End of Waste Project

Institute for Prospective Technological Studies (IPTS, Seville)
DG Joint Research Centre (JRC)

September 2006

http://www.jrc.ec.europa.eu
The mission of IPTS is to provide customer-driven support to the EU policy-making process, by researching science-based responses to policy challenges that have both a socio-economic as well as a scientific/technological dimension.
Background to Project

Thematic strategy on prevention and recycling of waste

Waste - something to be strictly controlled and disposed of as cheaply as possible or a resource to be exploited?

How to promote recycling / re-use / recovery of waste by reducing burdens on the recycling industries whilst ensuring high standards of environmental protection.

Waste hierarchy remains an excellent rule of thumb.

When might something which used to be waste be “safely” classified as no longer waste (if at all).

Need a careful scientific assessment.
Objectives of project

Develop a general methodology for determining end of waste criteria (end of waste methodology) using three specific pilot case studies:

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

Methodology should be generally suitable for application to any candidate waste stream to determine (if any) end of waste criteria.

Propose further candidate waste streams for consideration based on standard selection criteria.
Waste stream selection criteria
Objective and approach

To identify those waste streams where the use of “end of waste” could be appropriate.

• to develop a set of criteria enabling the selection and comparison of potential waste streams

• to analyse the waste streams by applying the criteria

• propose a list of waste streams with their relative importance
Principles for the Selection

- the existence of an environmental benefit;
  by clarifying when a given waste stream ceases to be waste (and being considered as secondary material) along the steps of waste management, there is clear environmental benefits: from a life cycle point of view in comparison to alternative management options, no any additional health and environmental risk during both production and usage of the secondary material.

- the existence of a market for recycled substances from the waste stream
  an established or potential market for the derived secondary material, some of which will compete with either a primary material or one or more products performing a similar function. In any case, the production of the secondary material and its further process into products should be economically viable and technologically feasible.
Pre selection criteria

- Pre-selection criteria: indicative, or easily quantifiable, elimination

Example 1: The secondary material derived from the waste stream can replace raw material, the production of which has high environmental impact

Example 2: The derived secondary material is being traded in and outside the EU and a market harmonisation is expected to be beneficial
Selection criteria

• Selection criteria:

  Example 1: Life cycle material and energy balance (output – input)

  Example 2: Secondary material market potential and trend

  Example 3: Economic benefit of the secondary material production
End of Waste project in general

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Waste

Process / treatment

Output material – product or waste?
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End of Waste project in (probable) reality
Project outline

Desk and literature studies already started

Research and analysis of information started and ongoing

Interim reports to DG Environment

Expert workshops 2007 for case studies possibly two workshops per case study

Stakeholder consultation through DG Environment

Final reports to DG Environment - 2008
Framework for end of waste project

1. Aims, objectives, scope, definitions

2. Potential treatments of the wastes in question

   Alternative processes;
   Technical problems/constraints;
   Type and quality of waste input material;
   Auxiliary chemicals/materials, utilities used;
   Characteristics and quality of end products and residues;
   Potential environmental impacts.
Framework for end of waste project

3. Potential uses of the treated material

Description of the different uses, market size and prices;
Technical constraints and product quality requirements;
Benefits and environmental risks associated with the uses;
Alternative products (primary and other secondary).

4. Existing standards and regulation in place (and under development) in Member States and at other relevant levels such as CEN. Analysis of how they have been developed.
5. Existing situation of national / regional waste generation, composition and treatments

Quantities and qualities of relevant waste arisings;
Relative significance of treatment technologies;
Main related environmental impacts;
Waste management industry structure.

6. Current national/regional uses of the treated material

Quantities of treated material of different qualities/classes used in different areas of application;
Import and export data;
Waste or product status for different uses.
Framework for end of waste project

7. The costs and benefits of options

Compare the financial and external benefits and costs of the recovery option in question in comparison to other treatment options for the wastes under investigation (Qualitative and, as far as possible, also quantitative).

8. Proposal of end of waste criteria

or propose that no end of waste criterion is appropriate.
End of waste criteria

a) Based on the analysis above, an assessment will be made whether end of waste criteria can be determined in compliance with the basic principles of when waste might cease to be waste.

b) If this possibility is confirmed, then one or several sets of such criteria are determined and the corresponding cut-off levels are proposed.
End of waste criteria

The criteria may refer to different aspects such as:

- Input material selection / sourcing;
- Processes and techniques;
- Quality control procedures;
- Product quality in respect of various uses / applications.

They may include standards aiming at:

- Avoiding or limiting the environmental risk;
- Ensuring the functionality and safe use of the product.
End of waste criteria

Examples of possible different types of end of waste criteria:

Technical criteria:

- Functionality and safety of the product;
  chemical, physical or biological parameters;
- Comparability to replaced raw material;
- Process / treatment characteristics.

