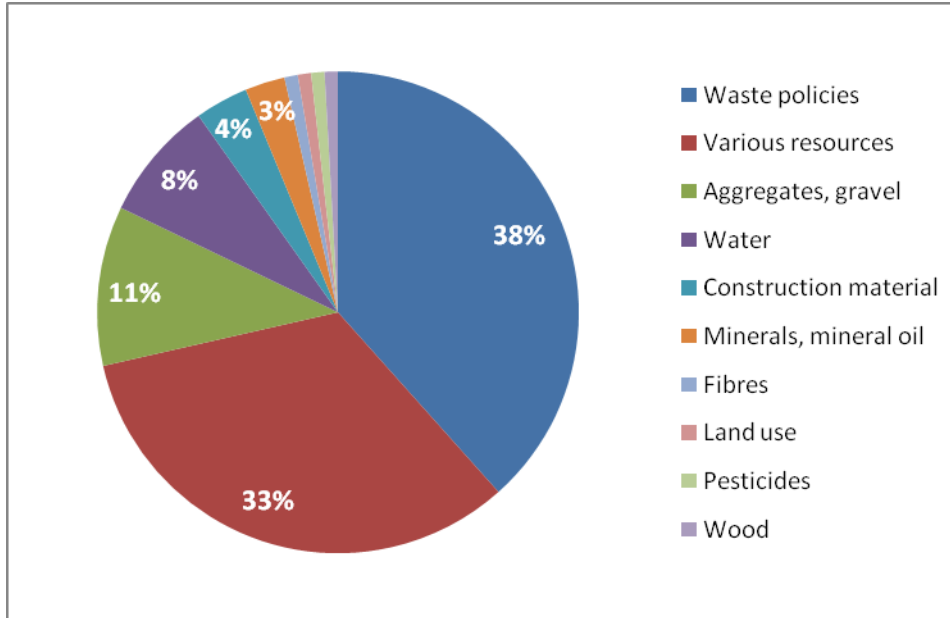
Resources related to the target sectors with economic savings potential in a European context were found to be metals, minerals, biomass, plastics, aggregates, water and food.

Resource efficiency policies identified

The findings of this study show that most countries have much stronger focus on energy efficiency policies than on resource efficiency policies. Further, the scope of a wide range of policies is to improve environmental performance, but a positive spillover effect of such policies is improved material efficiency. An example is the Danish pesticide tax. The scope of the tax is to reduce environmental impacts of pesticide usage. A spillover from the policy is reduced pesticide consumption.

The type of resources addressed by the identified resource efficiency policies are shown in the table below. Waste policies targeting waste prevention, reuse and recycling of waste account for 38 per cent of the identified resource efficiency policies. 11 per cent of the policies concern aggregates and gravel levies and taxes. The purpose of a number of aggregates levies and taxes is to generate income to the state and not to increase materials efficiency. Other objectives of the policies are reducing or making more efficient water use, ensuring materials efficiency in the construction sector or securing sustainable use of minerals and mineral oil, land use, pesticides and wood.

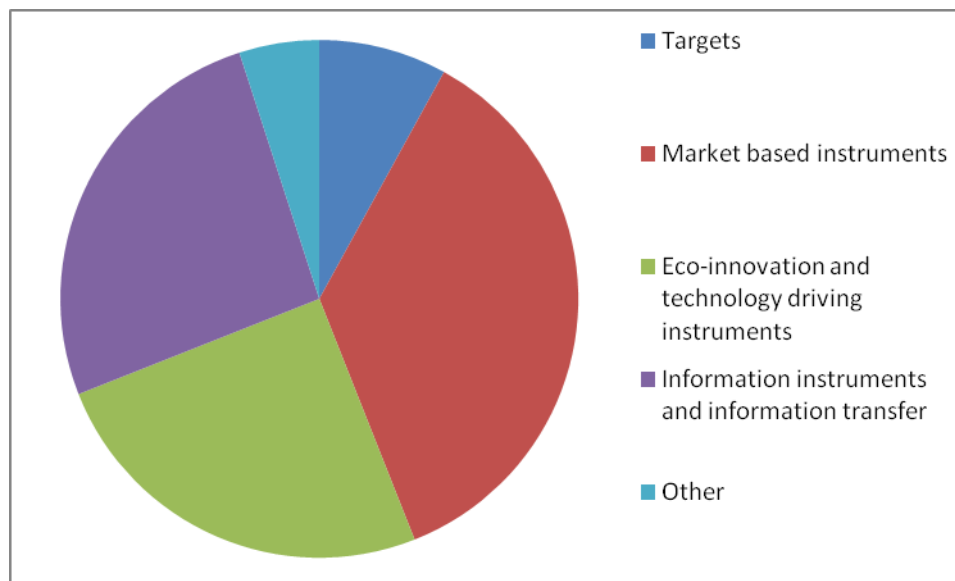
Resources addressed in identified policies



A limited number of the identified policies address material efficiency in specific economic sectors; most of these policies target the construction sector.

33 per cent of the identified policies do not target specific resources. The majority of the policies broadly address resource efficiency in industrial production. Waste minimisation and cleaner production are promoted through a number of different policy instruments, including information schemes and networks, awareness raising, green procurement, R&D programmes on environmental technologies, governmental loan programmes and development of a 'circular economy'.

Instruments used in the identified policies



In-depth assessment of economic benefits from resource efficiency policies

The key findings of the nine in-depth assessments of economic benefits arising from resource efficiency policies are shown in the table below:

Overview of the case studies

Policy initiative	Country	Resource	Instrument	Sector
Aggregates levy	UK	Aggregates	Levy	Construction
PIUS - Product Integrated Environmental Protection Effizienz Agentur NRW	Germany	Water energy	Consultancy/Information on best	Cross-sectoral

Policy initiative	Country	Resource	Instrument	Sector
		Metals Chemicals	practises	
NISP	UK	Waste	Consul- tancy/Informati on on best prac- tises	Cross-sectoral
Aluminium can recycling policies	Sweden/ Belgium	Aluminium	Deposit fee Green dot scheme	Metals
Sustainable clothing roadmap	UK	Textiles/fibres	<ul style="list-style-type: none"> • Regulation • Tax (landfill tax) 	<ul style="list-style-type: none"> • Waste • Textile
Green supplier network	USA	Energy Water Waste Raw materials	Information on best practises	Cross-sectoral
Water for the Future - Murray Darling Basin	Australia	Water	<ul style="list-style-type: none"> • Purchase of water rights/tradable permits • Funding/subsidies 	<ul style="list-style-type: none"> • Agriculture - crops farming or animal farming • Food production
Food waste reduction	South Korea	Food	<ul style="list-style-type: none"> • Networks • Information • Funding/subs 	<ul style="list-style-type: none"> • Food industry • Waste

Policy initiative	Country	Resource	Instrument	Sector
			idies	
Basic policy on promoting green purchasing and green purchasing network (GNP)	Japan	Paper Office furniture	Green procurement	Cross-sectoral

Potential net economic benefits to EU

An analysis of the net economic benefits to the EU economy from resource efficiency policies was made to identify high-impact areas. This analysis is based on an in-depth analysis of the nine case studies, from which it became evident that it is a challenge to translate specific national results to EU27 or from one sector to another.

Not possible to draw general conclusions

The case studies identified enabled the - partial - estimation of the economic impacts at business operational level. The conclusions drawn are based on a limited number of cases, which unfortunately do not provide substantial evidence for drawing general conclusions or detecting trends for all sectors and resources in the EU27. Discussion of how the net impacts of resource efficiency policies may affect the EU balance of trade was therefore omitted, as drawing up EU-wide conclusions would require a much broader analysis of the economic impact.

The case studies represent different sectors, different policy instruments and types of resources. Hence, the policies are developed for different contexts and respond to different circumstances. Resource efficiency policies have been found to be highly relevant in an EU context, but it is not prudent to draw general conclusions applicable elsewhere from nine cases due to their diversified nature.

The future impact of resource efficiency policies

Further, it was realised that it is impossible to assess the future impact of resource efficiency policies due to the diversity of the case studies and their limited range. Where possible, the net potential economic benefits of a future application of a specific resource efficiency policy has been assessed, but the basis for assessing the future impact of such policies at the EU level is too uncertain and such assessments would rest on sheer speculation.

Conclusions drawn from case studies

The case studies provide in-depth analysis of specific resources or instruments and offer valuable information for policy makers to consider in the specific areas.

1) Aggregates levy, UK

The UK aggregates levy addresses the environmental impacts of the extraction and transportation of construction materials, including noise, dust, vibrations, visual intrusion, loss of biodiversity, etc.

Potential impact in EU

The potential economic savings from applying the policy in all EU Member States amount to EUR 1.7 billion for the private sector and EUR 2.1 billion for the public sector in Europe. The tax revenues from implementation Europe-wide would generate a total of EUR 5,682.6 million (EUR 2/tonne).

2) PIUS-Check (Produktionsintegrierter Umweltschutz), Germany

The Effizienz-Agentur NRW (EFA) initiative was launched by the North Rhine-Westphalia (NRW) Ministry in 1998. The EFA initiative is aiming at promoting cleaner production methods in SMEs. The EFA has developed a toolbox with a range of consulting services for SMEs. The purpose is to help SMEs improve their resource efficiency through avoiding pollution and improving resource conservation in the production process.

Potential impact in EU

The estimated economic benefits for SMEs of participation in PIUS-Check or a similar scheme is estimated to EUR 333,000 over 10 years. If the same share of manufacturing SMEs EU-wide were audited by means of a PIUS-check, the potential economic benefit of offering the PIUS-Check to all SMEs in EU-27 would be EUR 776 million.

3) National Industrial Symbiosis Programme, UK

The National Industrial Symbiosis Programme (NISP) is a free (to business) advice and networking programme. NISP's approach uses industrial symbiosis to identify sustainable resource management solutions for business.

Potential impact in the EU

By applying a system similar to NISP in EU27, cost savings are estimated to EUR 1,411.1 million, additional sales for participating companies are estimated to EUR 1,591.1 million. The cost of implementing such a programme is estimated to EUR 167,000.

4) Recycling of aluminium beverage cans, Belgium and Sweden

Producers of canned beverage and importers of metal beverage cans for the Swedish market are required to join an approved deposit-based recycling system. Every Belgian company that packages or arranges for the packaging of products sold in Belgium is liable to collect used packaging material to achieve the prescribed recovery and recycling rates.

Potential impact in the EU

The annual potential economic benefit to operators of aluminium recycling systems in EU-27 of introducing a recycling system similar to the Swedish recycling system is estimated to be EUR 19.6 million. The potential economic benefit of implementing a recycling system similar to the Belgian system is estimated to be in the magnitude of EUR 7.4-28 million.

5) Sustainable Clothing Roadmap, UK

The Sustainable Clothing Roadmap was established in 2007 to increase sustainability throughout the clothing supply chain, thereby maximising reuse and recycling of fibres. It is coordinated by the Department for Environment, Food and Rural Affairs (Defra) and is part of Defra's Sustainable Consumption and Production (SCP) Programme.

Potential impact in the EU

At EU level, 1.3 million tonnes unused clothing and textile resources annually have recycling potential. The economic benefit has not been estimated due to diversity at production level, making generalisations difficult. It is estimated that annual savings of EUR 56 million on landfill taxes in the EU can be achieved.

6) Green supplier network

The Green Suppliers Network (GSN) is a collaborative programme run by a combination of industry, the US Environmental Protection Agency (EPA) and the US Department for Commerce's National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP). The GSN works specifically within the manufacturing sector, in particular with large manufacturers to assist them in engaging their SME suppliers through low-cost technical reviews that use 'Lean and Clean' methodologies to increase productivity, reduce waste, and boost profitability.

The GSN programme has produced very impressive environmental and economic benefits for those companies that have taken part in it. Many of these savings are related to process improvements brought about by 'lean manufacturing' techniques.

Potential impact in EU The manufacturing sector has gained most from the outputs of this programme. Whilst SMEs are well represented in this sector across Europe, the lack of an independent evaluation to quantify the achievements of the GSN makes it difficult to estimate how well the programme could be replicated across the EU.

7) Water policy in Murray-Darling, Australia

In 2008, *Water for the Future* was elaborated by the Australian government as a response to the pressure on the water resources in the Murray-Darling Basin. The Murray-Darling Basin is under great stress from the combined impacts of historical over-allocation of water for consumption, severe drought, growing population, and the early impacts of climate change and anticipated reduction in water availability in the future.

Potential impact in EU By combining the use of a water quota system and financial support for implementation of water efficiency measures, there is a total potential of water savings for Bulgaria, Greece, Spain and Romania of approximately 6,600 million m³ annually. Based on an agricultural production loss of 4.8 per cent annually and an estimated cost of implementing the policy of approximately EUR 36 billion, there is a potential surplus of 23.5 per cent for the EU irrigation farmers adopting a policy initiative as the one introduced in the Murray-Darling Basin.

8) Food waste, South Korea

The Food Waste Reduction Policy from 2003 contains different food waste reduction programmes, such as campaigns for changing table settings, food waste-to-energy policy, use of food waste for fodder and compost and prohibition of direct landfill of food waste all aiming at promoting an environment-friendly food culture to reduce the amount of food waste.

Potential impact in the EU The potential savings include costs savings from reduced processing costs. Further, the costs of implementing the food waste reduction policy should be offset. These cost figures are difficult to estimate since they depend on the potential for reducing the amounts of food waste in the individual EU countries.

At EU25 level the total import of animal feeds in the first semester of 2006 was EUR 5.200 million, hence internal production of animal feed and fodder substituting the current import holds a potential for savings in the order of EUR 10.400 million annually for livestock holders in the agricultural sector.

9) Green purchasing, Japan

The Act on Promoting Green Purchasing requires the national government to set up a Basic Policy on Green Purchasing. It is obligatory for the public sector to follow the green procurement guidelines.

Potential impact in the EU

Based on the available data, it is not possible to estimate the economic benefits to companies arising from the policy. The demand for green products, however, gives strong incentives to product manufacturers to develop and produce green products. The magnitude of economic benefits to businesses that would emerge from transposing the Japanese green procurement policy into a European context is highly uncertain.

Policies yielding the highest economic benefits in the private sector

- The highest economic benefits to businesses are brought about by policies that aim at improving companies' resource household (PIUS-Check, NISP and Green Supplier Network).
- The Australian water policy entails significant income to water consumers. On the other hand, the policy has high costs to society through the purchase of water rights and implementation of efficient water supply and irrigation technologies.
- The UK aggregates levy has socio-economic benefits, but imposes extra costs on businesses. The levy combined with the UK landfill tax gives companies economic incentives to use recycled material instead of using virgin aggregates. Where substitutes for virgin aggregates are not available, the extra costs of the levy are likely to be passed on to customers.
- Recycling of aluminium cans is economically feasible. There is an economic potential for improving the recycling of aluminium beverage cans in the EU by using the Swedish or Belgian example. However, it should be recognised that the potential economic benefits are modest.
- Reuse of food waste has limited economic potential in the EU.
- Production of rags, filling and padding by recycling of clothing and textile waste constitutes an economic potential. Presently, it is not economically feasible to reuse clothing and textiles waste for production of clothing.

- The economic potential of the Japanese green purchasing policies is uncertain, but it is likely to entail economic benefits to the private sector.

The magnitude of the benefits to the private sector of the policies reviewed in the case studies is estimated in the table below.

Policy initiative	Private economic benefits ¹
Aggregates levy	++
PIUS - Product Integrated Environmental Protection Ef-fizienz Agentur NRW	+++
NISP	+++
Green supplier network	+++
Water for the Future - Murray Darling Basin	+++ ²
Aluminium can recycling policies	+
Sustainable clothing roadmap	++
Food waste reduction	+
Basic policy on promoting green purchasing and green purchasing network (GNP)	(+)

The cases presenting cross-sectoral policies, such as the PIUS and NISP cases, show high resource efficiency potential. An influencing factor may be the fact that companies see rapid results, which is a strong incentive.

¹ Max score is 3 plus and minimum is 3 minus.

² From a socio-economic view, this policy is extremely expensive and would receive a lower score if this cost was included.

Overall, the analysis of the case studies found that the resource efficiency policies with the highest economic benefit to the companies are generally those that are backed by substantial national funding. The Murray-Darling, NISP and PIUS cases are good examples of this.

1 Introduction

1.1 Objective and scope of the study

The purpose of the study

The purpose of the study is to provide a sample of existing resource efficiency policies, which have been analysed in terms of their economic impacts. The results should be used as a case study to businesses establishing the potential economic advantages likely to follow from implementing certain resource-efficient policies. An example could be that the businesses will gain a competitive advantage due to cost savings, improved corporate image, etc.

The objective of the study is three-fold:

- to inform decision-makers on the potential economic impact of applying resource efficiency policies in EU Member States
- to provide guidance on the areas where a resource policy would deliver the greatest net economic returns
- to provide guidance on the most beneficial form of policy under different conditions, and on the factors which would affect net economic benefits.

Hence, the scope of the study is the following:

Inform decision-makers on the potential economic impact	<p>By analysing the results of resource efficiency policies currently being implemented inside and outside the EU, the study will transfer/scale up results to the wider EU context, thereby providing guidance on the most beneficial policies and the potential economic impacts in the EU.</p> <p>The study seeks to determine the potential of implementing policies in Europe at full scale.</p>
Provide guidance on net economic returns	Resource efficiency policies are organised according to a typology, and a number of resource efficiency policies that best illustrate the economic impact of such policies will be selected for in-depth analysis. The study should take into account, inter alia, the aim of the Thematic Strategy to increase resource productivity by 3 per cent annually and the aim of the Raw Materials Strategy to decrease the use of primary materials.
Provide guidance on benefits in different conditions	The study will furthermore analyse resource policies under different conditions as well as the factors that could affect net economic benefits. The scope of the study is to analyse the efficiency of resource policies applied in EU Member States as well as in the countries outside the EU, such as Japan, South Korea, Australia and North America.

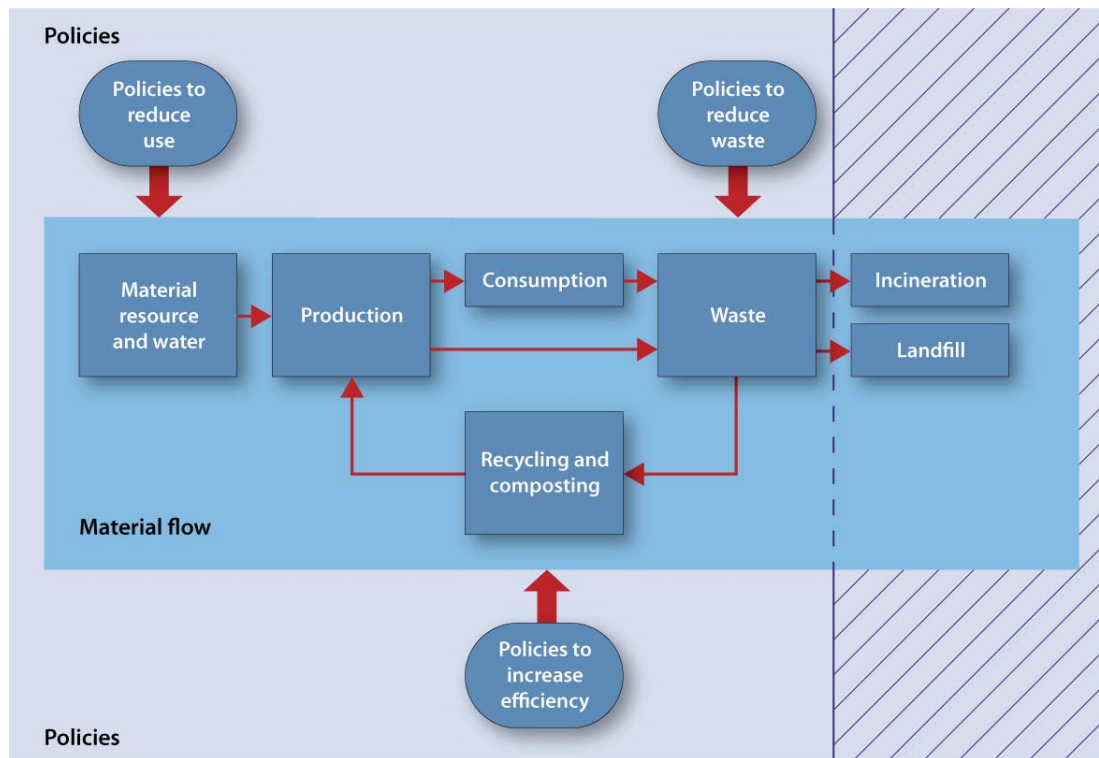
1.2 Background

Currently, the general impression is that European economic resources are used inefficiently, leading to reduced competitiveness. Theoretically, in a perfectly competitive market, resources are allocated efficiently over time, when firms and consumers individually maximise benefits, which in turn lead to greater economic benefits due to resource efficiency measures.

