Life Cycle Thinking and Assessment for Waste Management

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CONTENT

Waste Management in the EU

Around 3 billion tonnes of waste are generated in the EU each year - over 6 tonnes for every European citizen. This has a huge impact on the environment, causing pollution and greenhouse gas emissions that contribute to climate change. Good waste management can significantly reduce these impacts, and Life Cycle Thinking and Assessment can help policy makers choose the best environmental options.

A key aim of EU policies on resources and waste is to move to a more resource-efficient and sustainable future. EU policies and legislation on waste highlight the need for good waste management. The Waste Framework Directive establishes the waste hierarchy. This sets an order of priority, starting with the preferred option of waste prevention, followed by preparing waste for re-use, recycling and energy recovery, with disposal (such as landfill) as the last resort.

Following the waste hierarchy will generally lead to the most resource-efficient and environmentally sound choice. However, in some cases refining decisions within the hierarchy or departing from it can lead to better environmental outcomes. The "best" choice is often influenced by specific local conditions and care needs to be taken not to simply shift environmental problems from one area to another. Decision-makers need to base their choices on firm factual evidence. Life Cycle Thinking and Assessment provide a scientifically sound approach to ensure that the best outcome for the environment can be identified and put in place.

Source : http://ec.europa.eu/avservices/photo/photo_thematic_en.cfm

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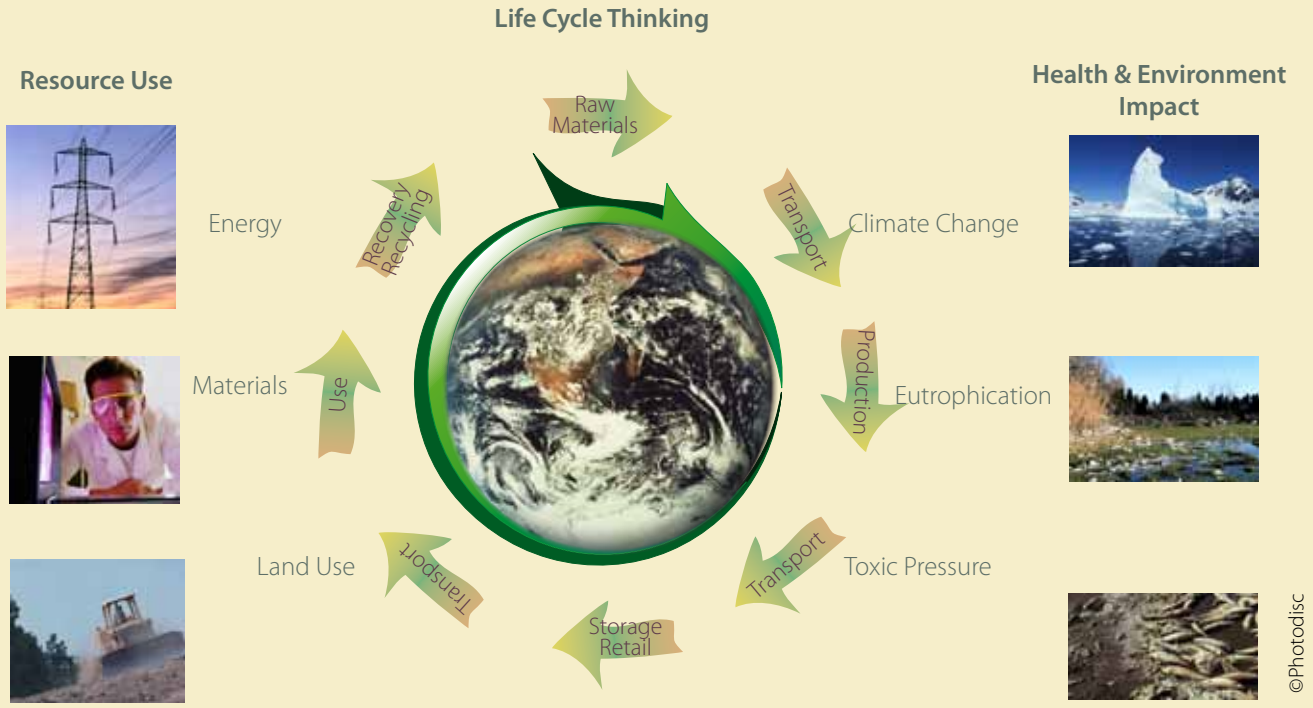
Life Cycle Thinking and Assessment