Environmental criteria:

- Concentration or leaching limits of certain substances;
- Suitability of use under different environmental conditions.
9. Assess the end of waste criteria

Comprehensive assessment of the impacts that the application of the criteria would have compared to a business of usual scenario, covering potential economic, social and environmental impacts. Assessment also includes whether proposed end of waste provisions would comply with different pertinent obligations from other legislation (environmental, product safety, etc.).
10. Conclusions of pilot case study

Do end-of-waste criteria at EU level make sense for the case study waste stream at all?

Advantages and disadvantages of different types or sets of end of waste criteria.

Proposals for appropriate criteria including possible thresholds.

In general terms, what can be concluded concerning a general methodology to apply when determining end of waste in other cases?
Case study – Compost

Contacts : Peter Eder
Main waste types that are composted

- ‘Green waste’ (garden and park waste)
- ‘Biowaste’ (food waste)
- Mixed municipal solid waste
- Sewage sludge
- Slurries and manure from husbandry
Compost uses

(Organic) fertiliser, soil improver/conditioner, manufactured topsoil, growing medium, mulch for use in:

- Agriculture (intensive, organic)
- Fruit and wine growing
- Horticulture
- Potting
- Nurseries
- Greenhouses
- Private gardens
- Landscaping (e.g. parks)
- Ground rehabilitation
- Silviculture
Compost quality parameters

Particle size distribution, moisture, organic matter and carbon content, nitrogen content and forms, phosphorus and potassium, salinity and the nature of irons responsible for it, cation exchange capacity, water holding capacity, porosity and bulk density and the state of maturity or stability, contents and availability of toxic substances (in particular toxic elements and organic pollutants), biological activity
Compost standards

Different types of standards exist in EU countries and regions:

- Statutory, complementary statutory, voluntary (quality assurance systems)
- Sometimes linked to end of waste provisions
- One to three compost classes
- Regarding input materials, process control, end product quality
End product quality standards

Heavy metals:
- either strict limit levels, yet allowing considerable variation
- or moderate limit levels, small allowed deviations

Organic contaminants: only in some countries

Pathogens, impurities: considered in most systems of standards

Weeds: only in the most developed systems

Stability, maturity: no agreement on how to measure

Phytotoxicity: different types of plant growth tests
Production and market

Number of green and biowaste composting plants: 1800
Capacity: 11 Mt/y biowaste and 7 Mt/y green waste
Capacity sufficient for 42% of organic waste potential
Compost production: 9 Mt/y

Estimates for EU-15 in 2003 by Josef Barth (European Compost Network)

Size of the compost use potential: ??
Some questions to ask…

…that have no easy answers:

Market sizes of the different compost applications in the different countries, currently and potentially

Import and export of compost: amounts and qualities, currently and potentially

How to assess the value of compost applications when there are many uncertainties about the benefits?

What exactly does the waste (or not) status imply for producers and users of compost?

Which is the common denominator of the compost standards across the EU?
Case study – Aggregates

Contacts: Don Litten, Ana Catarino
Case Study - Aggregates

Secondary or recycled aggregates are currently produced from:

- Construction and demolition wastes
  - Concrete, bricks, tiles, blocks, road surface etc.
- Fired-clay broken products – “new” bricks, tiles etc.
- China clay mining wastes
- Iron and Steel furnace slags
- Foundry casting sand
- Ash from combustion processes (IBA / PFA)
- Waste glass
- ?
Case Study - Aggregates

Secondary or recycled aggregates are currently used in:

- Mass concrete
- Concrete blocks
- Sub base engineering
- Bituminous road surfacing
- Railway track ballast
- Grit / sand blasting
- Decorative finishes
- Water filtration media
- ?
Case Study - Aggregates

Processes involved in production of secondary or recycled aggregates:

- Waste segregation at source; Sorting; Screening
- Crushing, size reduction and shaping
- Classifying (product into various particle sizes)
- Washing
- Chemical and/or physical stabilisation
- Storage, loading and transport
- Quality Assurance
- ?
Case Study - Aggregates

Legislation:

- EU Construction Products Directive
  - Technical standards and guidance
  - But note scope of a traded “construction product”
- National building / construction regulations
- ?
Case Study - Aggregates

Example organisations active in secondary aggregates:

- **WRAP** – UK Waste & Resources Action Programme
- **Aggregain** - WRAP Aggregates Programme, funded from the UK Aggregates Levy Sustainability Fund
- **ACRR** - an International Network of local and regional authorities to promote the exchange of information and experiences on municipal waste management, and particularly on the prevention at source, recycling and recovery.
- **EEA topic centre on waste**
- **Hanson plc** – example of one of the largest aggregate suppliers, also specialising in recovering aggregate material.
Case Study - Aggregates

Noted from initial research:

UK amongst the highest rate of recycled aggregates – circa 25%.