Knowledge gap	A knowledge gap exists on the net economic benefits that emerge from launching resource efficiency policies. The study will provide solid evidence of such economic benefits, which will be estimated based on sample data on governmental costs of implementing and enforcing such policies and data on the costs of companies of adapting production to new policy requirements.
Resource situation	<p>The worldwide use of almost every significant resource material has been rising throughout decades. China, India and Brazil and other growing economies of the developing world use natural resources at an accelerating pace.</p> <p>Among the impacts are depletion of finite resources, over-exploitation of renewable resources as well as related environmental pressures. Humans have changed the earth's ecosystems more rapidly and extensively through the last 50 years than in any comparable period in human history, primarily in order to meet rapidly growing demand for food, fresh water, timber, fibre and fuel (MEA,</p>

2005: 1). This has resulted in a concern over shortage of natural resource stocks, the security of supply of energy and other materials, and the environmental effectiveness of their use (OECD, 2008a). The efficient use of resources contributes to growth, whereas inefficient use of resources and over-exploitation of renewable resources constitute long-term barriers to growth. Moreover, the use of resources entails significant environmental pressures.

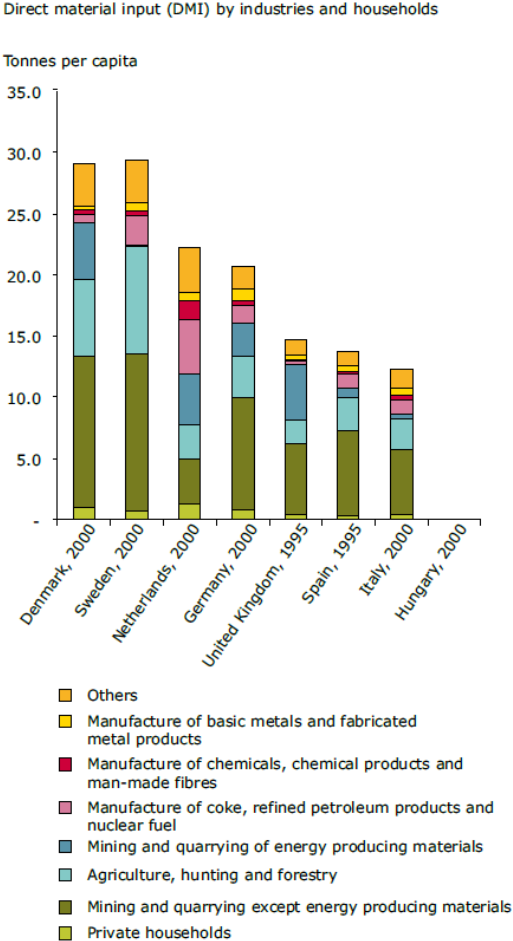
Figure 1-1 Interfaces between resource use and waste and related policies



Source: Own compilation.

Resource policies	<p>Potential resource efficiency policies both address avoidance and reduction in the harvesting/excavation of resources, the use of resources in the production process, and the efficiency of the operation of products. Moreover, the relevant policies also address the reuse and recycling of resources.</p> <p>The choice of instrument will depend on the design and the main purpose of the policy. Chapter 2 of this report deals explores this issue in more detail .</p> <p>Furthermore, the nature and cause of environmental externalities will be analysed, whereas no attempts will be made to estimate the economic value of environmental externalities. The focus of economic impacts of resource efficiency policies will be on the 'private sector' costs of these policies.</p> <p>Policies targeting the disposal of waste are not relevant to this study. Energy efficiency policies or policies that address the management of fish stocks will neither be addressed by the study.</p>
Sectors affecting the environment	<p>The four most dominant economic sectors in the EU exerting direct pressure on the use of resources are agriculture, the electricity industry, transport services and some basic manufacturing industries (refinery and chemical products, non-metallic mineral products, and basic metals). Materials extraction is dominated by agriculture and mining industries. Of these four hotspot sectors, only the manufacturing sector has been successful in decoupling three main environmental pressures (greenhouse gas emission, acidifying emissions and ground ozone precursors) from economic growth (Moll et al., 2009: 4-5).</p> <p>Figure 1-2 shows the priority economic sectors that generate significant environmental pressures from resource use. It is apparent from the figure that the direct material input in terms of tonnes per capita differs significantly across the EU. The differences across the EU partly reflect the differences in the composition of the domestic industries, partly differences in resource efficiency.</p>

Figure 1-2 Priority economic sectors generating significant environmental pressures



Source: EEA (2007: 257).

Market imperfections	Over-exploitation of resources and related environmental externalities can be seen as a market imperfection, since prices do not fully reflect the costs to society of deploying resources. One should also bear in mind the imperfections of current international recycling markets. Information asymmetry is another market imperfection of high relevance. As mentioned in the terms of reference, a perfectly competitive market should, in theory, lead to optimal allocation of resources over time, when firms and consumers individually maximise benefits. If, however, market prices do not reflect the total production costs of a good, including resource costs and external costs, consumption will tend to be too high, compared to a situation with optimal resource allocation. In that case, governmental bodies should correct market imperfection by using appropriate policy instruments.
Europe 2020 strategy	In January 2011, the European Commission launched the Europe 2020 strategy for smart, sustainable and inclusive growth, which should contribute to creating high levels of productivity, employment and social cohesion, both at EU and Member State level. The strategy contains a number of specific targets and flagship initiatives, including “A resource efficient Europe”. This initiative puts resource efficiency high on the political agenda and aims to support “the shift towards a resource-efficient, low-carbon economy to achieve sustainable growth ³ ”.
Resources in this study	<p>The <i>thematic strategy on the sustainable use of natural resources</i> launched by the European Commission in 2005 mentions four types of natural resources: raw material such as minerals, biomass and biological resources; environmental media such as air, water and soil; flow resources such as wind, geothermal, tidal and solar energy; and space (land area) (European Commission, 2005a: 3). The types of resources considered in this study are primarily material resources, including raw materials and environmental media (primarily water).</p> <p>These resources can be divided into renewable resources, such as agricultural products, animal farming and wood, and non-renewable resources such as coal, oil, metals and gravel. Non-renewable resources are finite, and hence the net economic benefit of the use of the resources depends on the optimal allocation of resources in terms of use, e.g. by reducing the use intensity of the resource or by replacing the use of a scarce or environmental harmful resource with a resource that is less scarce and/or environmentally harmful. Optimal allocation of resources may also be achieved by the allocation of resources over time, as the net economic benefits of the use of the resource may constitute a higher (or lower) value in the future than the value of the use of the resource today.</p>

³ http://ec.europa.eu/resource-efficient-europe/index_en.htm

Waste constitutes an important secondary source of resources. A range of policies target the reuse and recycling of waste. Recycling policies that aim to increase resource generation from waste in economically beneficial ways will therefore also be considered resource efficiency policies, whereas waste policies that aim to reduce the environmental externalities caused by waste such as waste treatment standards not will be included.

1.3 Limitations

Limited access to data at production level

A limitation to the results of the study turned out to be limited access to data at business operational level. This is the case with *The Sustainable Clothing Road Map* showcase from the UK, where financial information about production input and processing was inaccessible. It is not clear why the clothing industry did not deliver this information, but apparently it was regarded an issue of competitive relevance.

Another shortcoming is the inability of the study to draw general conclusions based on the nine case studies. The case studies represent different sectors and different policy instruments and types of resources. Hence, the policies are developed in different contexts, and they respond to different circumstances. Resource efficiency policies have proved to be highly relevant in an EU context, however, one should be cautious about drawing general conclusions from the nine cases due to their diversified nature.

1.4 Outline of report

The report has been structured to address systematically the study objectives.

Chapter 2

Chapter 2 discusses and defines the central typology, which serves as the theoretical framework for identifying the key elements for the later in-depth analysis of the potential resource efficiency policies.

Chapter 3

Chapter 3 presents the methodology of the study and the key elements of the approach. It further presents the data collection for the screening and case studies into detail, which is a core element of the study.

Chapter 4

Chapter 4 introduces the term 'potential' and explains how it has been used in this study.

Chapter 5

Chapter 5 introduces our approach to elaborating the database and the criteria for selection of the case studies.

- Chapter 6 Chapter 6 presents the results of the case studies in short summaries highlighting the key elements and conclusions. The detailed analysis of each case can be found in annex 1.
- Chapter 7 Chapter 7 presents the overall findings and conclusions of the study.

2 Typology

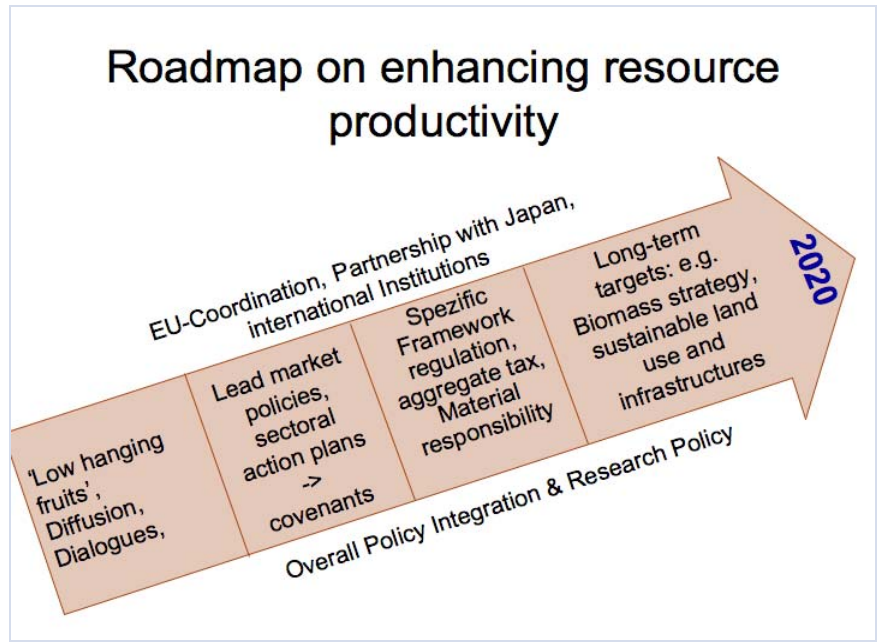
Framework	To be able to gather evidence to illustrate the net economic benefits of different types of policies, a <i>typology of resource policies</i> has been established for the project to serve as the framework for identifying the key elements of the study. The typology provides a practical segmentation of resource policies categorizing them according to for example policy type, type of market failure tackled, type of economic actor targeted or nature of the resource(s) concerned.
Custom-made typology	Against the background of the approach above, the main task of this chapter is not to provide an exhaustive overview of different typologies, but rather to develop a custom-made typology for a quick comparison across instruments and their (possible) impacts in terms of economic costs and benefits. The typology also facilitates comparison between types of policies aiming at achieving similar objectives, also for future readers.
Different typologies	Many typologies exist accentuating one type of policy more than other types (e.g., market based instruments, informational instruments, etc.), but most refer to the conventional classification. Starting from the conventional classification, this section will develop a typology that provides the information as is suggested by the ToR. It aims to include the possible qualitative economic costs and benefits of the instruments. The chapter will not discuss the advantages and disadvantages of the policies in detail, i.e. in monetary terms. Instead, it will demonstrate theoretically the likely economic costs and benefits of the implementation of a certain policy. The typology will thus provide the reader with information about instruments that are most optimal for eco-innovation purposes and for income-generating purposes etc.

2.1 Overview of existing typologies

Typology of resource policies

In an attempt to identify market failures and possible political abatement costs to enhance resource productivity, Bleischwitz et al (2009: 228ff) have developed an outline of a resource policy with different pillars. Pillars include ‘diffusion policies’ of lowering material purchasing costs, improving process innovation and spreading best-practice examples, developing lead markets for new products and services and sectoral action plans. In addition, long-term targets should be formulated and infrastructure should be subject to change. This is illustrated in the figure below.

Figure 2-1 Roadmap on enhancing resource productivity



Source: Bleischwitz et al. 2009: 239.

Policy instruments according to governmental interventions

A classical option is to switch to policy instruments and categorise them according to the governmental intervention level. Böcher and Töller show policy instruments ranging from persuasive instruments to regulative instruments while increasing the necessary degree of intervention (see **Error! Reference source not found.**below).

Table 2-1 Policy instruments according to governmental intervention

Persuasive instruments	Cooperative instruments	Procedural instruments	Market-based instruments	Regulative instruments
<ul style="list-style-type: none"> • Environmental information • Environmental education • Labelling (...) 	<ul style="list-style-type: none"> • Voluntary agreements • Round tables • Dialogues • Mediation (...) 	<ul style="list-style-type: none"> • Environmental impact assessments • Eco-audits (...) 	<ul style="list-style-type: none"> • Environmental taxes • Tradable permits • Subsidies • Loan programmes (...) 	<ul style="list-style-type: none"> • Bans • Thresholds • Approval processes (...)
low Degree of governmental intervention high				

Source: Böcher/Töller 2007, 306

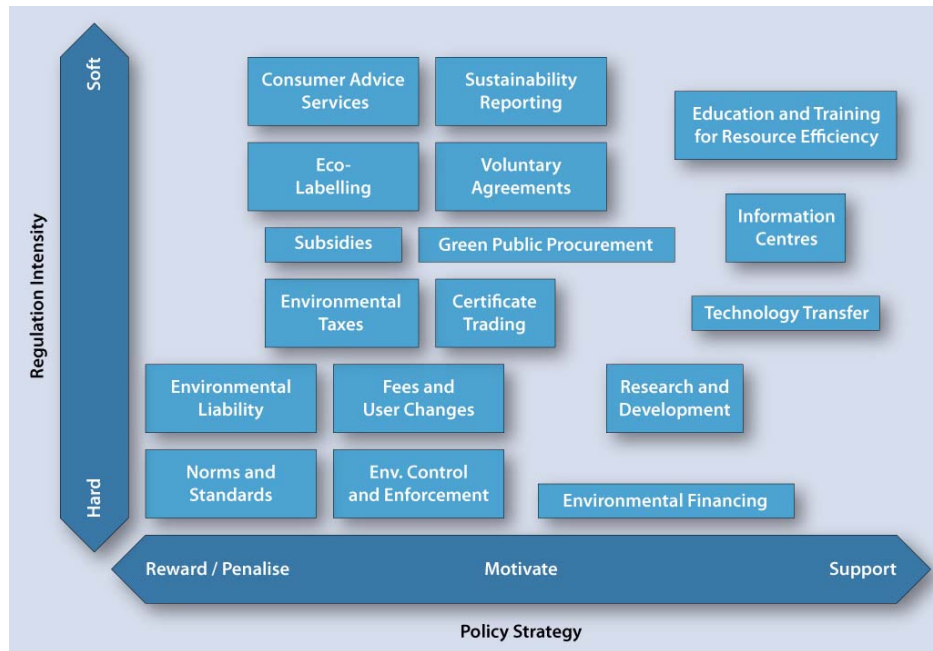
Although this classification does not refer to resource efficiency policies, it can be applied in this context. Most typologies of environmental policies do not exclude the application to resource efficiency policies. While it might be interesting for policy makers to have knowledge of the inevitable level of intervention for a certain policy, it is usually not the main decision criterion for policy makers concerned with economic considerations. It is important to secure that the governmental intervention is cost-intensive.

Sustainable production and consumption policies

A typology of sustainable production and consumption policies used for boosting resource efficiency (CSCP, 2006) clusters instruments and broader policies according to regulatory, economic, education and research, cooperation and information policies and characterises them by positioning the policy instruments in a two-dimensional diagram (Figure 2-2 below). On the horizontal axis, the

policy instruments are organised according to whether the policy instrument provides assistance and enables support or rather rewards or imposes penalties on producers and consumers.

Figure 2-2 Resource efficiency policy diagram



Source: CSCP (2006: 5).

The vertical axis reflects the regulation intensity. The policy instruments are sorted according to whether they address 'hard' or 'soft' factors. The hard factors are tangible factors that at least are partially necessary to engage producers (and consumers) in resource efficiency activities. Hard factors may encompass access to finance and technology. Soft factors are intangible factors, which can include issues such as human resources and organisational structures.

Although this resource-efficiency policy diagram provides a useful positioning of the available basket of instruments according to two basic characteristics of the instrument, namely the degree of voluntary business and consumer participation and the need for investments that the use of the instrument entails, it does not refer to the interest countries might have in implementing resource policies. Furthermore, potential economic performance is not included. Practical experience also shows that instruments differ from country to country. For instance, an “eco-tax”, may entail elements of support in one country and penalisation in another. Moreover, the diagram does not take into account the variety of resources, specific interests of environmental policy (e.g. to prioritise resources) or of foreign policy (e.g. access to resources).

International scale

Looking at the international scale, it might be important to take into account the broader strategies of countries that are less aligned to environmental policy and closer to foreign policy (e.g. purchasing of materials in Africa, i.e. strategic metals, and access to resources) as well as to growth policy in general. The latter is especially important for those countries that are rich in natural endowments and seek to exploit them in a most beneficial way (e.g. Russian gas policy).

Based on the more traditional division of policies into types of instruments such as targets, market-based instruments and informational instruments, the dynamics of the policies should be captured by introducing other types, eco-innovation and technology driving policy (including regulatory and voluntary instruments). Further, the qualitative advantages and disadvantages of achieving certain economic targets besides increasing resource efficiency are briefly displayed. The different types of instruments should be used on a generic level as examples of the types of instruments, i.e. an environmental tax as a type of market-based instrument, etc. Interest is not concentrated on finding out whether an instrument is a market-based instrument or not but on identifying the differences in economic terms that have to be discussed.

2.2 Typologies used for this study

Objective of the new typology

This section develops a typology that is to be used throughout this study. As shown in the previous section, many typologies exist already and they all cover different aspects of resource efficiency policy. The typology developed here aims to concretise the concept of resources efficiency and the policies linked to obtaining that. In particular, the matrix aims to reflect a new development in the resource efficiency field, namely increasingly being a fusion point of innovation and environmental policies. “While environmental policy has been insufficiently oriented towards technology development and innovation, innovation policy has often been too broad to address specific environmental concerns appropriately” (OECD 2009: 183). Now a series of new policies implemented in some OECD countries have acted on the suggestion to integrate the two policy areas. As this typology expresses, it complements the existing typologies by providing information on:

- The link between resource efficiency and the belonging policies
- The design of the policies and instrument influences the resource efficiency

Methodology for developing the new typology
Categories

The typology is built up as a matrix that links the type of instruments with a number of characteristics such as the market failure they address, the sectors and resources they target at and finally the cost and benefits related to the instrument.

In order to maximise information, and supported by previous analysis (Bahn-Walkowiak et al 2007), the following categories are distinguished: market failures addressed (asymmetric information) and information deficits, i.e. lack of market transparency and imperfect rationality, public goods, external costs, market power. Further barriers concern path dependencies, orientation deficits, coordination failures (Bringezu/Bleischwitz 2009: 228ff.). The type of economic actors targeted (e.g., sectors or single industries), the resource(s) concerned, type of behavioural response intended (incentives set), (theoretical) economic benefits (as far as evident and, at a later project stage ideally, documented) and national examples are the following categories. The matrix put more emphasis on governmental action as bottom-up approaches are desirable but difficult to measure.

Adverse effects of policies

It should be noted that the policies listed in the matrix could both be potential policies in one country and actual policies in other countries. Moreover, many countries implement policies with a tangible adverse effect on resource efficiency; some of which even aim at spurring resource use for economic cycle reasons. This is particularly true for subsidies in the mining sector, which are frequently provided in order to keep the material flow at a steady level or to foster a growing level depending on the economic relevance of the sector to the country in question. The mixture of opposite purposes or split incentives is a realistic picture in most countries of the world.

Narrow definition of resource efficiency policy

The typology uses a narrow definition of resource efficiency policy, i.e. a policy that aims at reducing the resource input or use or the direct impact of which is the reduction of resource use. The main purpose of a resource tax may be to generate public income, and the direct effect may be reduction of resource consumption. There are a vast number of environmental policies that could also be classified resource efficiency policies (such as CO₂ taxes, etc.) as an indirect effect is a reduction of resource input or the like (see e.g., EEA 2005). In order to keep track, we have to exclude these policies only generating indirect resource efficiency effects here.