Over their life-time, products (goods and services) can contribute to various environmental impacts. Life Cycle Thinking considers the range of impacts throughout the life of a product. Life Cycle Assessment quantifies this by assessing the emissions, resources consumed and pressures on health and the environment that can be attributed to a product. It takes the entire life cycle into account – from the extraction of natural resources through to material processing, manufacturing, distribution and use; and finally the re-use, recycling, energy recovery and the disposal of remaining waste.

The fundamental aim of Life Cycle Thinking is to reduce overall environmental impacts. This can involve trade-offs between impacts at different stages of the life cycle. However, care needs to be taken to avoid shifting problems from one stage to another. Reducing the environmental impact of a product at the production stage may lead to a greater environmental impact further down the line. An apparent benefit of a waste management option can therefore be cancelled out if not thoroughly evaluated.

The European Commission has developed guidelines for Life Cycle Assessment which are fully compatible with international standards. These aims to ensure quality and consistency based on scientific evidence when carrying out assessments. Further information as well as reference material is available at: http://lct.jrc.ec.europa.eu/



Supporting Waste Management Decisions - Examples

European, national and local public authorities and businesses are increasingly being encouraged to make use of Life Cycle Thinking and Life Cycle Assessment as support tools for decision-making.

Waste management is an area where local conditions often influence the choice of policy options. Life Cycle Thinking and Life Cycle Assessment can be used to weigh up the possible environmental benefits and drawbacks linked to policy options in a specific situation.

Typical questions that can arise in local or regional settings include:

- Is it better to recycle waste or to recover energy from it? What are the trade-offs for particular waste streams?
- Is it better to replace appliances with new, more energy efficient models or keep using the old ones and avoid generating waste?
- Are the greenhouse gas emissions created when collecting waste justified by the expected benefits?

The next pages provide a handful of practical examples of how Life Cycle Thinking has been applied to answer these kinds of questions.

Should cars be made of lighter or more recyclable materials?

Car manufacturing requires a wide variety of materials. Steel has traditionally been used, but is progressively being replaced by plastics and composite materials which are typically lighter. Steel makes a car heavier, which in turn increases the amount of fuel needed to drive the car. However, steel parts are easily recycled at the end of the vehicle's life, while plastics and composites often are not.

For a specific case, an environmental impact analysis showed that only if a car is driven more than 132,000 km is there a net benefit gained by using the lighter but less recyclable materials. In this example there is a trade-off between two environmental benefits. One is the lower fuel consumption due to the use of lighter materials and the other is the energy savings due to recycling. Benefits will also depend on many other variables, such as replaced parts and the car type.

This example illustrates that it is important to consider a number of aspects of a product, including its weight and recyclability. Reducing weight is typically seen as a way of limiting the environmental impact of products. However, this needs to be balanced against the recyclability of the product and its components. The example further suggests that if plastic components were more easily recyclable, benefits for the environment could be greater.

Duflou JR, et al. Environmental impact analysis of composite use in car manufacturing. CIRP Annals - Manufacturing Technology (2009)

Should we keep on using old washing machines?

Keeping and using a 3-year-old washing machine that is efficient (such as category A) is probably an environmentally sound choice. However, when you have a 7-year-old washing machine with low energy efficiency (e.g. category C) should you continue to use it for another 5 years, avoiding waste, or should you recycle it and buy a new, more efficient machine (e.g. category A)?