NL and DE also cited for high aggregate recycling rates.

Increasing customer specification for recycled aggregates.

Increase in recycling inhibited by continuity of quality and quantity of suitable source material. Upstream education would help.

Technological advances in mobile crushing equipment means that more demolition contractors are crushing and processing waste on site and selling crushed products directly or using products on site in reconstruction. Examples noted of selling processed material “at any price” to get rid of it during demolition contract period.
Case Study - Aggregates

Noted from literature:

“The challenges that go with recycled and secondary aggregates are threefold:

• Environmental - recovery of some wastes that have become part of a local landscape can have environmental consequences.

• Technical - quality constraints have to be considered. An absence of adequate technical specifications has inhibited wider use of recycled materials to date

• Economic - recycling isn't always cheaper. Transport costs, for example, can make recycled aggregates prohibitively expensive in some areas.”
Case Study - Aggregates

Noted from literature (glass = special “aggregate” case):

“in environmental terms, recycling glass into aggregates, appeared to be marginal or even disadvantageous” (open loop recycling compared to landfill but based on a single study). Also, processing waste glass to aggregates is minimally attractive as a result of processing costs and market price for product.

However, from a UK study on recycling of glass:

The UK is the world’s largest importer of wines, much in green glass. UK waste glass stream includes about 1 Mtpa green glass plus “mixed” glass. Recycling to new glass would be the environmentally preferred option. UK glass industry produces about 400 ktpa of new green container glass (average 80% recycled cullet).
Case Study - Aggregates

Noted from literature:

Production of virgin aggregates requires substantially more energy than aggregates recovery.

“increased recycling was accompanied by increased transport activity, which outweighed the recycling benefits”.

For aggregates in general, economically viable road transport from supply to user is < 50 km.

Use of “waste glass” aggregate in concrete limited by potential alkali-silica reaction. Amount of very fine material allowed in concrete mix is limited.
Case Study - Aggregates

Noted from initial research:

Some virgin aggregates are not replaceable by secondary aggregates due to surface chemistry demands (bituminous material) or some functionality such as grip for road surface, or natural surface of gravel particles.

Use of “waste” recycled aggregate under exemption clause of waste management legislation in UK attracts EUR ~800 exemption fee per case (first year) plus management time which causes barrier to use of recycled aggregates.

Concern over future environmental liability from use of waste in construction.
Case study – metal scrap

Contact: Zheng Luo
Scope of the case study

Two types of metal scrap are included:
- iron and steel
- aluminium

Sources of metal scrap:
- ship building
- transportation
- construction material
- machinery and spare parts
- electronics and accessories
- packaging material
- consumer durables
Key characteristics of metal scrap

1. Recycling is proven to be clearly beneficial in comparison to any alternative of waste treatment both environmentally and economically from life cycle point of view

2. The rate of recycling has been and will be continuously increasing due mainly to costs (energy and resources) and GHG emissions

3. Similar materials are recovered in the secondary production and, to a large extent, they are competing the same segments of the market as primary metal

4. Both scrap and secondary metal are traded in a well established world wide market
Scrap on the market

1. Currently app. 33% of steel and 25% of aluminium consumed are recycled each year, making up the scrap market. And world total export was around 3,5 and 7,5 billion US$ for aluminium and steel scrap in 2001.

2. Scrap is traded using different standards and system, with detailed specifications, requirements, grade, etc. EU standards « EN 13920-1 to 13901-16, contains aluminium scrap types», country/industry level standard, even company specification...
Important EU regulations

- Waste stream
  - End-of-life vehicle
  - WEEE
  - Packaging directive
  - Waste prevention and recycling
  - Resource strategy

- Secondary production
  - IPPC directives
  - Climate change policies
Case Study – metal scrap

Case study methodology

Step 1: understanding the life cycle
- Details of waste stream (sub-stream) flows
- Waste management: process and technology
- Key environmental issues and solutions

Step 2: recycling and policy intervention
- Opportunities and limitations
- The harmony of current regulation?
- The need for end of waste?
Case study methodology

Step 3: end of waste criteria
• Where along the process? Input standards? Process standards? Comparison to primary material? … distinction among sorted waste steam (sub-stream)?
• Comparison of scenarios

Step 4: the impact of end of waste criteria
• Environmental aspects (LCA): resource, energy, emissions, health risks, etc.
• Market aspects: industry perspective, trade, etc.
• Policy aspects: regulation conflict and harmonisation
• Administrative cost
Conclusions
End of Waste Project outputs

- Three pilot case study reports
  - Compost
  - Aggregates
  - Scrap metal
- Proposal for an end of waste methodology
- Proposed waste selection criteria
- Candidate waste streams for end of waste assessment
Project team - contacts

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