Table 2-2 Typology of resource efficiency policies and selected national examples

Instrument / Policy	Main market failure addressed	Economic actor targeted (sector / demand area)	Nature of resource(s) concerned	Type of behavioural response intended (incentive for...)	Possible economic and other costs	Possible economic benefits	National examples
Targets							
Resource efficiency targets (e.g., sustainability strategy, road maps)	orientation deficit, information deficits	all sectors	all resources	change behaviour	development expenses and consultancy costs	superior orientation for the public and industries	Fundamental Plan for Establishing a Sound Material-Cycle Society (2000), Japan; Sustainability Strategies of Member States, The National Eleventh Five-year Plan for Environmental Protection (2006-2010), China
Market-based instruments							
Resource taxes (ad quantum) – tax base is the physical amount of the resource extracted	external costs	mining & quarrying and downstream industries	e.g. aggregates, petroleum	resource use reduction, substitution of material, recycling	administrative costs, monitoring (if infrastructure is not given) potential reduction of employment in raw materials industry less effective in guaranteeing a given environmental outcome	public income generation employment in recycling and substituting industries stabilisation of world market prices clear cost signals valuable to capacity building – help to provide information	Aggregates Tax, (implemented in 16 European countries) Mineral Oil Tax (implemented in practically all European countries) Peat (Latvia, Lithuania, Sweden)
Resource taxes (ad valorem) percentage of the cost of extracted mineral raw materials	external costs	mining & quarrying and downstream industries	e.g. aggregates	resource use reduction, substitution of material, recycling If market is strongly competitive rebound effects may occur	administrative costs, monitoring (if infrastructures are not given) potential reduction of employment in raw materials industry less effective in guaranteeing a given environmental outcome	public income generation employment in recycling and substituting industries clear cost signals valuable for capacity building - help to provide information	Mining taxes/charges (Czech Republic, Moldova, Poland and Russia)

Instrument / Policy	Main market failure addressed	Economic actor targeted (sector / demand area)	Nature of re-source(s) concerned	Type of behavioural response intended (incentive for...)	Possible economic and other costs	Possible economic benefits	National examples
Tradable permits	external costs	mining & quarrying	e.g. fish, (CO ₂ emissions)	reductions in use of resources	administrative costs and burdens need for monitoring, verification and enforcement	appropriate allocation	
Differentiated VAT rates - products - product groups - sectors	external costs, asymmetric information	e.g. food & beverages industry public utilities mobility, e.g. rail-road traffic vs. automobile traffic	all resources - mainly food & beverages, water, automotive/public transport Czech Republic: biological treatment of wastewater, energy efficiency water and wind turbines, photovoltaic, biodiesel, - gas, etc. Portugal: Photovoltaic, renewable resources equipment UK: insulation materials	behaviour changes	public expenditure for reduced tax rates resistant to change; tax breaks require active decision by lawmakers to eliminate them	public income from standard tax rates	in most European Member States, usually not implemented for resource efficiency reasons, apart from tax reduction schemes in Czech Republic from 1993 to 2003 Portugal since 2001 UK since 2000
Subsidies	adaptation deficits	agriculture, forestry	energy crops, biofuels (disputed), forestation	technology introduction & diffusion	public expenditure	competition edges (risk of being in place for too long and creating vested interests that are difficult to abolish)	United States, for example, companies producing liquid biofuels receive direct subsidies for every gallon of ethanol produced
Eco-innovation and technology driving instruments							
Recycling / circular economy (3R laws)	adaptation deficits	waste industry, recycling sector	construction and demolition materials - wood, timber,	reduction of re-source use and increase of secon-	investments in infrastructure compliance costs	reduction of waste	Circular Economy Law, China Construction Material Recycling Law, Japan

Instrument / Policy	Main market failure addressed	Economic actor targeted (sector / demand area)	Nature of resource(s) concerned	Type of behavioural response intended (incentive for...)	Possible economic and other costs	Possible economic benefits	National examples
			concrete, asphalt	dary input			
Eco-innovation	adaptation deficits (path dependencies, market power vs. niche markets)	forestry, agriculture	wood, land, crops	research & development, dissemination of innovations	public expenditure	competition edges, cut in resource use	Framework Programme Renewable Resources, Germany (€ 800 million fund) Resource Efficiency Science Programme, UK
Sectoral policies / covenants	coordination failure	steel, paper, chemical and non-ferrous metal industries	steel, paper, chemicals, non-ferrous metals	market introduction & diffusion	public expenditure (depending on how strong involvement of sectoral actors is) compliance costs	sectoral benchmark	Dutch Target Group Policy, NL Law for the Promotion of Effective Utilization of Resources, Japan
Dynamic standards / top runner	adaptation and information deficits	electric appliances	product-specific minimum standard (of secondary input)	reduction of primary material use, increase of secondary material use	administrative and monitoring costs	product benchmark	Top Runner Programme, Japan
Voluntary Top ten	adaptation and information deficits	buildings, mobility, electronics, appliances	electricity	market introduction & diffusion, change in purchasing behaviour	monitoring costs	product benchmark	Market Pull for High Efficiency Products, Euro-Topten Plus (2009-11) will be expanded to 16 countries and include 20 partners
Green purchasing	adaptation and information deficits	electric appliances	machinery (office equipment)		compliance costs	product benchmark	
Governmental loan programmes	capital deficits			market introduction & diffusion	has to be re-approved with each budget cycle public expenditure		Recycling Market Development Revolving Loan Program, State of California, US
Funding for resource efficiency investments	capital deficits			market introduction & diffusion			Loans for the Promotion of Environmentally Conscious Management Programme, Japan
Information instruments and information transfer							
Information Networks	information deficits			change in purchasing behaviour			Environmental Sustainability Knowledge Transfer Network, UK Green Suppliers Network, US Green Purchasing Network, Japan

Instrument / Policy	Main market failure addressed	Economic actor targeted (sector / demand area)	Nature of re-source(s) concerned	Type of behavioural response intended (incentive for...)	Possible economic and other costs	Possible economic benefits	National examples
Information Services				change in purchasing behaviour, market introduction & diffusion			Information service for product integrated environmental protection in industries (PIUS), Germany

Source: Own compilation

Different national understandings

Many countries have different understandings of resource policies. In the Asian countries, one may find particularly waste and recycling (end-of-pipe) policies as resource policies, other countries rather refer to agriculture or mining policies. The geological conditions and economic framework of the countries in question have to be considered when policies are compared. Furthermore, “experience in recent years shows that the question of 'which instrument is best' has changed to 'which mix of instruments is best', both in terms of using MBIs alongside other environmental measures such as regulations and in terms of using MBIs to meet environmental objectives in combination with economic and social objectives e.g. environmental tax reform and subsidy reform” (EEA 2005: 6). On this note, the typology aims to be suggestive of the broad policy spectrum but can naturally not be exhaustive. It is a first input for further investigation, but it should help clarify different options and restrictions of policies.

3 Methodology and definitions

This chapter presents the key elements of the study approach and the main methodological tools applied in the analysis.

3.1 Basic elements of approach

Case studies

This study is based on a case study methodology. The economic costs and benefits arising from the application of illustrative examples of resource efficiency policies (REPs) have been estimated based on in-depth economic analysis of a selection of policy instruments. Based on a screening exercise to identify such REPs, a stepwise analytical approach has been designed to ensure the relevance of the resource efficiency policies that are selected for further investigation.

The analytical approach includes three basic elements: target sectors, critical resources and experiences with the use of resource efficiency policies.

Identification of target sectors

Sectors with the highest resource-saving potential are identified based on literature indicating where the largest potential for resource efficiency can be expected.

Identification of critical resources

Identification of resources related to the target sectors that are critical to Europe. Focus for this analysis is on interesting patterns related to the use of resource efficiency policies.

Experience with resource efficiency policies

Based on the characteristics and relative economic importance of the target sectors, a number of countries are identified. For the selected countries, the relevant resource efficiency policies that may have caused the changes in resource use, stock and/or price are identified. The selection includes countries inside and outside the EU.

In the following, the three basic elements of the analytical approach i.e. target sectors, critical resources and experiences with the use of resource efficiency policies will be detailed.

3.1.1 Identification of target sectors

Analysis of resource efficiency policies in non-EU-countries that similarly adheres to resource efficiency potentials has to be guided by a systematic ap-

proach. The first step will therefore address the identification of relevant sectors and relevant resources by means of the MFA/OECD methodology (Bringezu/Bleischwitz 2009; OECD 2008) and the following central questions:

1. **At the macro level:** Within the countries selected, which sectors are most relevant to domestic resource use and/or environmental impacts?
2. **At the meso level:** Within these sectors, which resources are most relevant to the sectoral resource use and/or environmental impacts?

Economic importance and resource intensity

In order to select sectors for further analysis, it is important to bear in mind that two criteria are relevant. A sector can be of **economic importance** in terms of its monetary contribution to the national Gross Domestic Product (GDP), and it can be of ecological relevance in terms of its environmental impacts, externalities or scarcities, i.e. its **resource intensity** contributing to the Total Material Requirement (TMR)⁴ of a country.

Recent studies using monetary input-output tables show that in many, if not most, industrial countries and emerging markets, at least two sectors belong to the most important five sectors in economic terms. These are the food & beverages sector and the construction sector. Concerning resource use, however, they are not always associated with the strongest environmental impacts but often show huge quantities in waste accumulation.

⁴ TMR is an input indicator of the Economy-Wide Material Flow Analysis (EW-MFA) including unused domestic extraction and indirect flows of resource extraction imports

Table 3-1 *Main production sectors according to their economic relevance in selected countries*

Country	Main production sectors ⁵
Argentina	construction, food industry , agriculture (particularly meat)
Austria	..
Australia	construction, food , basic metals, agriculture, refineries
Bolivia	crude oil, natural gas, metals (huge reserves of lithium, antimony and other minerals)
Brazil	food & beverages , chemical industry, motor vehicles, construction
Chile	copper industry
China	agriculture, construction , chemical industry, communication equipment, metal working & pressing, food industry , textile industry (huge demand for all materials, strategic supplier e.g. for steel, indium, antimony, molybdenum, neodymium, germanium, tantalum and rare earth metals)
Czech Republic	..
Finland	..
Germany	..
France	..
Italy	..
Japan	construction, food , motor vehicles, electrical machinery & apparatus, machinery & equipment, chemical industry
Malaysia	..
Mexico	food & beverages, construction , motor vehicles, chemical products, agriculture & hunting, extraction of crude petroleum
Poland	
Russia	crude oil, natural gas (huge demand for all materials, strategic supplier e.g. for gas, nickel, platinum, germanium, neodymium, tantalum, cobalt)
South Africa	food , chemicals, motor vehicles, other mining & quarrying, construction , basic metals, agriculture
South Korea	radio/television/communication equipment, construction , chemical industry, basic metals, machinery & equipment, motor vehicles
Spain	..
Sweden	..
United Kingdom	..
Turkey	..
USA	construction , motor vehicles, chemical industry, food industry , computer & communication, radio/television, manufacture of machinery & equipment, electricity

Source: Acosta-Fernandez (2010).

Hot spot sectors in Germany

In Germany, for example, five sectors have to be regarded as very important. Acosta (2008) showed the relevance of various sectors to Germany with regard to ancillary and intermediate products. More than 50 per cent of the Total Ma-

terial Requirement (TMR) are caused by five sectors: construction, food, metals, energy and automotive. These sectors are viewed as hot spots with respect to resource efficiency potentials. In these sectors, the three production chains automotive, steel and cement are comparatively resource intensive. They can be regarded as prototypic for an end-user-oriented production (automotive), an industry close to the raw materials industry with homogeneous inputs and highly diverse product outputs (steel) and a homogeneous material usually produced within regional markets (cement) (Bleischwitz et al. 2009). The results correspond with other analyses made by Moll et al. (2004, cf. EEA 2005), who identify eight final demand groups with large-life-cycle-wide resource use and environmental impact potentials.

Although production processes may differ in the countries to be analysed, industrial countries are often quite similar in their outcomes, in particular in sectors where companies operate worldwide, such as the automotive industry. At the same time, environmental standards differ and can be a location factor. Emerging markets such as China and Brazil, on the contrary, rely strongly on the agricultural sector. For this reason, agriculture will also be included in the analyses.

Identification of sectors

Policies address most sectors with a bundle of instruments that are partly inconsistent and serve different goals. An advantage of studying sectors is that these inconsistencies can be mapped and the economic impacts analysed. Picking up relevant sectors allows for a comprehensive analysis of different instruments while considering business strategies and market development. We therefore regard the sector specific approach as most appropriate for further analyses and suggest including the following sectors (according to the ToR, energy is to be excluded):

- Agriculture – crops farming or animal farming
- Food production
- Electronics
- Construction
- Automotive
- Waste.

Sectors redefined according to key resources

In order to identify policies that contribute to enhancing resource efficiency, sectors will be refined according to the MFA/OECD methodology with respect to the key resources that are used by these sectors. The following table shows the preliminary results and thus constitutes our suggestion for further analyses. Analogue results were provided by van der Voet et al. (2004, cf. EEA 2005) for EU25.

Table 3-2 Key sectors to be analysed and key resources used

Sector	Key resources ⁶ (focus of study)
Agriculture	Water
	Soil/land
	Fertilisers (phosphor)
Food & beverages	Meat (as intermediate product)
	Milk (as intermediate product)
Metals	Steel
	Copper
Construction	Aggregates & limestone (concrete, cement)
	Wood
Automotive	Steel
	Aluminium
	Plastics
Waste	Textile
	Food

Systematic data collection

This approach will allow for systematic data collection by supporting the identification and industrial associations and localisation of experts in the countries selected⁷. Industrial associations are often organised according to raw materials and intermediate inputs while authorities are often organised according to policy fields.

Tackling lack of data

For most sectors, it will not be possible to make a detailed mapping of resource efficiency potentials. In these cases, the resource efficiency potential will be based on rough estimates.

3.1.2 Definition of resources

When calculating the total materials consumption, it is crucial to consider the ecological rucksack.

Identification of critical resources

The purpose of this task is to identify the critical resources in the target sectors. Based on trends for consumption of critical resources, the likely impacts of resource efficiency policies are identified.

The critical resources in each sector will be identified based on a desk study of sector characteristics. Focus is on the resources that constitute the largest quan-

⁶ With regard to evident scarcities or quantity of material flows.

⁷ (<http://iira.free.fr/directory/index.php>)

tities of materials input in the sector. Resource policies typically target these dominating material flows.

The relevant material flows include both virgin and recycled resources. However, the bulk of analyses will address virgin resources.

Data collection

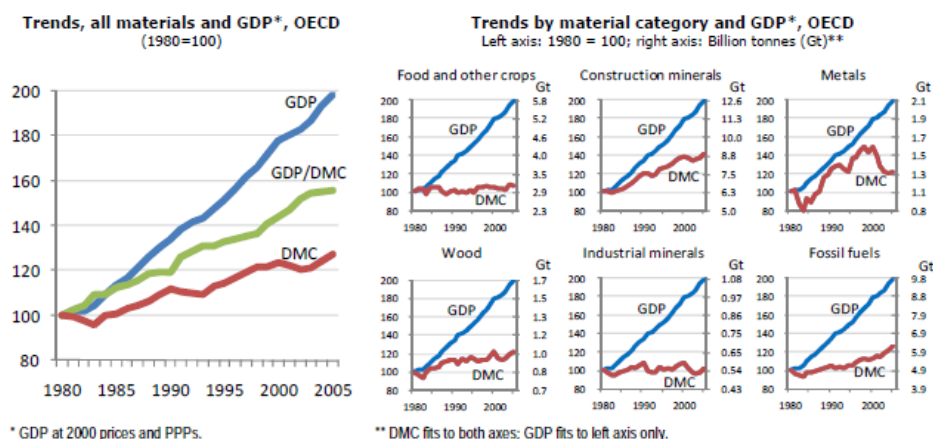
Where data are available, historical trends for the consumption of the identified resources will be distinguished. These trends can contribute to identifying the changes in resource consumption. The resource consumption trends will be analysed to detect any significant decline in resource consumption, which may reflect the introduction of resource efficiency policies.

The level of aggregation of data for resource consumption depends widely on the characteristics of the resource. Water is normally consumed very close to where it is extracted. Changes in resource consumption are therefore likely to occur locally. Data on water consumption may therefore be relevant to aggregate at a regional level. For the type of resources traded on the global market, e.g. metals, it is most relevant to analyse consumption trends at a national or at a pan-national level.

Trends in domestic material consumption

To exemplify data available on resource consumption and its coupling and decoupling to GDP, the figure below (OECD 2008) shows trends in domestic material consumption.

Figure 3-1 Trends in domestic material consumption (DMC), OECD, 1980-2005



Source: OECD (2008: 40; Figure 12)

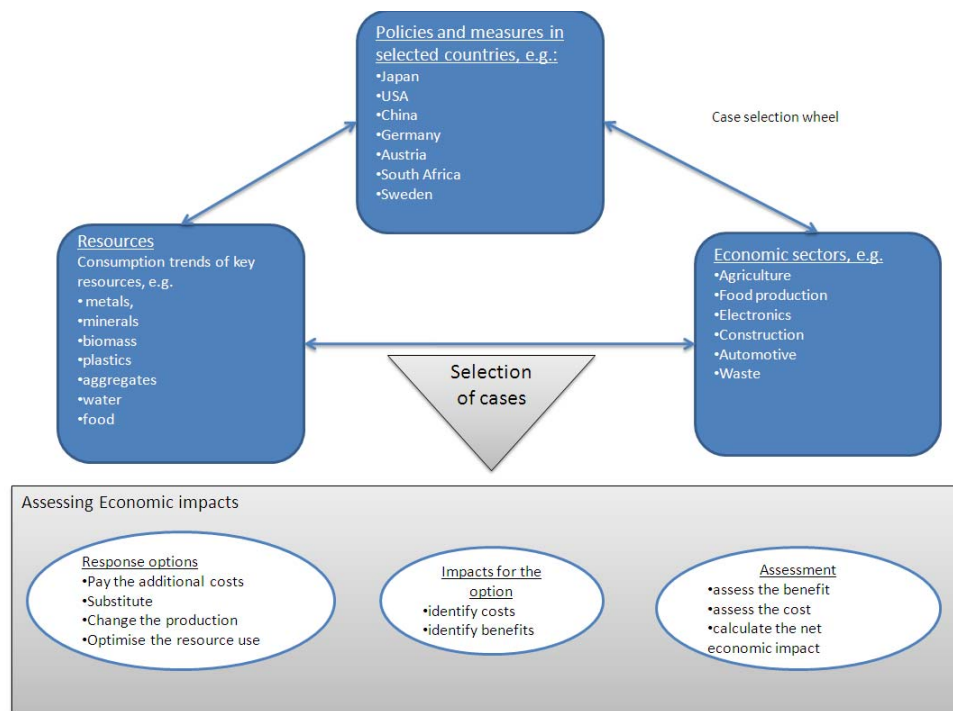
The figure shows that a relative decoupling of resource consumption has taken place between 1980 and 2005. However, resource consumption has increased for all types of resources.

3.1.3 Experiences with the use of resource efficiency policies

The selection wheel

In principle, the process of identifying illustrative REPs can start at any of three 'entrance points' in the figure below; resources, sectors or through identified policies at country level. We refer to this as the 'selection wheel'.

Figure 3-2 Selection wheel



Source: Own compilation.

The selection of policies for case studies will be based on relevance criteria, including the extent to which a REP would constitute a large economic potential in Europe and the degree to which regulation is already in place in EU countries to address the kind of market failure in question.

Economic impacts and benefits

For each of the policy cases selected, the resource saving potential is assessed. This assessment will draw on existing assessments of the economic impacts, supplemented by interviews with key stakeholders with insights into governmental costs and benefits of implementing and enforcing resource efficiency policies and the costs and benefits to companies brought about by the policies, and the untapped resource efficiency potential.

The economic net benefits from the use of resource efficiency policies are assessed based on the collected data of economic costs and benefits arising from resource efficiency policies.

Cost of implementation of policy

The costs of implementation and operation of the policy are estimated according to the following cost indicators:

Table 3-3 Cost data to be collected from national officers

Actors		Indicator
Government	Investments	Subsidies Policy development
	Operation	Enforcement Taxes Subsidies

Limitations

A key limitation in the suggested analytical approach is that the screening exercise cannot be complete and only known or published REPs will be identified. For instance, by focusing on the main production input, resources that do not constitute a main resource input in the target sectors will not be analysed. By 'main production input' is understood the resources that make up the quantitatively largest production input measured by tonnage.

3.1.4 Screening and selection of resources efficiency policies for further assessment

Countries

The following EU countries were investigated for REPs: Austria, Denmark, Finland, France, Germany, Netherlands, Spain, Sweden, and UK. The following extra EU countries were screened for REPs: Argentina, Australia, Brazil, China, Japan, Malaysia, New Zealand, South Korea, Turkey and the United States.

Policy instruments

For each sector, the analysis of the REPs addresses the instruments that have been used to influence the use of specific resources. However, the total pool of instruments analysed will reflect the various characteristics of instruments. The characteristics are:

- Nature of existing market failure (e.g. knowledge gaps, external effects, market power, public goods, etc.).
- Context of use of policy instrument (impact level, the importance of the resource use in the country)
- Representativeness of policy instrument (with respect to the type of policies identified in the typology)
- Type of behavioural response.

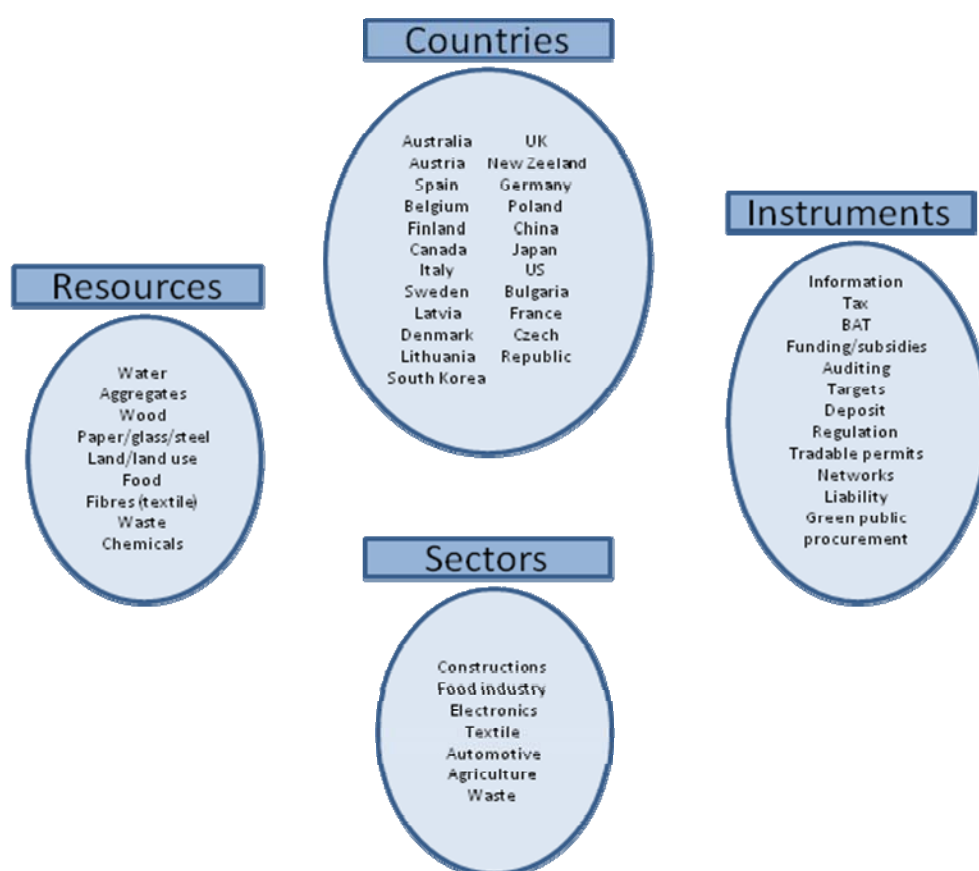
The following policy instruments were identified as key in the efforts to enhance resource efficiency: information, tax, BAT, funding/subsidies, auditing, targets, deposit, regulation, tradable permits, networks, liability and green public procurement.

Case studies

Based on the screening, nine cases were selected for in-depth analysis of economic impact covering a range of the above-mentioned countries, policy instruments, sectors and resources. Two cases were selected as pilot cases in order to test the format and ability to gather information and to test results may best be transferred to the wider Europe.

The different types of policy instruments, the countries of implementation and the sectors and resources addressed are shown below:

Figure 3-3 Overview of countries, sectors, instruments and resources included in the screening



Source: Own compilation

3.1.5 From a company's perspective

Companies aiming at optimising profit

Companies aiming at optimising their profit have incentives for enhancing cost-effective use of resources. Many companies have already harvested low-hanging fruits in terms of resource optimisation. However, improved information on resource management and on new production methods in many cases constitutes a potential for increased resource efficiency. Many companies - especially SMEs - have a relatively short time frame for payback on investments. Therefore, many voluntary instruments are only effective if breakeven for such investments are reached in one to three years.

Where information schemes and voluntary instruments may not change a company's behaviour sufficiently, more strict regulation may be needed to obtain the desired resource efficiency.

Types of corporate response to resource efficiency policies

Companies may respond to resource efficiency policies in different ways. The type of response depends on the type of policy instruments applied, the significance of economic impact of policy and the company's technical and organisational capabilities to adjust to the market changes triggered by the policy.

Pay the additional costs	The company may choose to continue the existing production methods and pass on the costs of the policy to the customer. This response strategy does not increase resource efficiency. If competing companies are capable of adapting their production processes, this may entail a loss of competitiveness to the company and hence loss of market shares.
Substitute	Another response strategy is to replace the resource subject to resource efficiency policies with other resources. Substitution typically involves a higher cost to the company than the original resource.
Optimise the use of resources	Resource consumption improvements can be brought about by improved resource management or by the introduction of new technologies. Better resource housekeeping typically includes the lower-hanging fruits, whereas introduction of new technology (eco-innovation) requires up-front investments.
Change product portfolio	A more radical response to resource efficiency policies is to phase out the existing product portfolio in favour of producing new products, using other resources.

3.2 Data collection

Screening of literature

The starting point for identification of illustrative resource policy examples was a review of relevant literature.

The following literature has been key sources of identification of policies:

Table 3-4 Key source listed

Key sources
ETCRWA (2006), Economic instruments to promote material resource efficiency, Main report from phase 1. European Topic Centre on Resource and Waste Management
Hutinen (2009), Instruments for Waste Prevention and Promoting Material efficiency - A Nordic Review, TemaNord 2009:532
OECD (2008), Inventory of international initiatives related to Sustainable Materials Management, Paris.
OECD (2008), Measuring Material Flows and Resource Productivity – Vol. III; Inventory of Country Activities, Paris.
OECD (2009), Report of the 2nd survey on SMM-related activities in OECD countries, Paris (including a questionnaire on SMM on p. 36ff.)
EEA (2005), Market-based instruments for environmental policy in Europe. EEA Technical Report No 8/2005. Copenhagen, European Environment Agency
EEA (2005), Sustainable use and management of natural resources, EEA Report No. 9/2005, Copenhagen, European Environment Agency
ECOTEC in association with CESAM, CLM, University of Gothenburg, UCD and IEEP (CR) (2001): Study on the Economic and Environmental Implications of the Use of Environmental Taxes and Charges in the European Union and its Member States
Little (2005), Studie zur konzeption eines programms für die steigerung der materiaeffizienz in mittelständischen unternehmen. Fraunhofer-Institut für System- und Innovationsforschung Fh-ISI und Wuppertal Institute für Klima, Umwelt, Energie
Sang-Hun (not dated): Policies for Sustainable Resource Management in the Republic of Korea
CSCP (2006). Policies for Resource Efficiency, Towards Sustainable Consumption and Production. CSCP, GTZ, the Federal Ministry for Economic Cooperation and Development and the Wuppertal Institute for Climate, Environment and Energy, Wuppertal.
OECD / EEA data base on instruments for environmental policy and natural resources management: http://www.oecd.org/LongAbstract/0,3425,en_2649_34295_34622631_119656_1_1_1,00.html
Database on sustainable consumption and production in North America: http://nasca.icspac.net/db/

Internet search

The literature review has been supplemented with a comprehensive search on the Internet including review of home pages of governmental bodies in the selected countries (mentioned above). Through the Internet search, a number of national and regional policies were identified.

Support from national authorities

The national authorities in the selected countries were contacted by email and phone and asked to assist in identifying additional relevant policies. These national authorities are national ministries or agencies with responsibility for resources and the environment. Contacts with key national officers contributed to identifying policies with the highest resource efficiency potential and largest impacts.

Table 3-5 Topics to discuss with national officers

Topics to address to national officers
Identification of REPs introduced at national and regional levels
Identification of the reasons for introducing these policies
Expected impacts with respect to economic impacts, resource stock impacts and environmental impacts
Identification of assessments conducted of the impacts of the policy (ex-ante or ex-post)
Identification of the national officers' experiences with the use of these instruments
Identification of costs related to the introduction and monitoring of the policy
Identification of companies that are affected by the policies
Identification of national experts, e.g. at universities, who have knowledge of the economic impacts of these policies
Identification of relevant national officers from other ministries or agencies to contact

Embassies and academics

Representatives of embassies and academics also assisted in identifying illustrative examples of resource efficiency policies.

Table 3-6 Topics to address to national experts

Topics to address to national experts
Identification of REPs introduced at national and regional level
Impacts of the use of the identified instruments, primarily economic impacts
Identification of assessments conducted of the impacts of the policy (ex-ante or ex-post)
Identification of companies that are impacted by the policies
Assessment of company responses to the REPs
Identification of further literature
Identification of other relevant experts to contact

National industry organisations

National industry associations in the countries where REPs have been applied were contacted with the aim of identifying the industrial structure in the target sectors and finding additional companies to contact.

Table 3-7 Topics to discuss with industrial associations

Topics to address to industrial association
Industrial structure of targets sectors, i.e. number of companies by size and type of production
Identification of companies that are impacted by the policies
Identification of the industrial sector's response to the policies

Data from companies Contact was made to companies in countries where REPs are applied. The bulk of the data from which conclusions will be drawn will be gathered through direct contact to companies.

Table 3-8 Topics to discuss with companies

Topics to address to companies
Identification of the resources that are used both in the production process and as a part of the final product
Identification of the company's response to REPs, i.e. the strategies the company has used to respond to the policy according to the response typology (substitution, paying additional costs, change of production, optimising the resource usage)
Identification of the reasons for choosing this response
Identification of the costs of resources of the total production costs before and after the introduction of REPs
Identification of the extent to which the company passes on increased costs to customers
Identification of internal assessments of the costs of response to the policy (e.g. ex-ante)
Identification of the cost indicators for the total costs that the policy has entailed for the company
Identification of the new costs as share of turnover.

Costs The costs of the investments will be assessed separately for each interviewed company. The cost data that will be collected cover the following areas:

Table 3-9 Cost data to be collected from companies

Actors		Indicator
Business	Investments	Up-front investments in new technology R&D Consultancy costs
	Operation	New or change in operation costs (for instance cost of employees to segregate waste streams) Fees and charges Taxes Subsidies received Costs of substituting a resource (e.g. due to bans) Economic gains achieved in terms of increased resource efficiency Increased competitiveness (e.g. due to improved quality) Administrative costs Changes in market prices

Validation of data If the response given by a company differs from the response anticipated by national experts and trade associations, efforts will be made to validate data. If

the sector is made up by different types of companies in terms of type of products manufactured and size, an additional company will be contacted to provide a broader data basis.

The REPs identified during the screening exercise were collected in a database.

Tackling lack of data

It is a major challenge to obtain the required data on economic impacts from companies. First, in some countries there is no culture of participation in studies. Second, companies are reluctant to share information perceived as confidential. Third, it is difficult for companies to estimate the costs/benefits deriving from the use of REPs. Companies may not have the needed data on resource consumption or resource consumption may constitute a relatively modest share of total production costs for which reasons companies may perceive costs/benefits as unimportant. These scenarios have been addressed in the following way:

- Case 1. A company is willing to share certain parts of information, but the company is not capable of or willing to provide cost data on all desired areas. To the extent possible, missing data will be estimated based on data from similar companies in the same sector.
- Case 2. A company is willing to share information in certain areas, but data on costs are not available. The respondent will be asked to make rough estimates of the impacts, e.g. have labour costs increased slightly, somewhat or strongly, are substitutes used cheaper, cost neutral or more expensive, etc.
- Case 3. A company is only ready to share a few pieces of information on costs. No specific cost estimates will be made for the company, but the data obtained may be used to supplement cost data for other companies.

Rebound effects

To the extent possible, rebound effects will be mapped. A rebound effect may for instance occur if improved production performance entails lower production costs. The increased competitiveness of the product may lead to increased demand, outweighing the potential impact on the resource stock. Based on the data available, such rebound effects may, however, be difficult to identify.

4 Potential

The term resource saving potential can be interpreted broadly and, as discussed earlier, resource is not a term that has restricted use. Some resources are renewable, others are non-renewable, and the type, quality, quantity and accessibility can vary significantly across types of resources.

Different interpretations

In this context, the resource savings potential is analysed from the business sector point of view. Literature suggests different approaches to estimating the resource saving potential or the resource efficiency potential. The following are examples of how potentials are assessed in the literature:

- Resource use in different sectors in tonnes and in EUR
- Resource productivity (production out/production input)
- Experts' identification of resource saving potential
- Technical potential for resource savings - referring to material
- Economic potential - referring to policies.

Resource use in tonnes

In a 2007 study conducted by Wuppertal Institute, the sectoral potential for reducing resource consumption in Germany enterprises was investigated. The table below estimates, for each sector, the direct and indirect resource consumption in tonnes. Estimations are based on resource streams detected in Germany using an input-output framework based on data collected by the statistical bureau in Germany. The table only includes the most resource-intensive sectors.

Figure 4-1 Resource use in sectors in tonnes and their distribution on sectors in Germany,

NACE Rev.1 sect. ¹	Production sector	Direct & indirect use of resources in 2000	
		million tonnes	%
45	Construction	964	18
15	Manufacture of food products and beverages	465	9
27	Manufacture of basic metals	459	9
40	Electricity, gas, steam and hot water supply	405	8
34	Manufacture of motor vehicles, trailers and semi-trailers	335	6
24	Manufacture of chemicals and chemical products	269	5
29	Manufacture of machinery and equipment n.e.c.	211	4
10	Mining of coal and lignite; extraction of peat	188	4
1	Agriculture, hunting and related service activities	183	3
23	Manufacture of coke, refined petroleum products and nuclear fuel	157	3
26	Manufacture of other non-metallic mineral products	157	3
14	Other mining and quarrying	136	3
	Other production sectors	1.360	26
	All production sectors in sum	5.843	100

Source Acosto-Fernández (2007)

From the table, it is evident that the construction sector is the most resource-demanding sector. The construction sector is followed by food, metal and electricity and gas production, however, each of these only accounts for half of the resources consumed by the construction sector. The focus of the study is more on the magnitude of resources used rather than on the actual saving potential in these sectors.

Potential as per cent of value added

Based on the knowledge of resource consumption in 1991 and 2000, changes have been calculated and the value added estimated. The total value added in that period is 28 per cent and at the same time 9 per cent less resources were used. That means that average resources price increased significantly from 1991 to 2000.⁸

⁸ Source: Studie zur Konzeption eines Programms für die Steigerung der Materialeffizienz in mittelständischen Unternehmen, Arthur D. Little GmbH

Figure 4-2 Estimates of the resource use in different sectors by SMEs

Übersicht 1: Für die Analyse ausgewählte Branchen und ihr Materialeinsatz in Betrieben zwischen 20 und 500 Beschäftigten

Nr.	Branche	Materialeinsatz in Mrd. € (2002)
1	Herstellung von Metallerzeugnissen	18,6
2	Herstellung von Kunststoffwaren	10,8
3	Herstellung von Geräten der Elektrizitätserzeugung, -verteilung u. ä.	10,2
4	Chemische Industrie (ohne Grundstoffindustrie)	11,1
5	Verlags-, Druckgewerbe, Vervielfältigungen	7,3
6	Be- und Verarbeitung von Holz	5,5
7	Medizin-, Mess-, Steuer- und Regelungstechnik, Optik	5,5
8	Baugewerbe: Hochbau und Ausbaugewerbe	11,1
9	Herstellung von Waren aus Papier und Karton	4,0

Source: Little (2005).

Mapping of resource saving potential using various methods

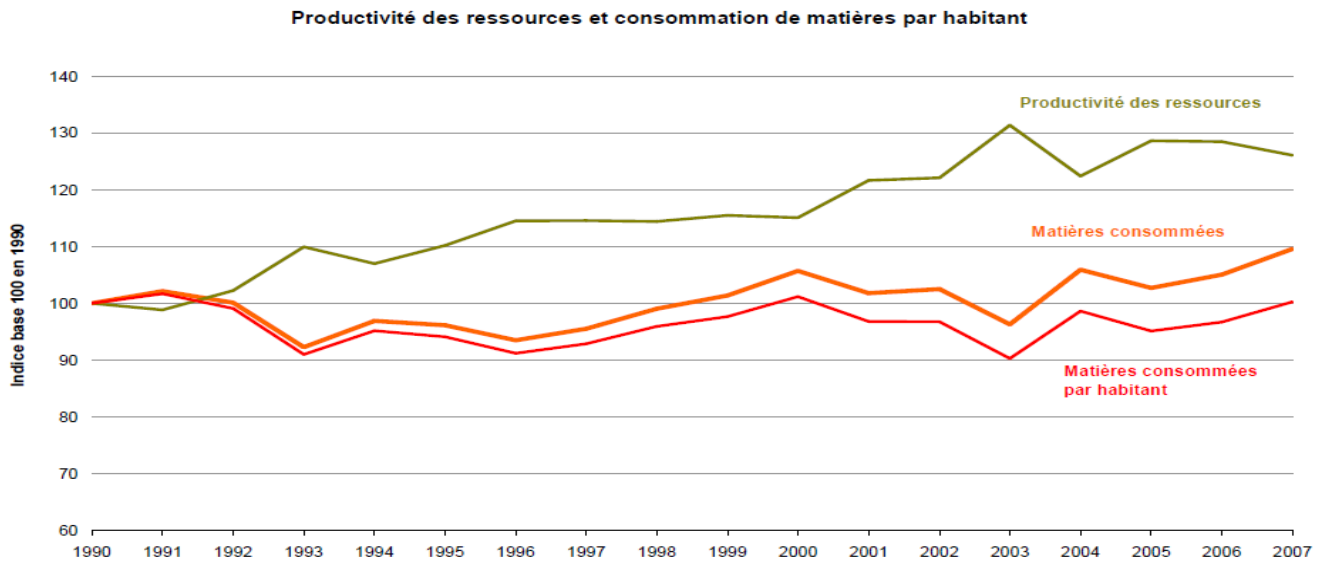
The study focuses on the resource used by SMEs in nine sectors (see table above). The resource savings potential for each sector was estimated by seven different methods. (Six of the methods involve changes in used techniques and the seventh method involves designing products with minimum resource input). Based on the mapping, the potential for each sector has been estimated. The result is total expected savings for the nine sectors in the range of EUR 6.400-13.100 million per year for the period 2012-2015. The resource saving potential varies substantially across sectors ranging from 3 per cent to 20 per cent. The highest potential is found in the chemical sector and the production of plastics, being two of the sectors with relatively cost-intensive use of materials, however, in limited volumes.

Resource productivity

Resource consumption compared to the output from the production have been estimated in France by the National Institute of Statistics and Economic Studies. The result is referred to as the resource productivity, which is defined as the quantity of a good or service (outcome) that is obtained through the consumption of one unit resource.

In the figure below, resource productivity is illustrated by the green line (upper) where the orange line (between) illustrates materials consumption in general and the red line (lower) consumption per capita. It can be seen that resource productivity has gone up by almost 30 per cent from 1990 until today. Material consumption increased by 10 per cent in the same period, whereas consumption per capita remained stable.

Figure 4-3 Resource use and resource productivity in France



Note : Métropole et DOM.
Source : SOeS, 2009.

Top 20 based on a survey

A totally different way of estimating the potential of resource savings has been devised by Holger Rohn et. al. in a study entitled "Identification of technologies. Products and strategies with high resource efficiency potential – result of a cooperative selection process". As part of the study, a questionnaire was sent out to 15,000 industries, researchers and institutions in Germany. Based on the answers received, the resource saving potential was estimated, and a top 20 (24) list was drawn up.

Table 4-1 below presents the top 24 list resulting from the study.

Table 4-1 Top 24 list of resource saving potentials

Nr.	Topic
1	Resource efficiency potentials through the implementation of light construction beyond use of the diversity of new materials
2	Resource efficiency potentials through use of the micro reactor technique for the production of chemicals
3	Resource efficiency potentials through new transformation technologies for high and highest strength steels
4	Resource efficiency potentials through surface functionalisation with nanotechnologies
5	Resource efficiency potentials through shiftable adhesives for a better separability of construction connections
6	Resource efficiency potentials in production techniques
7	Green IT – Resource efficiency potentials in selected fields
8	- Resource efficiency potentials of servers
9	- Resource efficiency potentials of I&C-end-devices
10	- Resource efficiency potentials of telephone and data network
10	Resource efficiency potentials in the clothing industry through fibre substitution
11	Observation of resource efficiency potentials in design
12	Resource efficiency potentials through new approaches of "use instead of possess" in the industrial sector
13	Resource efficiency potentials through production on demand
14	Resource efficiency potentials of the non-energetic use of algae
15	Resource efficiency potentials through new applications of membrane technology for special applications
16	Resource efficient energy production
17	Resource efficient energy storage
18	Resource efficiency potentials of selected value chains of foods
19	Resource efficiency potentials of intelligent agricultural engineering
20	Resource efficiency potentials of insulating materials
21	Resource efficiency potentials in traffic systems
22	Resource efficiency potentials in individual traffic through electric vehicles
23	Resource efficiency potentials through saving of primary mineral construction materials in earth-moving
24	Resource efficiency potentials through separation processes and design possibilities for material composites

S

ource: Rohn et. al. (2009).

Specific saving potentials

The results are much more specific than the results of the other studies reviewed in this chapter. Some of the topics are specific methods that are applicable to many different sectors. An example of such a technology is items 7-9 "Green IT". IT is used in all sectors, and the implementation constitutes an enormous resource saving potential at the EU level.

The more sector-specific topics relate to the following sectors:

- Construction
- Chemical
- Metal
- Clothing
- Food.

In the food sector, the potential is expected to be found in the supply chain. It is assumed that a part of the potential will be realised by improving handling and transport as large quantities of waste are generated by these activities.

The clothing sector has not been identified earlier. As to clothing, it is not immediately obvious where the potential can be realised in the production chain. A case study on clothing is included in the study in order to explore this in detail.

The price determines the development in the use of resources

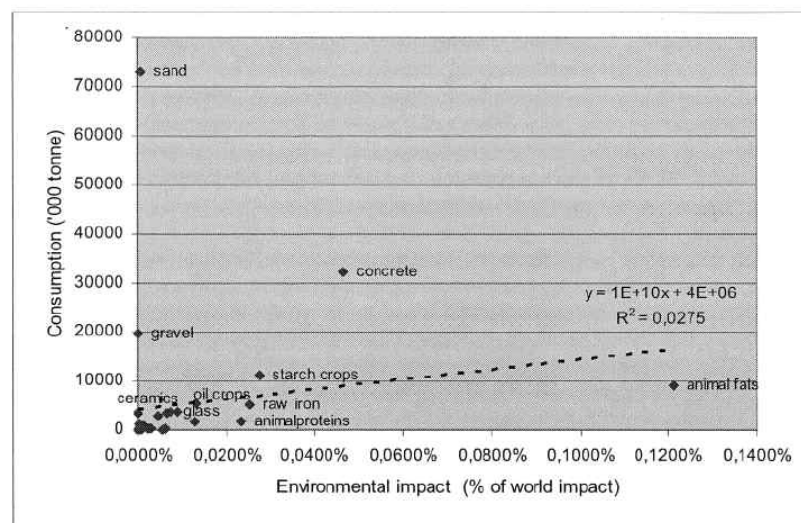
A 2009 study by Bruyn et. al., entitled "Resource productivity, competitiveness and environmental policies" attempts to answer why Europe has not seen the same progress in resource productivity as in labour productivity. The reason adduced for this paradox is different price development of the two inputs. It is argued that the amount of resources used in production is directly determined by the price.

The study argues, from a theoretical perspective, that both companies and the environment benefit from the introduction of resource saving policies. The study advocates introducing a tax scheme and calls attention to the need for using instruments to support the implementation of a resource saving policy.

Environmental impact

The report presents an overview of the consumption of selected resources (in tonnes) in the Netherlands combined with the resulting impact on the environment. It is evident that the impact varies significantly from one resource to another.

Figure 4-4 Relationship between consumption and environmental impact for selected resources



Bruyn Bruyn et. al (2009)

Based on these findings and assuming that environment is the major concern when designing a resource saving policy, such a policy should target:

- Concrete
- Animal fats
- Starch crops
- Raw iron
- Animal proteins.

Once more, it is evident that the construction, metal, and the food sectors have major impacts on the environment.

Conclusion

Conclusions drawn point to a resource saving potential in the EU. From the data and evidence found so far, all sectors have resource saving potentials, some sectors with up to 20 per cent. It seems that the sectors with the highest potentials are construction, chemicals, metals and food.

In the following, a screening will be made for policies already in place, which have had a positive impact on the use of resources. After the screening, a number of policies will be selected as case studies. In the selection process, the results of the analysis of the resource saving potential will be used as selection criteria.

5 Policies gathered

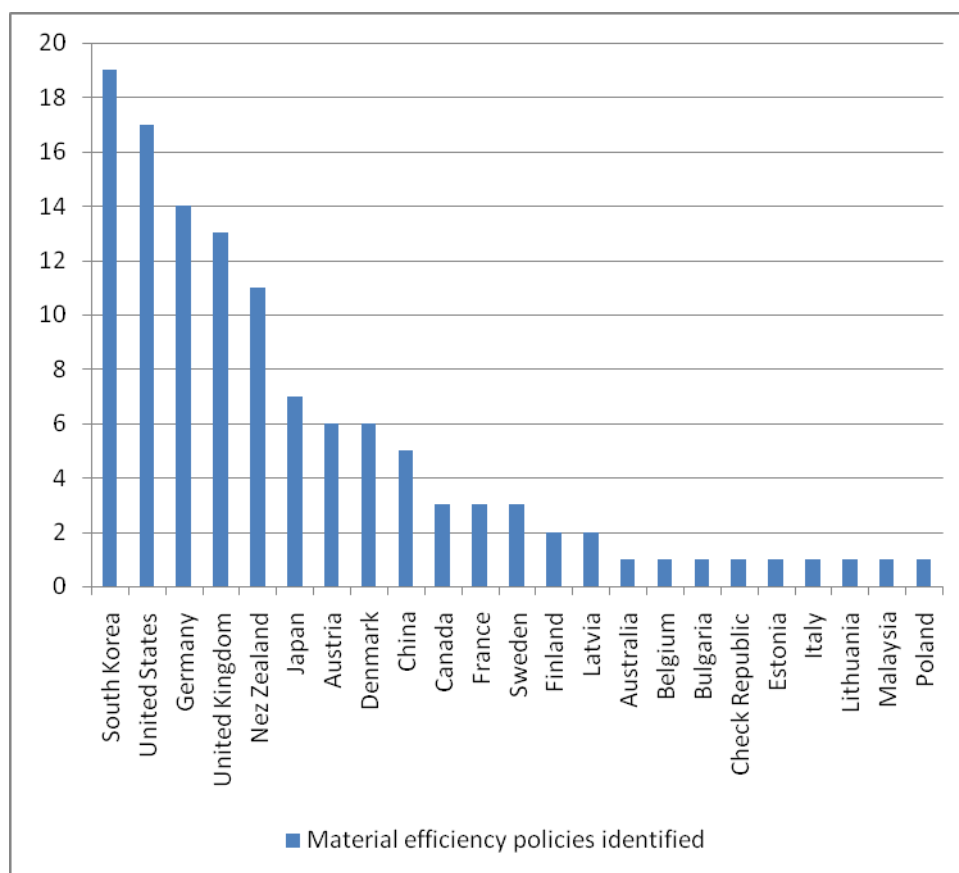
A total of 120 material efficiency policies were identified in 23 countries. The identified policies have been compiled in a database. An extract of the database is attached as annex 2. For each policy, the database contains information on the following parameters:

- Name of policy
- Type of policy instrument
- Market failure addressed
- Resources concerned
- Economic sectors targeted by the policy
- Context in which the policy is applied
- Private economic impacts of the policy
- Macro-economic impacts of the policy.

Where evaluations of the policies were at hand, information about the economic impacts of the policies is derived from these evaluations. Unfortunately, many materials efficiency policies have not been evaluated in terms of their economic impacts.

As a part of the policy identification process, the websites of relevant national agencies (such as resource, environmental and agricultural ministries and environmental protection agencies) were screened for relevant policies. Further, national officers, industrial organisations and NGOs were contacted in a number of countries, including Denmark, Sweden, Finland, the Netherlands, Germany, United Kingdom, New Zealand, Australia, South Korea, Argentina, Brazil, Turkey and the US. A major finding from this screening process is that most countries have much stronger focus on energy efficiency policies than on resource efficiency policies. Further, the scope of a wide range of policies is to improve environmental performance, although a positive spill-over effect of such policies is improved resource efficiency. An example is the Danish pesticide tax. The scope of the tax is to reduce environmental impacts of pesticide usages. A spill-over from the policy is reduced consumption of pesticides.

Figure 5-1 Number of resource efficiency policies identified



Source: Own calculations

Figure 5-1 shows the distribution of resource efficiency policies according to country. More than 10 policies were identified in South Korea, the US, Germany, the UK and New Zealand.

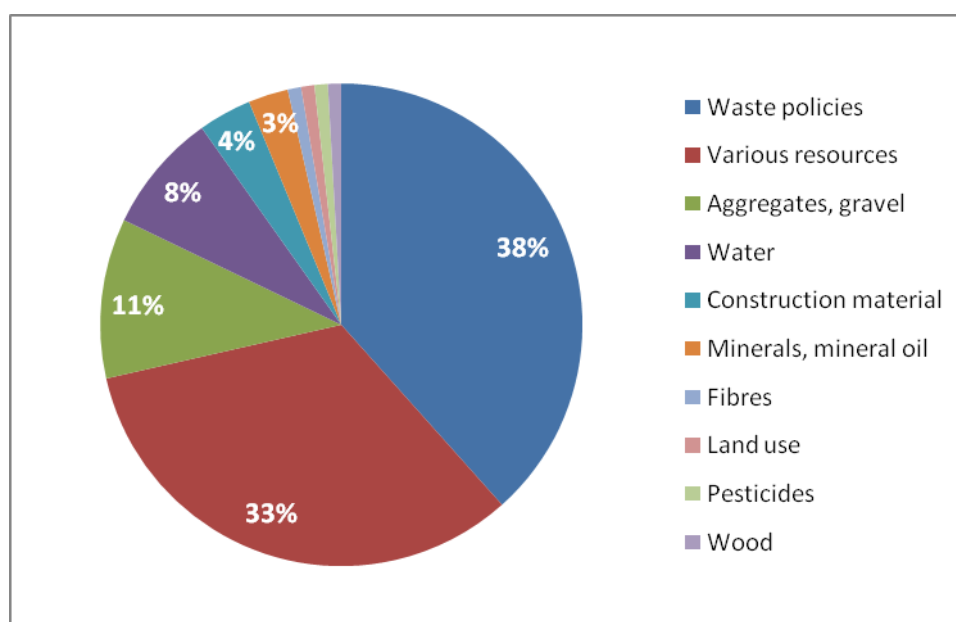
A limited number of the identified policies are targeted directly towards material efficiency in specific sectors. Most policies address either material efficiency related to specific resources such as water and aggregates or target wider materials efficiency in industrial production. The scope of such policies is to improve material efficiency in SMEs through dissemination of information on best practices. A number of projects and schemes have been identified in the UK, Germany, Belgium, Finland and the US. Such information-based instruments have proven to be able to generate resource savings for businesses.

All investigated countries focus on waste management and reduction of waste generation through recycling. In the EU member states, the EU legislation on waste management is normally the driver of this type of resource policies. In countries outside the EU, South Korea has the most coherent focus on preventing waste generation and improving reuse and recycling of waste. The waste policies identified in other countries outside the EU have more or less the same ambition level as waste policies applied in EU Member States. New Zealand has for instance a strong focus on reducing the generation of construction and demolition waste (C&D-waste). The present requirements for sorting and treat-

ing C&D waste in New Zealand are, however, at a much lower level than similar requirements in the EU Member States with the most far-reaching policies in this area.

The type of resources addressed by the identified resource efficiency policies are shown in Figure 5-2. Waste policies targeting waste prevention, reuse and recycling of waste make up 38 per cent of the identified resource efficiency policies. 11 per cent of the policies are aggregates and gravel levies and taxes. The purpose of a number of aggregates levies and taxes are to generate income to the state and not to increase material efficiency. Other resources targeted by the policies are reduced or more efficient water use (8%), material efficiency in the construction sector (4%) and minerals and mineral oil (3%).

Figure 5-2 Resources addressed in identified policies

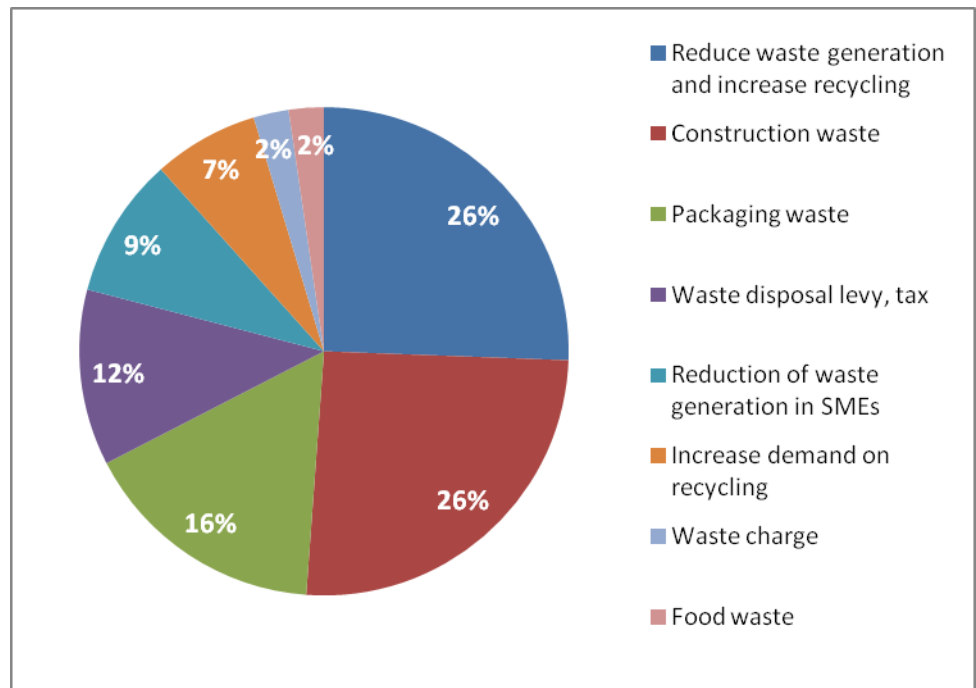


Source: Own compilation.

33 per cent of the identified policies do not target specific resources. The majority of the policies broadly address resource efficiency in industrial production. Waste minimisation and cleaner production is promoted through a number of different policy instruments including information schemes and networks, awareness raising, green procurement, R&D programmes on environmental technologies, governmental loan programmes and development of a 'circular economy'.

The identified waste policies address material efficiency in a range of different ways. The scope of 26 per cent of the identified waste policies is to increase recycling and to reduce waste generation. In addition to this, the specific purpose of nine per cent of the waste policies is to increase material efficiency and reduce the generation of waste in SMEs.

Figure 5-3 Resource efficiency promoting waste policies



Source: Own compilation.

26 per cent of the waste policies address reduced waste generation and increased recycling of C&D waste. Policies on packaging and packaging waste make up 16 per cent of the waste policies, and policies that increase demand on recycled material make up seven per cent of the identified policies⁹. Food waste is only targeted by one of the identified policies. A South Korean policy aims at reducing the generation of food waste and increasing recycling of the same.

⁹ Some policies are targeted towards more than one of the outlined categories, e.g. increase demand for recycling of C&D waste. In this context, the policy is categorised according to the main characteristics of the policy.

Table 5-1 Identified resource efficiency policies by type of policy instrument

Type of policy instrument	%
Targets	
Command and control regulation	6%
Environmental liability	2%
Market based instruments	
Deposit fee	2%
Resource taxes	9%
Fees and user charges	8%
Tradable permit	2%
Funding for resource efficiency investments	2%
Framework programmes	7%
Governmental loan programmes	6%
Eco-innovation and technology driving instruments	
Green purchasing	6%
Eco-innovation driving instruments	6%
Voluntary agreements	3%
Circular economy policies	4%
Sectoral policies	6%
Information instruments and information transfer	
Information services and networks and awareness raising policies	26%
Other	5%

Source: own compilation

Table 5-1 shows the distribution of the identified resource efficiency policies according to the type of policy instruments. 26 per cent of all identified policies are based on information sharing and establishment of different types of networks. Policies on information include information on clean production and waste minimisation services and producer and consumer information. Various economic instruments (taxes, levies and charges) have been implemented to reduce the consumption of aggregates and the generation of waste. The economic impacts of a range of these policies have been assessed. The effectiveness and economic impacts of many of the identified resource efficiency policies have, however, not been evaluated.

5.1 Criteria for selection of cases

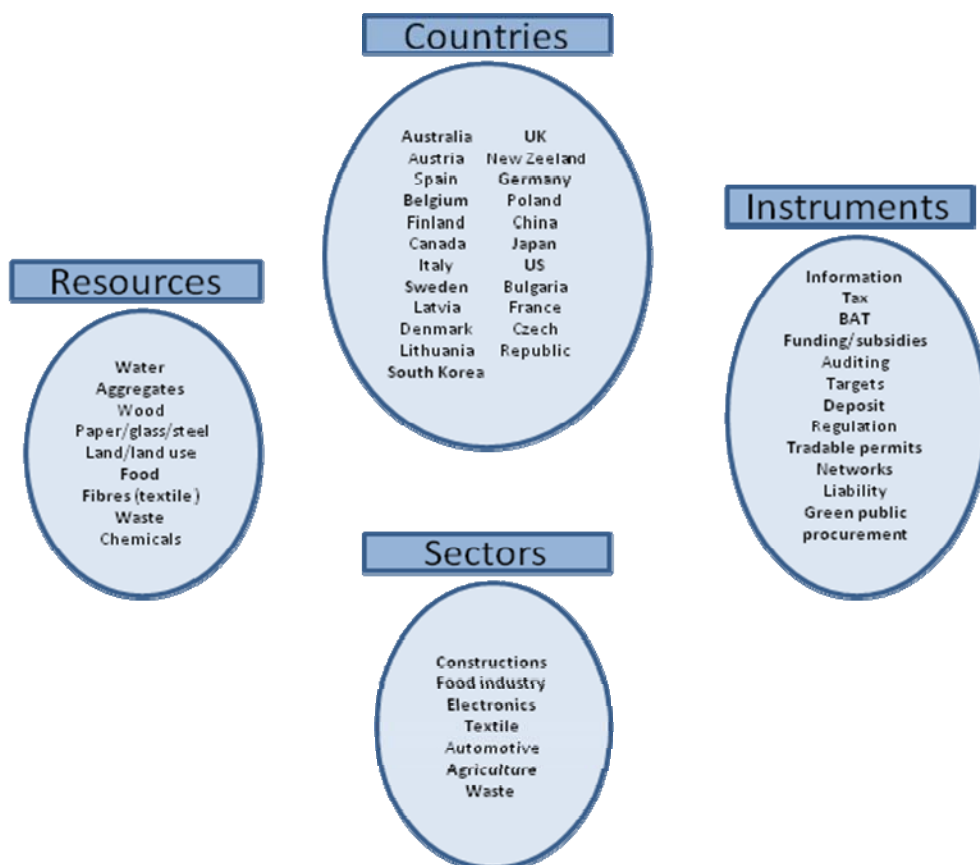
As a result of the establishment of the database, a wide range of case options are available for in-depth analysis. Nine cases were selected from a number of criteria developed to ensure broad coverage of different resource efficiency policies, instruments and resources in a variety of countries. The cases were selected according to the following criteria:

- Relevant accessible information prevails
- Expectation of large resource efficiency potential
- Coverage of key sectors
- Coverage of key resources (inclusion of water as resource)

	<ul style="list-style-type: none"> • The economic structure of the country is similar to Europe • Coverage of different countries inside and outside the EU.
Relevant accessible information prevails	Data accessibility is considered an essential criterion for the selection of a case. In the absence of estimations information available for the team to make own calculations, cases will not be included. In these cases, data are inadequate for valid estimates of the impact of the resource efficiency, and such cases will not to contribute towards attaining the objective of the study.
Expectation of large resource efficiency potential	The study focuses on policy initiatives representing a large potential for re-source efficiency. By selecting the cases that represent the largest resource efficiency potential, the study aims at identifying the highest economic and environmental benefits.
Coverage of key sectors	<p>Following the literature study, focus was on the sectors where expectations of a resource efficiency potential are highest. The following economic sectors were identified as sectors with high resource consumption and a potential for a major resource savings: agriculture, food production, electronics, construction and automotive. The following were chosen for the case studies, representing the most important sectors in terms of resource potential and economic importance:</p> <ul style="list-style-type: none"> • Agriculture (crops/livestock) • Food industry • Electronics • Construction • Automotive • Waste.
Coverage of key resources	<p>A variety of resources is relevant to the study. In this context, the term 'resources' will cover a range of material streams that are used in industrial production - either as a part of the production process or as a part of the final product.</p> <p>The case studies primarily covers two of the four types of natural resources mentioned in <i>The thematic strategy on the sustainable use of natural resource</i>; raw materials, such as minerals, biomass and biological resources; and environmental media, such as air, water and soil. These resources were identified as particularly critical in the European context combined with other resources, such as metals, plastics, aggregates and food. Hence, the material streams in the case studies selected include:</p> <ul style="list-style-type: none"> • Metals • Minerals • Aggregates • Water • Food/ Biomass/energy • Textiles/fibres • Paper/wood • Plastics.

The suggested material flows have been selected due to their importance, both in EU countries and in countries outside the EU. The resources include both renewable and non-renewable resources.

Figure 5-4 Illustration of the selected countries, resources, sectors and instruments



Source: Own analysis

The economic structure of the country is similar to Europe

A key criterion for selection of cases from outside the EU was that the economic sectors targeted by the policies were similar to the economic sectors in the EU and that the outcome of applying the policy in a European context would be similar.

Coverage of different countries inside and outside of the EU

The majority of European countries were identified in the database when searching for relevant resource efficiency policies at the global level. Of the seven countries identified outside the EU, four were selected for case studies: Australia, Japan, South Korea, and United States, thereby representing almost 50 per cent of the cases and several continents. The inclusion of non-EU cases was found important due to the desire to include experiences from other parts of the world not yet known to the EU system.

Of the five cases geographically situated in the EU, three are from the UK, one from Sweden and one from Germany. Originally, the EU cases were geographically more widespread, but due to several limitations to the first case choices, the final case selection covers three cases from the UK.

In the table below, the main characteristics of the cases selected are presented to provide an overview of the countries, resources, instruments and sectors covered (in alphabetical order):

Table 5-2 Overview of the case studies

Case No	Policy initiative	Country	Resource	Instrument	Sector	Private economic benefits ¹⁰
1	Aggregates levy	UK	Aggregates	Levy	Construction	++
2	PIUS - Product Integrated Environmental Protection Effizienz Agentur NRW	Germany	Water energy Metals Chemicals	Consultancy/ Information on best practices	Metals/ Metal finishing Food industry	+++
3	NISP	UK	Waste	Consultancy/ Information on best practices	Cross-sectoral	+++
4	Sustainable clothing roadmap	UK	Textiles/fibres	<ul style="list-style-type: none"> Regulation Tax (landfill tax) 	<ul style="list-style-type: none"> Waste Textile 	+
5	Green supplier network	USA	Energy Water Waste Raw materials	Information on best practices	Cross-sectoral	+++
6	Water for the Future - Murray Darling Basin	Australia	Water	<ul style="list-style-type: none"> Purchase of water rights/tradable permits Funding/subsidies 	<ul style="list-style-type: none"> Agriculture - crops farming or animal farming Food production 	+++ ¹¹
7	Aluminium can recycling policies	Sweden/ Belgium	Aluminium	<ul style="list-style-type: none"> Deposit fee Green dot scheme 	<ul style="list-style-type: none"> Metals 	+
8	Food waste reduction	South Korea	Food	<ul style="list-style-type: none"> Networks Information Funding/subsidies 	<ul style="list-style-type: none"> Food industry Waste 	+
9	Basic policy on promoting green purchasing and green purchasing network (GNP)	Japan	Paper Office furniture	<ul style="list-style-type: none"> Green procurement 	<ul style="list-style-type: none"> Cross-sectoral 	(+)

¹⁰ Max score is 3 plus and minimum score is 3 minus.

¹¹ From a socio-economic point of view, this policy is extremely expensive and would score lower if this cost was included.

6 Case studies

In the following, each case study is presented by extracting the most essential elements of the analysis, such as context of the policy initiative, the results gained at national level, assumptions for transferring the policy to EU level and the potential resource savings in an EU context¹².

To the extent possible, the case studies identify the economic impacts at business operation level and presents calculations of the economic benefits reaped by applying resource efficiency policies.

General trends

The findings of the case studies are used to reach conclusions on general trends in the last section of this chapter. When reading the cases, it soon becomes obvious that it is a challenge to transfer results from the national levels to EU27 or from one sector to another.

The conclusions are therefore drawn based on the specific cases, as these cannot support the formulation of general conclusion or trends for all sectors and resources in EU27. The quality of EU-wide estimates would not be usable given the limited number of cases. Consequently, in terms of general estimation of resource saving potentials, this study does not bring the discussion further than the findings presented in the chapter on potentials. The case studies, however, provide more in-depth analyses of specific resources, sectors or instruments the cases.

Policy description

6.1 Aggregates levy/UK

The Aggregates Levy introduced in April 2002 in Great Britain and Northern Ireland (United Kingdom) is an example of a centralised ad quantum-tax (quantity tax) by weight. The aggregates levy, which is understood as a "green tax" in the UK/Northern Ireland, is to address the environmental impacts of the extraction and transportation of the construction materials, including noise, dust, vibrations, visual intrusion, loss of biodiversity, etc. and internalise them. The funds are earmarked for environmental projects used in the construction industry and to compensate the regions. The most important aim of the levy is to maximise the use of alternatives, such as recycled construction and demolition waste, and secondary materials, such as china clay waste, and to encourage the more efficient use of aggregates, greater resource efficiency in the construction

¹² Each case is further detailed in annex

industry, and a move away from aggregates by development of a range of alternatives, such as the use of waste glass and tyres in aggregate mixes.

Context

The British aggregates industry provides employment for around 40,000 people, mainly in rural communities in around 1,300 quarries, and contributes around EUR 3.7 billion in primary products to the GDP.

The Aggregates Levy is embedded in a set of progressive initiatives and policies in UK that should be considered. Those policies are, inter alia, the Strategy for Sustainable Construction, a joint industry and Government initiative intended to deliver benefits to both the construction industry and the wider economy. The benefits to the companies are:

- Increasing profitability by using resources more efficiently
- Increased resource efficiency
- Increased process efficiency
- Minimisation of waste and waste charges
- Enhancing company image and profile in the market
- Opportunities for firms that supply recycling and secondary aggregates
- Reduced reliance on non-renewable resources (quarried mineral products)
- Reduced embodied carbon content.

National results

In the Government's view, the levy has been a significant factor in reducing sales of virgin aggregates by about 18 million tonnes in total between 2001 and 2005. In the fiscal year 2008/2009, the aggregates levy received a total of EUR 407 million in tax revenue (HMRC 2010). The effect of the tax is to increase prices by the order of 20 to 25 per cent. However, the low elasticity of demand for the product means that much of the burden of the levy has been passed on to the purchasers of aggregates (Legg 2007).

The primary effect of the levy is a decrease in the extraction of aggregates (of 275 million tonnes of total demand) of around 6 million tonnes in 2005. 68 million tonnes recycling/secondary materials are used (equivalent to approximately 25 per cent of all aggregates required).

Further, the market for aggregates in the UK has changed in the last years. The Aggregates Levy has encouraged the use of recycling and secondary material, which has led to a decrease of the aggregates output. However, views on the effectiveness of the levy are mixed. Compared with an overall levy cost of over EUR 488 million a year, the additional one million tonnes of recycled aggregates supplied due to the levy has therefore "cost" EUR 488 of additional taxation. On the other hand, using recycled aggregates means avoiding paying the levy, and suppliers offering recycled aggregates are likely to experience an increase in business.

Waste is a key issue to the construction industry. Around 400 million tonnes of materials are used every year by the construction industry in UK while at least 90 million tonnes of construction, demolition and excavation inert waste is produced, which is about three times the amount of waste generated by all UK

households combined¹³. 40 million tonnes (44%) of this was used as recycled aggregate and six million tonnes (6.5%) as recycled soil for landfill engineering or restoration. In addition to the 91 million tonnes, 15-20 million tonnes of non-inert and mixed construction and demolition waste and a further 13 million tonnes of waste is created through material waste that is delivered to the site, unused and then disposed of (WRAP estimations).

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- The resource saving potential is the same in construction across EU27
- The average division of recycling facilities in the aggregates sector is the same across EU27
- The administrative costs related to the introduction of an aggregates levy are the same in all Member States
- The implementation costs are the same in all Member States
- However, one should be aware of the fact that in some countries policies are already in place that achieving substantial recycling rates

Results at EU level

Over the period from 1990 to 2007, the share of the aggregates supplied from recycled and secondary sources in UK rose rapidly from 10 per cent to 22 per cent. The use of recycled and secondary materials in UK is hence close to its full potential. This is not the case in Europe. Assuming that a 22 per cent share of secondary/recycling aggregates was possible in Europe, the results show that there is a huge unexploited potential. If an average price of a tonne of aggregates is assumed to be about EUR 9.8 all over Europe, the reduction of primary aggregates extraction would be equivalent to EUR 3.8 billion.

When estimating the usage and the importance of aggregates the UK based on the different applications of aggregates, it is evident that the public sector pays most of the aggregates levy. Assuming that the proportion of the public to the private sector is similar in Europe, the UK material cost reduction would correspond to savings of EUR 1.7 billion for the private sector and EUR 2.1 billion for the public sector in Europe. A rough calculation of the revenues from a tax with a range similar to the UK Aggregates Levy implemented in all European Member States could generate a total of EUR 5,682.6 million in potential revenue (for EUR 2/tonne).

6.2 PIUS-Check in North Rhine-Westphalia

Policy description

The Effizienz-Agentur NRW (EFA) initiative was launched by the North Rhine-Westphalia (NRW) Ministry in 1998. The EFA initiative is aiming at promoting cleaner production methods in SMEs. The EFA has developed a

¹³ <http://www.bis.gov.uk/files/file37173.pdf>

toolbox with a range of consulting services for SMEs. The purpose is to help SMEs improve their resource efficiency through avoiding pollution and improving resource conservation in the production process.

The EFA offers a PIUS-Check, which is an audit where the relevant material flows and current level of production technology are analysed and recommendations for possible improvements are made. The PIUS-Check's assessment of production optimisation is based on best available technology (BAT) in sectors that are included in the IPPC Directive. The total costs of conducting an audit are EUR 10-15,000. Up to two-thirds of these costs can be covered by the national clean production programme *Verbesserung der Materialeffizienz* under the Federal Ministry of Economics and Technology. The EFA assists companies in applying for financial support to implement the proposed measures. The EFA uses the available funding mechanisms, including low interest loans. The available funding schemes are an important driver for companies to implement cleaner production methods.

The benefits to companies participating in the programme are:

- More cost-effective production
- Increased resource efficiency
- Increased process efficiency
- Minimisation of waste
- Efficient waste and environmental management
- Increased employee motivation
- Improved company image.

Context

The total number of SMEs in the NRW is 600,000.¹⁴ 12,000 of these companies are engaged in industrial production. The largest sectors are metal processing, chemical, electronic, paper and printing, electronics and the food sector.

The industrial production in the NRW entails a wide range of environmental impacts. Of particular importance is energy and water consumption, but a wide range of resources are used in the production, including metals(ferrous and non-ferrous), plastics, food, liquids, solvents, etc.

National results

The PIUS-Check has been particularly successful in introducing cleaner production methods in the metal processing, the metal finishing and the food processing industries (Interview Matthias Graf, 21 April 2010). Since the PIUS-Check was initiated in year 2000, more than 500 PIUS-Checks have been conducted. 216 of the companies involved have implemented measures (which corresponds to more than 40 per cent).¹⁵ 75 per cent of the companies have less than 250 employees.¹⁶

¹⁴ SMEs are in this context defined as companies with 20-500 employees.

¹⁵ <http://www.efanrw.de/index.php?id=40&L=1>

¹⁶ Most of the 25 per cent of companies that went through the PIUS -Check employ between 300 and 600 employees.

In around 70 per cent of the PIUS-Checks, the suggested measures include implementation of new production equipment. In the remaining 30 per cent of the PIUS-Checks, the suggested measures include organisational changes (Walbaum, 2007). The aggregate results of the PIUS-Checks are shown in Table 6-1.

Table 6-1 Investments and realised saving after PIUS-Checks

	Total	Per SME
Investments (EUR)	36 million ^a	167,000 ^d
Annual savings in the production processes (EUR)	10.4 million ^a	50,000 ^d
Savings of water/wastewater (m ³ /y)	1.169 million ^a	6,000 ^b
Annual energy savings	50.5 GWh ^b	300 MWh ^b
CO ₂ reduction (tonne)	20,000 ^c	113 ^c

a) Based on data from 2010; b) Based on data from 2009; c) Based on data from 2008; d) Own calculations. Source: <http://www.efanrw.de/index.php?id=40&L=1>; Graf (2009); Jahns (2008)

In approximately 90 per cent of PIUS-Checks, measures that will be cost-effective to implement by the company are identified (interview Andreas Kunleben, 3 May 2010). The investments made and the saving achieved vary significantly from company to company. None of the participating companies, however, takes up a significant share of the total investments or economic savings achieved.

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- The average division of SMEs by sector is the same across EU27
- The cost of carrying out the PIUS-Check will be the same in all Member States
- The administrative costs related to the PIUS-Check will be the same in all Member States
- The share of SMEs choosing the PIUS check and the share not choosing it is the same across EU27
- The resource saving potential is the same in each industrial sector across EU27
- The implementation cost are the same in all Member States
- There are 215,442 similar SMEs in EU-27 compared to 12,000 in the NRW.

- The investment period is 10 years, and savings will be achieved in the same period
- A calculation rate of 5 per cent is used, deemed reasonable for alternative investments.

Results at EU

Scaling up the results of the PIUS policy pursued in the NRW the potential economic benefit of offering the PIUS-Check to all SMEs in EU27 is estimated to EUR 776 million. This result is based on the assumption that the same percentage of SMEs as in the NRW will accept the PIUS check (4.2 per cent of companies) using a discount rate of 5 per cent and a 10-year investment horizon. If all SMEs go through the PIUS-Check, and if the share of companies that implements the proposed measures equals the share of PIUS-Checked companies in the NRW, the potential economic benefit of the PIUS-Check across EU-27 is EUR 22.5 billion.

The average economic benefits to companies from participating in PIUS-schemes are estimated based on a persistence of ten years of the savings achieved from participation in the programme. The economic savings over ten years are estimated to EUR 500,000. The average costs of companies that accept the PIUS-Check and implement the suggested technical and organisational changes amount to EUR 172,000. Thus, the estimated economic benefits for SMEs of participation in PIUS-Check or a similar scheme is estimated to EUR 333,000, see Table 6-2.

Table 6-2 Estimated average economic benefits to SMEs participating in the PIUS-programme, with a 10-year persistence of the achieved cost savings

	Euro
Cost of PIUS-Check	5,000
Investments	167,000
Total costs	172,000
Savings achieved over 10 years in the production processes	500,000
Economic benefit over 10 years	333,000

Source: Effizienz-Agentur NRW

6.3 NISP in the UK

Policy description

The National Industrial Symbiosis Programme (NISP) is a free (to business) advice and networking programme. NISP's approach uses industrial symbiosis to identify sustainable resource management solutions for business. The fundamental approach of the programme is to help identify and broker ongoing resource exchanges between companies. Typically, these exchanges involve one company taking a process-by-product from another company and utilising it within its own process. This brings benefits to the company producing the by-

product in terms of avoided waste disposal costs and brings benefits to the company taking the product in terms of avoided raw material and energy costs.

Context

NISP is a national programme, applied at a regional level across the UK. Each of the UK regions has a team of Industrial Symbiosis Practitioners working closely with businesses in their area to recruit members to the programme and help them form symbiotic relationships with each other. The practitioners' knowledge and relationships that they form with NISP members is a key success factor of the programme.

In the UK, NISP works directly with businesses of all sizes and sectors. A programme advisory group, consisting of key industry representatives, assists each of the regional teams to ensure that the programme is driven by genuine business requirements and that the strategic direction is relevant for each region.

The unique industrial network developed by NISP has been built up over the last five years. As of May 2010, membership of NISP exceeded 13,400 companies of all sizes, and 40 per cent of these have actively been involved in at least one synergy project.

All NISP facilitation costs are covered by government; hence the members do not pay any fees.

National results

Over the past five years, the UK NISP has yielded impressive results. The results are based on the cumulative effect of continuing savings achieved in each year. In terms of NISP's role in facilitating a synergy, an average figure of 60 per cent attribution was used, i.e. it was assumed that 40 per cent of the idea (and therefore subsequent benefit) originated from the companies taking part. This led to a calculation of the net impact of NISP activity as shown in the 'Net for 5 years' column of Table 6-3.

The 'EUR per Unit Output' column of Table 6-3 presents the value for money of the NISP programme. Under the assumption of equal resource allocation between the seven Key Performance Indicators metrics, a value for money indicator can be derived as a relative measure of the cost-effectiveness for each metric. The total amount of direct Defra funds invested into NISP for the five years of operation (2005/06 to 2009/10) is (GBP 27,650,000) EUR 33,180,000¹⁷, an average of EUR 6,636,000 per year. For the last year, discussions with NISP indicated that 93 per cent of the budget was spent on staff costs with the remaining 7 per cent covering premises, administration, IT, telephones, etc.

¹⁷ NISP, the Pathway to a Low Carbon Sustainable Economy, 2009

Table 6-3 Total Output for each of the 7 NISP KPIs and Value for Money

	Net for 5 years	EUR per Unit Output
Landfill diverted	10.,97 (t million)	0.43 (EUR/t)
CO ₂ reduction	10.84 (t million)	0.44 (EUR/t)
Virgin materials	16.62 (t million)	0.29 (EUR/t)
Hazardous Materials	1.09 (t million)	4.34 (EUR/t)
Water	18.6 (t million)	0.25 (EUR/t)
Sales	406.68 (EUR million)	0.012 (EUR/EUR)
Cost savings	358.8 (EUR million)	0.013 (EUR/EUR)

Source: NISP Economic Valuation, Final Report October 09 and own calculations

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- The limiting factor is the number of advisers (and funding) available rather than the number of companies.
- The same amount of money (and therefore advisers) in each Member State would be able to engage the same amount of companies and achieve savings of the same scale and nature as has been achieved in the UK.
- However, given the difference in scale between Member States, it was decided that a simple multiple of 27 would not be appropriate. E.g. some Member States would be too small to support a direct copy of the UK scheme while some are much larger and could support a larger version. We have therefore constructed a simple scenario multiplying the costs and benefits of the programme (over the first five years) by 7.53 to reflect the percentage of GDP that the UK represents for the EU27. In 2009, the GDP for the EU27 was reported by EUROSTAT to EUR 11,808,717 thousand million. For the UK, the figure was EUR 1,566,740.70 thousand million.

We have assumed that over the first five years of operation of a NISP equivalent in each Member State, the scale of savings achieved would be the same as the gross savings achieved by the UK scheme.

Results at EU

The potential costs and savings of a replication of the programme in EU27 for the businesses based on accumulation of the five years are shown in the following table:

Table 6-4 Overview of potential cost and benefits

	UK	EU 27
Programme costs (EUR million)	33.1	249.4
Landfill diverted (million tonnes)	7.02	52.9
CO ₂ reduction (million tonnes)	6.04	45.5
Virgin materials (million tonnes)	9.7	73.0
Hazardous Materials (million tonnes)	0.363	2.73
Water (million tonnes)	9.57	72.1
Additional Sales (EUR million)	211.3	1,591.1
Cost savings (EUR million)	187.4	1,411.1

Source Own calculations

It can be concluded that public expenditure on the programme would be EUR 250 million and that businesses will experiences savings in the order of EUR 1,400 million and additional sales of EUR 1,600 million. The additional sale is not profit, but additional turnover.

6.4 Aluminium beverage can recycling policies in Belgium and Sweden

Policy description

The Packaging and Packaging Waste Directive (Directive 94/62/EC) requires the producer to take responsibility for packaging waste. There are various approaches to ensuring recycling of cans in the Member States. Two of the most common approaches are deposit schemes and Green Dot schemes.

Producers of canned beverage and importers of metal beverage cans for the Swedish market are required to join an approved deposit-based recycling system. The Swedish government's target is 90 per cent recycling of aluminium beverage cans.

Every Belgian company that packages or arranges for the packaging of products sold in Belgium is liable to collect used packaging material to achieve the prescribed recovery and recycling rates. The recovery rate is 90 per cent, and the recycling rate is 80 per cent.

Context

The Swedish deposit scheme for metal cans is organised by AB Svenska Returpack. In the Swedish deposit scheme, consumers pay a deposit for every aluminium beverage can purchased. The deposit fee is SEK 0.50 (EUR 0.052), which is refunded to the consumer when he returns the can to a retailer. This gives the consumer a strong economic incentive to return the aluminium beverage can. The weight of aluminium beverage cans sold in Sweden 2007-2009 was in average 15,587 tonnes annually. The recovery rate of aluminium deposit cans through Returpack's recovery system remained stable at 73 to 74 per cent from 2007 to 2009. The official Swedish recycling rates of aluminium beverage cans include privately imported aluminium cans (cans without Swedish deposit

fee). The official recycling rates reached 91 per cent in 2008 and 88 per cent in 2009.

In Belgium, either companies can set up their own system for recovery and recycling of packaging waste or they can join an accredited body. With respect to household packaging waste, Fost Plus is the only accredited organisation to assume responsibility for the take-back and information obligations of a company. The companies that join Fost Plus pay a contribution to Fost Plus. This contribution is based on a specific rate for the type of packaging material in question. This contribution rate is known as a Green Dot rate, as the companies that pay contributions to Fost Plus are entitled to label packaging material with a Green Dot. The Green Dot is a label that reflects the company's commitment to the environment.

Household metal packaging waste is collected in special-purpose waste containers. Beverage cans are collected together with metal packaging waste from food tins, boxes, top, caps and lids of jars and bottles, aluminium plates, dishes and trays, cosmetics and food sprays.

The Belgian recycling rate of aluminium beverage cans reached 93 per cent in 2008. Reasons for reaching such high recycling rates are:

- Belgians are very good at separating the PMD fraction (plastic bottles and flasks, metal packaging and drinking cartons) from other waste types.
- All of Belgium is covered by Fost Plus's collection schemes.
- Fost Plus is very good at informing the public and their collaborating companies about sorting and management of waste.
- Quality control is made of the collection of the waste sorting where wrongly sorted PMD waste is refused.

Results of the Swedish system

In the period 2006 to 2008, Returpack-Burk Svenska AB (the branch of Returpack handling aluminium beverage cans) had a yearly average financial result after financial items and tax of EUR 4.92 million. The average financial result (after financial items and taxes) generated by Returpack is EUR 520 per tonne of aluminium scrap. Between 2007 and 2009, the value of the average annual deposit not reclaimed consumers amounted to EUR 15.1 million. Apparently, the deposits not recovered accrue to Returpack. The economic benefits arising from the Swedish deposit system seem to depend heavily on deposits not reclaimed by consumers. Without deposits from not returned beverage containers, it appears that the Swedish deposit system for aluminium beverage cans would yield a deficit before financial items and taxes of around EUR 7 million.

Results of the Belgian system

The unit cost of handling aluminium scrap is estimated to EUR 367.51 per tonne. The total annual costs of handling scrap from all aluminium cans in Belgium are estimated to EUR 1.587 million. The income generated from selling the scrap depends heavily on the value of the aluminium scrap. Based on a market price of aluminium scrap of between EUR 400 and 600 per tonne, the

total income from selling aluminium scrap from aluminium beverage cans is estimated to EUR 1.727-2.591 million. The annual financial results of Fost Plus's handling aluminium cans are estimated to be between EUR 0.312 and 1.175 million. Investments are not included. This corresponds to a financial gain of EUR 72-272 per tonne of aluminium scrap from beverage cans collected. It is thus profitable for Fost Plus to handle used aluminium cans.

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- The same recycling rates for aluminium beverage cans can be achieved throughout Europe by converting existing recycling systems into systems similar to those of Sweden and in Belgium.
- Companies using recycling schemes similar to the ones used in Belgium and Sweden are able to generate the same profit as in the said countries.
- The economic benefit harvested by implementing a system similar to the Swedish deposit scheme is EUR 520 per tonne of aluminium scrap from beverage cans collected.
- The economic benefit harvested by implementing a system similar to the Belgian Green Dot scheme is EUR 72-317 per tonne of aluminium scrap from beverage cans collected.
- The costs of handling aluminium scrap from used beverage cans are the same across Europe.

The average recycling rate in EU27 is equal to the average recycling rate in wider Europe, i.e. 63 per cent.

Results at EU

The annual potential economic benefit to operators of aluminium recycling systems in EU27 of introducing a recycling system similar to Swedish recycling system is estimated to be EUR 19.6 million. The potential economic benefit of implementing a recycling system similar to the Belgian Green Dot scheme is estimated to be in the magnitude of EUR 7.4-28 million.

The costs of improving the European recycling systems depend widely on how collection and handling of used beverage cans are managed presently. The development of a deposit scheme similar to the Swedish system involves considerable investments in infrastructure, including reverse vending machines. Similarly, considerable investments may be needed to establish the infrastructure necessary to operate a system similar to the Belgian recycling scheme, including costs of establishing efficient PDM waste sorting equipment.

To increase recycling rates of aluminium beverage cans, it is necessary to motivate consumers to recycle used cans. Deposit schemes provide such an incentive. The success in motivating the European population to increase recycling rates depends highly on the convenience of the system. The Belgian beverage can recycling system has been able to establish a system that is convenient to the consumers.

6.5 Sustainable clothing roadmap/UK

Policy description	<p>The Sustainable Clothing Roadmap was established in 2007 with the scope of increasing sustainability through the clothing supply chain, thereby maximising reuse and recycling of fibres. It is coordinated by the Department for Environment, Food and Rural Affairs (Defra) and is part of Defra's Sustainable Consumption and Production (SCP) programme.</p> <p>The clothing roadmap is a voluntary clothing industry initiative involving over 300 companies in the clothing supply chain. Through the road mapping, it is intended that business, government and other stakeholders reach a voluntary action plan for their product containing actions to improve sustainability performance, thereby obtaining environmental improvements and economic benefits for the industry. (Defra 2009) This requires that the businesses identify key impacts and agree on priority areas where actions will be most effective.</p>
Context	<p>In the UK, the clothing industry employs approximately 170,000 people, due to 90 per cent of clothing and textiles being imported (worth EUR 13.4 billion) and 10 per cent being exported (EUR 3.7 billion). The UK textile and clothing industry is small in comparison with the global industry, accounting for approximately 0.78 per cent of the UK GDP.</p> <p>A general trend observed in the UK is that clothing producers are relocating to the developing world. The vast majority of clothing consumed in the UK today is produced in other countries with the highest import volumes from China, Turkey, Italy, India, Bangladesh and Sri Lanka. Overall, clothing imports to Western Europe are estimated at 42 per cent of the global market.</p>
National results	<p>By using the UK sustainable clothing roadmap as a case, it has become evident that there are environmental and economic benefits of the recycling of clothing to be reaped by the clothing industry - and that there is a rather substantial potential for enhancing resource efficiency further due to unused clothing resources currently being deposited at landfill.</p> <p>Estimations show that more than 1 million tonnes of textile waste is produced every year in the UK. Only 25 per cent of this is reused or recycled, and the rest is thrown away and deposited at landfill.</p> <p>At least 50 per cent of the textiles thrown away are recyclable¹⁸; hence there are still 375,000 tonnes of unused resources a year with a recycling potential. This includes various economic savings, such as savings on landfill taxes and savings on the production of recycled textiles into new fibres.</p> <p>Within the solid waste stream going to landfill in the UK, there are potential savings in several areas. Waste going to landfill is taxed by the Landfill Tax rate for active waste, which will increase within the next two years to EUR 43</p>

¹⁸ These are Defra's own figures and must be considered conservative compared to the Textile Recycling Association's estimates that up to 95 per cent of textiles sent to landfill can be recycled.

per tonne; a rate which will bring the UK in line with other European countries (Waste online 2010). This is a total of (375,000 tonnes * EUR 43) EUR 16,125,000 per year that can be saved on landfill taxes only in the UK.

It turned out to be impossible to obtain specific economic data from companies recycling fibres/rags or filling produced from old clothing and textiles. It is clear, though, that the main financial savings can be achieved through energy and water savings in the production. This has to be weighed against collection and transportation of the recycled clothing to the production site, which has often turned out to involve over long distances.

The Wallisian enterprise Antur Waunfawr Cyf's own estimates show that fifty per cent less energy is used in the production of fabric if recycled fibres are used¹⁹.

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- Recycling of clothing is financially profitable to the recycling industry
- Estimates of resource efficiency are based on the assumption that the existing recycling companies have the capacity to produce new fibres from the used clothing.
- There is a market of buyers for the recycled fibres, cloths and padding produced from the used clothing.

Results at EU

The issue of clothing recycling is relevant at EU level due to clothing representing an increasing amount of total waste. At EU level, approximately 3.8 million tonnes of textile waste were generated in 2006. Of these, approximately 1.2 million tonnes were recovered, leaving an unused resource of 2.6 million tonnes of textiles disposed of as waste (interview with the Copenhagen Resource Institute). Assuming that at least 50 per cent of the textiles thrown away are recyclable, there are still 1.3 million tonnes unused clothing and textile resources each year, which potentially can be recycled.

Within the solid waste stream going to landfill in the EU there is also a savings potential on landfill taxes. Landfill taxes are different across the EU countries, but a range of countries is in line with the UK tax of EUR 43 per tonne (Waste online 2010). Based on this figure, a total of (1.3 million tonnes * EUR 43) EUR 55,487,000/year can be saved on landfill taxes in the EU.

6.6 Green supplier network/US

Policy description

The Green Suppliers Network (GSN) is a collaborative programme run by a combination of industry, the US Environmental Protection Agency (EPA) and the US Department for Commerce's 'National Institute of Standards and Tech-

¹⁹ http://www.anturwaunfawr.org/English%20site/clothes_recycling.htm Data extracted the 8th June 2010

nology Manufacturing Extension Partnership (NIST MEP). The GSN works specifically within the manufacturing sector, in particular with large manufacturers to assist them in engaging their SME suppliers through low-cost technical reviews that use 'Lean and Clean' methodologies to increase productivity, reduce waste, and boost profitability.

The programme came into operation in February 2001 with General Motors and the Saturn Corporation as the first two participants. The programme was scaled up in December 2003 and has been steadily expanded to other manufacturing sectors.

Context

The GSN aims to empower companies to combine 'lean and clean' manufacturing methods. A technical review seeks to optimise resources (labour and materials), identify opportunities to maximise return on investment and eliminate waste. To achieve these aims, the GSN adopts a top-down approach initiated by building strong relations with large multinational corporations (such as Johnson & Johnson) who are committed to improving supplier performance, with 'environmental sustainability' considered a fundamental factor in this performance.

National results

As of May 2010, 162 company members of the GSN had completed a Technical Review. The GSN team confirmed that of the 162, five are in the process of completing their review and ten are waiting for the plans to be finalised. The GSN has provided examples of the manufacturing sectors from which companies have undertaken reviews; these include aerospace, automotive, healthcare, and office furniture. The GSN team were not able to provide a breakdown of firms engaged by industrial sector.

Average annual savings per company (EUR 86,700) were obtained, which appear very attractive when compared to the cost to the company of participating (EUR 3,515). This excludes the capital costs of implementing any measures, as this information has not been collected by the GSN. However, given this average saving an average capital outlay of EUR 255,500 (plus the EUR 3,515 to participate in the programme) would still result in a payback time of three years.

Assumptions

If the GSN approach were to be replicated across Europe or by individual Member States these learning points would need to be understood in more detail, and much more detailed impact data would be required, if it was to be expected that comparable levels of outputs, costs and benefits were to be delivered by a similar programme.

- Corporate commitment and involvement of large multinationals is absolutely essential to the viability of the programme. This relates to the programme mechanism that relies on large companies requiring their suppliers to carry out their reviews in order to retain their business.
- Application of the GSN approach to Europe would require a 'public/governmental' intervention mechanism if a similar programme were to be replicated. Because without a resource to operate the programme and a

subsidised team of advisors many companies, particularly SMEs, would be unlikely to meet the full costs.

- The involvement of a manufacturing specialist like NIST MEP is absolutely critical, and the programme will not operate without it.
- Participation rates are unpredictable, and the network has struggled to expand (due to staff capacity constraints) beyond its current foundations.
- No company has ever stated that the investment to undertake the technical review has been too expensive or not worthwhile.
- The majority of the savings achieved are a result of management and process review, however some require a capital investment. The levels of capital investment made have not been recorded.

Result at EU

It is not easy to assess the potential of replicating the GSN approach in the EU. Although the network appears to address SMEs in different subsectors of manufacturing and does not seem to be exclusive in any way, there is limited quantitative information and no external evaluation to verify the programme and be confident of the level of **costs** and **benefits** of replicating this project in Member States.

The GSN programme has produced very impressive environmental and economic benefits for those companies that have taken part in it. Many of these savings are related to process improvements brought about by 'lean manufacturing' techniques.

Much of the cost of delivering the programme is accounted for by other public expenditure as it relies on the existence of a network of advisers for whom the GSN is not their only activity. As such, it is difficult to assess accurately the cost effectiveness of the programme, though even with a relatively conservative interpretation of available data it appears to offer a very cost effective process for the companies involved.

The manufacturing sector has gained most from the outputs of this programme. Whilst SMEs are well represented in this sector across Europe, the lack of an independent evaluation to quantify the achievements of the GSN makes it difficult to estimate how well the programme could be replicated across the EU.

However, there are two key points of interest to any Member State considering adopting the GSN approach:

- 1 Identification of large EU corporations who are committed to embedding environmental management systems within their supply chain is key to the success. Very large supermarket chains were suggested as a good example for the EU, as they have a broad range of suppliers who would be expected to meet stringent criteria in their supply chain contract. The key lesson here is that GSN have found without top down pressure on supply chains, SMEs will not seek assistance on 'greening' their business.

- 2 A partnership of public/governmental organisations that can provide the expertise and capacity to SMEs in how to improve their internal systems and procedures is also key. The NIST MEP involvement is vital to the GSN – the system that undertakes the GSN technical review is incorporated as part of a NIST MEP product, which has an annual operational cost of USD 100 million. Whilst EU Member States would not have to make that kind of investment, as many already have existing networks of this nature, it demonstrates the capacity of partners needed to role out a similar type of approach

6.7 Murray Darling Basin/Australia

Policy description

In 2008, *Water for the Future* was formulated by the Australian government in response to the pressure on the water resources in the Murray-Darling Basin. The two largest components of Water for the Future are the *Sustainable Rural Water Use and Infrastructure Program* and *Restoring the Balance in the Murray-Darling Basin*.

The Sustainable Rural Water Use and Infrastructure Program is aimed at giving subsidies to infrastructure to improve water use efficiency both off and on-farm with a total amount of EUR 4.1 billion. Hence, upgrading of irrigation systems is expected to reduce the volume of water required by irrigators to produce a given level of output.

In *Restoring the Balance in the Murray Darling Basin*, EUR 2.1 billion has been allocated by the Australian government with the aim of purchasing water entitlements which represent the rights of land owners to receive a share of the consumptive pool within an area, which can lead to the flexibility the farmers need to respond to drought and climate change. The objective of the programme is to reduce the over-allocation of water and secure permanent re-balancing of water available for the environment and water used for irrigated agriculture.

Context

The Murray-Darling Basin is under great stress from the combined impacts of historical over-allocation of water for consumption, severe drought, growing population, and the early impacts of climate change and anticipated reduction in water availability in the future. The area is home to more than 2 million people, which is 10 per cent of Australia's population. In 2006, 10 per cent of all people employed in the area of the Murray-Darling Basin worked in agriculture, compared to 3 per cent Australia-wide. This means that over one third (38 per cent) of Australia's farmers reside in the Basin and that about 85 per cent of all irrigation in Australia takes place in the Murray-Darling Basin, which supports an agricultural industry worth more than EUR 6.4 billion per annum²⁰.

National results

The policy initiatives have led to increased water efficiency on farms and better flexibility in responding to drought and climate change. In *Restoring the Balance in the Murray-Darling Basin Program*, 766 giga litres of water entitle-

²⁰ DEWHA (2010c)

ments worth over EUR 0.9 billion have been purchased²¹. The total cost allocated to the programme is EUR 2.2 billion, which will enable a total purchase of 12 per cent of water resources based on existing market prices. Further, the cost of *Sustainable Rural Water Use and Infrastructure Program* of EUR 4.11 billion is additional to the programme, and the initiatives should be seen integrated parts due to the savings the farmer can make by introducing water saving measures. Overall, the total expenses of the authorities amount to EUR 6.3 billion.

With 12 per cent of water resources to be purchased by the authority and therefore not extracted from the Murray-Darling Basin, the loss in the gross value of irrigated agricultural production per year will be 4.8 per cent. With the value of the agricultural sector of EUR 6.37 billion per year in the Murray-Darling Basin, this will result in an annual loss of EUR 0.3 billion. From the irrigation farmers' points of view, the agricultural loss in the production is compensated for by the sale of entitlements to the government worth over EUR 2.2 billion compared to an annual loss of EUR 0.6 billion in the agricultural production. This leaves a surplus of EUR 1.63 billion to the irrigation farmers in the Murray darling Basin.

Assumptions

The following assumptions were made in order to transfer the results to the EU:

- Existence of a water market including a tradable water entitlement system
- Water rights through entitlements. In Australia, the water is allocated on the basis of an entitlement system. Establishment of a similar quota system would be necessary by which a limited quantity should be made available to the irrigators and other industry
- Water basin point of departure for water allocation with no restrictions imposed by administrative borders
- The Potential for investments in and subsidising infrastructure projects also needs to be considered.

Results at EU

The policies led to increased water efficiency on farms and re-balancing of water available for the environment. The policies have been found most relevant to the areas of the EU where large irrigated, agricultural production areas depend on scarce and unpredictable water resources within an important water basin area prone to droughts and desertification. These are found in the southern parts of Spain and Italy and eastern parts of Greece, Bulgaria and Romania.

By combining the use of a water quota system and financial support for implementation of water efficiency measures, the total water saving potential for Bulgaria, Greece, Spain and Romania is estimated to around 6,600 million m³ annually. The main savings are found in the water efficiency measures. The water saved constitutes an economic value, be it used to increase industrial or agricultural production, to protect ecosystems or for other purposes. Water

²¹ Australian Government (2010a) Figures from 31 December 2009

prices vary significantly across the EU, and it is therefore not feasible to estimate the value of the water saved.

Based on an annual agricultural production loss of 4.8 per cent annually and an estimated cost of implementing the policy of approximately EUR 36 billion, calculations show a surplus of 23.5 per cent for the EU irrigation farmers if consenting to a policy initiative as the one introduced in the Murray-Darling Basin.

6.8 Food waste reduction/South Korea

Policy description

Policies for solid waste in South Korea have been developed through three phases starting before the 1990's:

Table 6-5 Overview of the solid waste policies in South Korea

	-1990s	1990s	2003-
Paradigm	Service Supply	Demand Control	Resource Recirculation
Goal	Expand Treatment Capacity	Reduce waste Increase recycling	Enhancing recyclability of products
Tools	Fixed Rate Waste Fee	Volume Rate waste fee Deposit-Refund Waste Charge	Pro-environmental traits of products Enforcement of Resource Recirculation Act

Source: Own analysis

In 2002, Korean waste policies experienced an important shift from waste reduction to resource efficiency issues in addition to recycling of waste and construction of a resource recirculation society (Park 2009). This was reflected through the second Comprehensive National Waste Management Plan (2002~2011) outlined by the Ministry of Environment. With the goal of "*firm establishment of a sustainable and resource circulating socio-economic foundation*" waste was viewed as a resource to be explored and no longer as waste to be disposed.

The Food Waste Reduction Policy is part of this management plan, which contains different food waste reduction programmes, such as campaigns for changing table settings, food waste-to-energy policy, use of food waste for fodder and compost and ban on direct landfill of food waste - all aiming at promoting an environment-friendly food culture to reduce the amount of food waste.

Context

South Korea's population counts almost 50 million, and the total land size of Korea is to 99,646 km², which is equivalent to 0.002 km² per capita. Thus, the country has one of the highest population densities of the world (490 persons per km²), and combined with accelerated economic growth, this has resulted in excessive household waste per unit area (480 kg/km² day). (Park 2009)

National results

A total of KRW 875.8 billion (EUR 581 million²²) was provided by the South Korean government to save 14,452 tonnes of food waste per day in 2008. This means that a total of 5,274,980 tonnes of food waste were saved in 2008 at a price of EUR 581 million - or put in other words, the Korean government paid more than EUR 1.5 million each day to save 14,452 tonnes of food waste per day.

The expected outcome of the food waste policy is a 20 per cent reduction in the volume of food waste by 2012 compared to that of year 2010. Still, it is difficult to estimate the potential financial savings of this reduction, but in the case of Jeonju City, food waste volumes were reduced by 12 per cent and savings in the order of KRW 1.1 billion (EUR 730 million) of processing costs were achieved following the introduction of a RFID Tag recognition system.

Table 6-6 Food recycling rates

	1998	2000	2004	2007
Food waste recycling rate in %	21.7%	45.1%	81.3%	92.2%
Food waste recycling rate in tonnes/day		5,200	9,316	14,452

Source: Ministry of Environment 2010

In South Korea, 95 per cent of the materials used for animal fodder are imported. Countries reflecting the same import pattern can make a better use of food waste as useful resources and at the same time save expenses on import of grain and materials for fodder.

Assumptions

Food waste for animal feed and fodder are produced and transported under such conditions that it is viable to use as feed and fodder for animals. Among other things, this requires that transportation is short to avoid rotting of the food waste.

The estimate of import substitution of animal fodder is based on the assumption that the total amount of import can be replaced with food waste, constituting a potential saving of EUR 10,400 million annually. This is the best-case scenario and a difficult one to reach, however, this figure will depend on the actions of the individual Member States.

Results at EU

By transferring and scaling up the food waste reduction policy to the EU, savings can be achieved in the agricultural sector by replacing current imports of animal fodder with fodder produced nationally from food waste.

At EU25 level, the total import of animal feeds in first semester of 2006 was EUR 5.200 million, hence, potentially, internal production of animal feed and fodder replacing current imports can lead to savings in the order of EUR 10,400 million annually for livestock holders in the agricultural sector.

²² Exchange rate 26 May 2010; 1 USD = 0.813794 EUR

Based on population density, Malta, the Netherlands and Belgium are eligible EU27 countries for implementation of a food waste reduction policy as are densely populated areas in e.g. the UK and Germany being areas with high food waste production. The livestock production is especially high in the Netherlands, UK and Germany, and as a result they constitute some of the biggest internal markets in the EU for animal feed and fodder.

From a government point of view, potential savings from the reduced processing costs offset the costs of implementing the food waste reduction policy. These figures are difficult to estimate and depend on the potential for reducing food waste in the countries compared with the current use of food waste. The current use of food waste has been difficult to estimate individually in all Member States.

6.9 Basic policy on promoting green purchasing and green purchasing network (GNP)/Japan

Policy description

The objectives of the green public procurement are to contribute to reducing environmental impacts by buying eco-friendly goods and services. The basic principles for procurement of eco-friendly items as outlined in the Basic Policy on Promoting Green Purchasing are

- 1 Consideration of environmental attributes in addition to price and quality considerations,
- 2 Consideration of products that contribute to the formation of a socio-economic system through an environmentally sound material cycle and reduce greenhouse gases.,
- 3 Reduction of environmental impacts throughout the product's lifecycle, from manufacture to disposal.
- 4 Long-term use, efficient utilisation, and appropriate disposal of procured goods and services (separation into appropriate waste streams).

The benefits of the green public procurement to the companies are:

- Increasing profitability by using resources more efficiently
- Increased resource efficiency
- Minimisation of waste and waste charges
- Enhancing company image and profile in the market
- Innovation effects
- Contribution to greening the supply chain
- Boost the market for eco-friendly products.

Context

The Act on Promoting Green Purchasing was enacted in May 2000 and enforced in 2001. It required the national government to set up a Basic Policy on Green Purchasing, which was first released in 2001 and has the goal to outline

the basic direction for public procurement of eco-friendly products²³. The main target group is the public sector, i.e. according to legislation, it is obligatory for ministries, agencies, the Diet (parliament), courts and other independent administrative institutions to follow green procurement guidelines. However, local authorities, private companies and individuals are also requested to advance in purchasing environmentally sound products and services. The process of implementing green procurement requires all state ministries, departments and agencies to draw up annual 'procurement policies' as well as to establish procurement targets every fiscal year based on the Act on Promoting Green Procurement taking into consideration its budget and planned projects and activities. The Green Purchasing Act dramatically contributed to the dissemination of green procurement among governmental sectors but also to companies, the products of which were covered by legislation.

The Green Purchasing Network (GPN), a non-profit organisation that works with the industrial, governmental, academic and private sectors, draws up the purchasing guidelines for various products, maintains the extensive product database, holds seminars as well as study meetings, and awards commendations to organisations, which develop and implement innovative Green Purchasing programmes²⁴. The principles of green procurement and procurement guidelines for each type of product (19 product categories and more than 11,000 products as of January 2007) are developed through discussions among the GPN members and supported by external consultations. The 3,036 member²⁵ organisations include businesses, local governments, consumer groups, environmental NGOs, and cooperative associations. Since 1997, the GPN has published a "data book" of quantitative and qualitative environmental information on each product in accordance with the procurement guidelines.

National results

The GPN guidelines and data books naturally have an influence on industries. On the one hand, they constitute a decision basis for the responsible purchasers, on the other hand, they are also a kind of benchmark in terms of the products that are categorised. The GPN is regarded as politically neutral; however, companies and academics that represent the network are able to influence national-level politics.

The market size of environmental business in Japan is forecasted to be rapidly increasing from EUR 270 billion in 2000 to EUR 430 billion in 2010 and EUR 530 billion in 2020 (Sato 2006).

A survey conducted in 2005 by the Ministry of Environment (MoE) among 2,524 respondents of large-sized companies found that 57 per cent of the private businesses had implemented green purchasing guidelines and 25 per cent consider introducing them and 18 per cent have no plans to introduce green purchasing guidelines (Sato 2006).

²³ last updated in February 2010

²⁴ Green Purchasing Network (GPN), <http://www.gpn.jp/English/>

²⁵ As of January 2008

According to the annual report of the Ministry of the Environment (2009), the target is to have 30 per cent of the (large, medium-sized and small) private companies applying green purchasing principles. The following companies are known to have implemented organisational green procurement schemes:

- Sony, Canon, NEC, Fuji Xerox, Ricoh, Honda, Toyota, Nissan, Matsushita Electric Industrial (now: Panasonic), Nippon Steel, Seiko Epson, Hitachi, Toshiba, Mitsubishi Corp., JT, Suntory, Kikkoman, Tokyo Gas, Development Bank of Japan, NTT, JR, Tokyo Electric Power, etc.

Assumptions

Due to lack of empirical data, general assessment of the effectiveness of the Japanese GPP policy is difficult. In general, ex-post evaluations of GPP policies are scarce (Johnstone 2003). There are no figures showing the magnitude of resources saved by GPP policies for the various products groups. More general data are available on the share of institutions purchasing green products and services.

Results at EU level

The purchasing power of the public organisations is immense, and they have considerable market influence. According to information of the Green Purchasing Network of 2003, public purchasing in Japan encompasses EUR 530 billion (76 per cent governmental procurement and 24 per cent procurement of local authorities) corresponding to 17.6 per cent of the total GDP (Sato 2006). In Europe, public spending amounts to EUR 1.5 trillion, which is about 16 per cent of the European GDP (ICLEI Procura+ Campaign 2010).²⁶

The Japanese Green Procurement Scheme seems to be effective due to the mandatory requirements of public green procurement and the detailed requirements for green products developed by the Green Purchasing Network.

Based on the available data, it is impossible to estimate the economic benefits to companies arising from the policy. The demand for green products, however, gives strong incentives to product manufacturers to develop and produce green products. The Japanese green procurement policy has contributed to creating a demand among private companies for green products. The magnitude of economic benefits to business that would emerge from the transposing the Japanese green procurement policy into a European context is highly uncertain.

²⁶ <http://www.procuraplus.org/index.php?id=4594>

7 Conclusions and recommendations for identifying and realising the resource efficiency potential in Europe

The current study has looked into a wide range of resource efficiency policies and provided in-depth analysis of the economic impacts of a sample of nine resource efficiency policies. This sample can be used by decision-makers to show the potential economic advantages likely to follow from applying these resource efficiency policies in EU Member States and to provide guidance on the most beneficial form of policy in different conditions.

7.1 Categorisation of issues and factors determining the success of resource efficiency policies

Categorisation

The typology of resource policies established in chapter 3 allows for a comparison between instruments and their possible outcomes in terms of economic costs and benefits. It shows from a theoretical perspective which economic costs and benefits can be expected when a certain policy is being implemented.

The typology shows that the four most dominant economic sectors in the EU that exert direct pressure on the environment are agriculture, the electronics industry, transport services and some basic manufacturing industries (refinery and chemical products, non-metallic mineral products, and basic metals).

Identification of target sectors

The selection of sectors for the analysis was made from two key criteria that are fundamental to the success of the resource efficiency policies. A sector can be of **economic importance** in terms of its monetary contribution to the national Gross Domestic Product (GDP), and it can be of ecological relevance, i.e. its **resource intensity** contributing to the Total Material Requirement (TMR) of a country.

Sectors with the highest resource-saving potential were identified indicating where the largest potential for resource efficiency was expected. The following economic sectors were identified as resource-intensive sectors with major resource saving potentials: agriculture, food production, electronics, construction and automotive. As can be seen, these sectors overlap with some of the dominant economic sectors in the EU identified through the typology: agriculture and electronics.

Looking at the sectors representing the highest potential for resource savings, it can be concluded that resource saving potentials of up of to 20 per cent are present all sectors in the EU. The sectors representing the highest potential are construction, chemicals, metals and food. The metal, construction and food sectors were included in the study as case studies for in-depth analysis.

Identification of critical resources

In the study, the resources related to the target sectors that are critical to Europe were identified as metals, minerals, biomass, plastics, aggregates, water and food.

7.2 Identification of potential net economic benefits to the EU economy and future impact of policies

Potential net economic benefits to EU

An in-depth analysis of the net economic benefits to the EU economy from resource efficiency policies was made to identify where they are likely to be highest. This analysis is based on nine cases, which made it evident that it is a challenge to transfer specific results from national levels in to EU27 or from one sector to another.

Impossible to draw general conclusions

Based on the case studies identified, it was possible to estimate to some extent the economic impacts at business operational level. The conclusions drawn are based on a limited number of cases, which do not provide sufficient evidence for drawing general conclusions or detecting trends for all sectors and resources for EU27. Discussion of how the net impacts of the policy are likely to affect the EU's balance of trade has therefore been omitted since conclusions resulting from such a discussion would require a much broader analysis of the economic impact.

The case studies represent different sectors and different policy instruments and types of resources. Hence, the policies are developed in different contexts and respond to different circumstances. The resource efficiency policies have shown to be highly relevant in an EU context, but it would not be prudent to draw general conclusions from the nine cases due to their diversified nature.

The future impact of resource efficiency policies

Further, it proved impossible to assess the future impact of resource efficiency policies due to the diversity of the case studies and their limited range. Where possible, the net potential economic benefits of a future application of a specific resource efficiency policy has been assessed, but the basis for assessing the future impact of such policies on EU level is too uncertain and findings would be based on speculation.

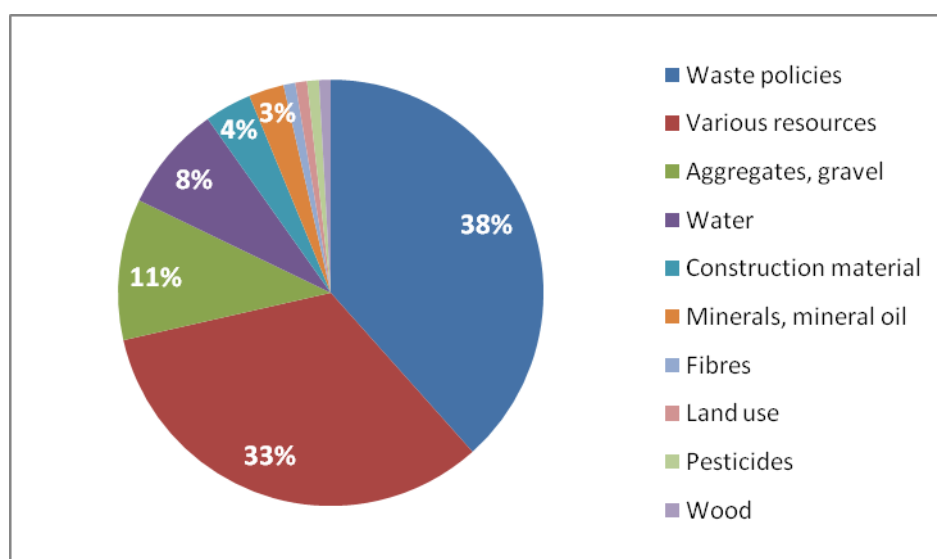
Conclusions drawn from screening of policies

Based on a literature review and stakeholder consultations, a total of 120 resource efficiency policies were identified in 23 countries. Most policies address either material efficiency of specific resources, such as water and aggregates or wider material efficiency in industrial production. The scope of such policies is to improve material efficiency in SMEs through dissemination of information on best practices.

A major finding from the screening process is that most countries have much stronger focus on energy efficiency policies than on resource efficiency policies. Further, the scope of a wide range of policies is to improve environmental performance, but a positive spill-over effect of such policies is improved material efficiency.

The type of resources addressed by the identified resource efficiency policies are shown below. Waste policies targeting waste prevention, reuse and recycling of waste make up 38 per cent of the identified resource efficiency policies. 11 per cent of the policies are aggregates and gravel levies and taxes. The purpose of a number of aggregates levies and taxes are to generate income to the state and not to increase material efficiency.

Figure 7-1 Resources addressed in identified policies



Source own compilation

33 per cent of the identified policies do not target specific resources. The majority of the policies broadly address resource efficiency in industrial production. Waste minimisation and cleaner production are promoted through a number of different policy instruments, including information schemes and networks, awareness raising, green procurement, R&D programmes on environmental technologies, governmental loan programmes and development of a 'circular economy'.

7.3 Conclusions drawn from case studies

The case studies analyse in-depth specific resources, sectors or instruments offering valuable information for policy makers to consider in the specific areas. The following conclusions can be drawn from the case studies:

Table 7-1 Conclusions draw from case studies

Policy initiative/instrument	Sector ²⁷ /Resource	Conclusions on potential net economic benefits at EU level	Private economic benefits ²⁸												
<i>UK</i> Aggregates levy	Construction: aggregates	The reduction of primary aggregates extraction has been estimated to be equivalent to GBP 3.1 billion. Assuming that the ratio of the public sector to the private sector is similar in Europe, the UK material cost reduction would correspond to savings of GBP 1.4 billion for the private sector and GBP 1.7 billion for the public sector in Europe. The revenues from a tax implemented in all European Member States could generate EUR 5,682.6 million of potential revenue (for EUR 2/tonne).	++												
<i>Germany</i> PIUS - Product Integrated Environmental Protection Effizienz Agentur NRW: • Information on best practises	Metal/metal finishing sector: Water energy Metals Chemicals	Scaling up the results of the PIUS policy, the potential economic benefit of offering the PIUS-Check to all SMEs in EU27 is EUR 776 million. The estimated economic benefits for SMEs of participation in PIUS-Check or a similar scheme is estimated to EUR 333,000.	+++												
<i>UK</i> NISP	Cross-sectoral: waste	The potential costs and savings of a replication of the programme in EU27 based on accumulation of the five years are shown in the following table: <table border="1" data-bbox="774 1189 1350 1406"> <thead> <tr> <th></th> <th>UK</th> <th>EU 27</th> </tr> </thead> <tbody> <tr> <td>Programme costs (EUR million)</td> <td>33.1</td> <td>249.4</td> </tr> <tr> <td>Additional Sales (EUR m)</td> <td>211.3</td> <td>1,591.1</td> </tr> <tr> <td>Cost savings (EUR m)</td> <td>187.4</td> <td>1,411.1</td> </tr> </tbody> </table>		UK	EU 27	Programme costs (EUR million)	33.1	249.4	Additional Sales (EUR m)	211.3	1,591.1	Cost savings (EUR m)	187.4	1,411.1	+++
	UK	EU 27													
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Cost savings (EUR m)	187.4	1,411.1													
<i>Sweden/Belgium</i> Aluminium can recycling policies: • Deposit fee • Green dot scheme	Metal sector: Aluminium	The annual potential economic benefit to operators of aluminium recycling systems in EU-27 of introducing a recycling system similar to Swedish recycling system is estimated to be EUR 19.6 million. The potential economic benefit of implementing a recycling system similar to the Belgian Green Dot scheme is estimated to be in the magnitude of EUR 7.4 - 28 million.	+												
<i>UK</i> Sustainable clothing roadmap policy: • Regulation • Tax (landfill tax)	Waste sector: Textiles/fibres	At EU level, there are still 1.3 million tonnes unused clothing and textile resources each year, which potentially can be recycled. The economic benefit has not been estimated due to the diversity at production level, which has made it difficult to draw general conclusions. A total of (1.3 million tonnes * GBP 35) GBP 45.500.000/year (EUR 56 million) can be saved on landfill	+												

²⁷ Sectors have been refined according to MFA/OECD methodology with respect to the key resources that are used in them.

²⁸ Max score is 3 plus and minimum is 3 minus.

Policy initiative/instrument	Sector ²⁷ /Resource	Conclusions on potential net economic benefits at EU level	Private economic benefits ²⁸
		taxes in the EU.	
<i>USA</i> Green supplier network Needs to be finished	manufacturing sector	The manufacturing sector has gained most from the outputs of this programme. Whilst SMEs are well represented in this sector across Europe, the lack of an independent evaluation to quantify the achievements of the GSN makes it difficult to estimate how well the programme could be replicated across the EU.	+++
<i>Australia</i> Water for the Future - Murray Darling Basin: <ul style="list-style-type: none"> • Purchase of water rights/tradable permits • Funding/subsidies 	Agricultural sector: Water Food production	By combining the use of a water quota system and financial support for implementation of water efficiency measures, total potential water savings for Bulgaria, Greece, Spain and Romania of around 6,600 million m3 annually can be realised. Based on an annual agricultural production loss of 4.8 per cent annually and an estimated cost of implementing the policy of approximately EUR 36 billion, the calculations have shown a surplus of 23.5 per cent for the EU irrigation farmers if entering a policy initiative as the one introduced in the Murray-Darling Basin.	+++ ²⁹
<i>South Korea</i> Food waste reduction policy: <ul style="list-style-type: none"> • Networks • Information • Funding/subsidies 	Waste sector: Food	The potential savings from the reduced processing costs should be added and the costs of implementing the food waste reduction policy should be offset. The accurate figures are difficult to estimate and depend on the potential for reducing the amounts of food waste in each country.. At EU-25 level, the total import of animal feeds in the first semester of 2006 was EUR 5.200 million, hence, potentially, internal production of animal feed and fodder substituting the current import would lead to a saving of EUR 10.400 million a year for livestock holders in the agricultural sector.	+
<i>Japan</i> Basic policy on promoting green purchasing and green purchasing network (GNP)	Cross-sectoral: Paper Office furniture	Based on available data, it is not possible to estimate the economic benefits to companies arising from the policy. The demand for green products, however, gives strong incentives to product manufacturers to develop and produce green products. The Japanese green procurement policy has contributed to creating a demand among private companies for green products.	(+)

²⁹ From a social economic view this policy becomes extremely expensive and would score lower if this cost was included.

Against the background of the analysed resource efficiency policies, a comparison of the results from the case studies and the findings of the theoretical framework, the sectors representing the highest resource-saving potential correspond well. The agriculture, food production, electronics, construction and automotive sectors identified in the theoretical framework as high resource consumption sectors and therefore high savings potential correspond with the findings of the case studies.

Types of corporate response to resource efficiency policies

Based on our analysis of the case studies, it is possible to draw conclusions on the types of responses the companies develop in response to resource efficiency policies. The case studies were analysed according to the four existing types of responses presented in the methodology chapter; pay the additional costs, substitute, optimise the use of resources and change product portfolio.

Pay the additional costs

This type of response is only seen in two of the case studies indicating that companies choose to maintain existing production methods and pass the costs of the policy on to the customer in case of implementation of resource efficiency policies. This is seen in the UK/Aggregates levy and the Murray-Darling cases, which represent the construction and agriculture sectors respectively.

Substitution

The highest represented response strategy observed is replacement of the resource subject to resource efficiency policies with other resources, which is seen in all the cases except one³⁰. The substitute typically constitutes a higher cost to the company than the original resource as seen in the sustainable clothing road map in the UK, where the company has to pay a higher price for the used textile in order to recycle it into new clothing. Only when down-cycling used textiles into rags etc. is it possible for the company to gain an economic benefit. The most interesting conclusion to be drawn from the sustainable clothing roadmap case is the fact that there is a large unexploited potential through the vast quantities of textiles going into the waste stream. This will not change until there is an economic incentive at corporate level for recycling.

The substitution response to a resource efficiency policy is also found in the food waste reduction policy from South Korea, where there is a potential for replacing import of animal feed and fodder with food waste. This can entail an economic benefit for the livestock holder and socio-economic savings through avoided payment of landfill taxes in the countries where household waste goes into landfills.

The UK aggregates levy case represents a case where substitution of water has been a result of the resource efficiency response. Water is a particularly difficult resource to substitute, which is why this policy must be regarded an interesting example of resource efficiency.

The aluminium can recycling case from Sweden and Belgium also represents a case where a substitution is regarded the most optimal response. An interesting characteristic of this case is the importance of the cultural aspects in Belgium, which seem a more efficient instrument than economic incentives in Sweden.

³⁰ The exception is the aluminium can recycling case in Sweden and Belgium.

Optimising the use of resources This response was identified in six of the cases, indicating that improvements in the resource use can be achieved by improved resource management or by the introduction of new technologies. The case of the Murray-Darling clearly shows that the introduction of new technology, such as water efficiency infrastructure, has led to water savings in irrigation agriculture and consequently an economic benefit for the farmer. The same pattern is evident in the PIUS and NISP cases, where consultation often leads to technology improvement and consequently resource efficiency and economic benefits for the company.

This type of response is only relevant when technology improvement is possible. In addition, up-front investments are often required.

Changes product portfolio The last response type is the most radical response to resource efficiency policies, which includes phasing out of the existing product portfolio in favour of producing new products using other resources. This response is found in two cases; basic policy on promoting green purchasing and green purchasing network/Japan and the Murray-Darling cases.

The case from Japan differs from the rest of the cases by representing a mandatory policy implementation imposed by the national authority and consequently a high percentage of resource savings. It is evident that where information schemes and voluntary instruments are not enough to change a company's behaviour to the desired degree, more strict regulation may be needed to obtain the desired resource efficiency.

Highest economic benefit The case studies that do not represent a single sector, but represent cross-sectoral policies, such as the PIUS and NISP cases, both show a high potential for improving for resource efficiency. An influencing factor may be the fact that the companies experience results on a short-term basis, which may offer a stronger incentive.

An overall conclusion to be drawn from the analysis of the case studies is that the resource efficiency policies with the highest economic benefit for the companies are generally those to which national authorities make substantial economic contributions through a programme or policy. The Murray-Darling, NISP and PIUS cases are all good examples of this.

7.4 Guidance of future analysis of economic impacts of resource policies

From the experiences gained from the present study, it has become evident that in order to provide a solid foundation for estimating the potential economic benefits of introducing resource efficiency policies, a much more detailed and in-depth analysis is needed. This has not been possible to provide through the present nine case studies covering a wide range of sectors, instruments, countries and resources.

The present study provides indications of trends of potential and economic benefits and visualises the effects. The case studies indicate that the resource

efficiency policies are either sector or resource specific and thereby a solid starting point for future analysis.

8 Literature

The literature used in the case studies is presented in annexes following each case description.

Acosta-Fernandez, Jose (2010), provisional information bases on data from the ongoing project EXIOPOL, monetary input-output tables, Wuppertal Institute.

Bahn-Walkowiak, B., Bleischwitz, R., Onischka, M., Röder, O., Steger, S. (2009), The relation between resource productivity and competitiveness, Project ENV.G.1/ETU/2007/0041 Part: Resource Productivity, Competitiveness

Böcher, M./Töller, A. (2007), Instrumentenwahl und Instrumentenwandel in der Umweltpolitik - ein theoretischer Erklärungsrahmen. Politische Vierteljahresschrift special issue 39/2007: 299-322

De Bruyn, S., A. Markowska, F. de Jong, M. Blom (2009), Resource productivity, competitiveness and environmental policies. Delft, December 2009

CSCP (2006), Policies for Resource Efficiency, Towards Sustainable Consumption and Production. CSCP, GTZ, the Federal Ministry for Economic Cooperation and Development and the Wuppertal Institute for Climate, Environment and Energy, Wuppertal.

EEA (2005), Market-based instruments for environmental policy in Europe. EEA Technical Report No 8/2005. Copenhagen, European Environment Agency

Little, A. D. (2005), Studie zur Konzeption eines Programms für die Steigerung der Materialeffizienz in mittelständischen Unternehmen, GmbH. Wiesbaden; Fraunhofer-Institut für System- und Innovationsforschung -ISI-, Karlsruhe; Wuppertal-Institut für Klima, Umwelt, Energie

OECD (2008), Measuring material flows and Resource Productivity. Syntheses report. OECD

OECD (2009), Report of the 2nd survey on SMM-related activities in OECD countries, Paris (including a questionnaire on SMM on p. 36ff.)

Rohn, H., C. Lang-Koetz, N. Pastewski and M. Lettenmeier (2009), Identification of technologies. Products and strategies with high resource efficiency po-

tential – result of a cooperative selection process. Wuppertal Institute for Climate, Environment and Energy, Resource efficiency Paper 1.3

Websites:

<http://www.insee.fr/>; National Institute of Statistics and Economic Studies

http://ec.europa.eu/environment/newprg/strategies_en.htm; Sustainable use of natural resources and waste

http://ec.europa.eu/resource-efficient-europe/index_en.htm: **Flagship** initiative “A resource efficient Europe” under the Europe 2020 Strategy