A study showed that replacing the machine instead of continuing to use it leads to lower energy consumption and emission reductions equivalent to around 30 kg of carbon dioxide (CO_2) over a 5 year period. Producing and recycling a new machine requires energy and creates emissions equivalent to 20 kg CO_2 over the same period. Replacing the machine therefore avoids the equivalent of about 10 kg CO_2.

This illustrates that it can be preferable to buy a new more efficient appliance rather than keeping an old one to avoid generating waste. However, to determine solutions for specific appliances, a Life Cycle Assessment needs to be made. Policy approaches in favour of one option over another can then be argued on the basis of verifiable evidence.

"Évaluation des bénéfices environnementaux, économiques et sociaux de différents scénarios de réutilisation des déchets par les entreprises d'économie sociale". RDC Environment study for the Walloon Waste Agency, 2008

Is recycling plastic bottles better than incineration with energy recovery?

A frequent issue in waste management is whether to recycle or incinerate used products. Life Cycle Assessment helps address this issue. In this example, plastic bottles are considered, and for simplicity only the energy aspects are taken into account.

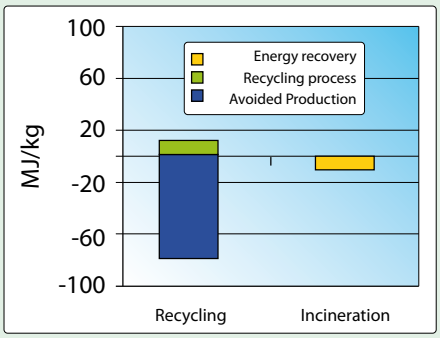
The production of plastic bottles from raw materials requires about 80 MJ/kg (energy per kilogramme). Incineration can generate about 3 MJ/kg of electricity and about 10 MJ of process steam from the recovered energy. However, despite this small energy gain, new bottles would have to be produced, requiring high amounts of energy. In contrast, recycling and selective collection consumes 9 MJ/kg while also avoiding the much higher energy consumption used in the production of new plastic from raw materials.

Recycling therefore normally results in lower energy consumption than incinerating bottles and producing new ones from raw material. This example assumes, however, that the plastic is not heavily soiled and is not degraded in the recycling process.

In this particular example, Life Cycle Assessment confirms that recycling is better than energy recovery, as described in the waste hierarchy. However, a Life Cycle Assessment carried out under different conditions (such as in another region) could result in different conclusions.

ELCD Database : http://lct.jrc.ec.europa.eu/

For amorphous PET (Bio-IS « Bilan environnemental sur les filières de recyclage : l'état des connaissances ACV ». For the Agence de l'Environnement et de la Maîtrise de l'Energie - ADEME (2001))



Should home composting be encouraged?

A comprehensive study that included both Life Cycle Assessment (LCA) and an evaluation of costs and benefits to society was conducted in order to assess the potential benefits of home composting.

The study concluded that home composting is not always environmentally preferable to separate collection, followed by industrial composting. A reason for this,

highlighted in the study, is that 20-65% of home composters do not manage their composting process appropriately. This generates a variety of harmful emissions (such as methane, nitrous oxide and ammonia).

However, home composting is much cheaper and promotes environmental awareness. It may therefore be necessary to complement policies that encourage citizens to practice home composting with information and guidance about best practice. This involves turning the compost regularly in order to enable the material to get enough air, as lack of oxygen leads to the generation of emissions and harmful compounds.

As this example illustrates, Life Cycle Assessment can help policy makers weigh up seemingly contradictory economic, social and environmental conclusions.

"Évaluation des politiques de prévention en matière de déchets ménagers et assimilés, Evaluation des politiques de compostage à domicile". RDC Environment study for the Walloon Waste Agency, 2004

Case Study: Copenhagen

Following new statutory requirements on waste collection, the city of Copenhagen needed to look into new options for managing drinks packaging waste, in particular for metals and plastics. To help with decision-making, a Life Cycle Assessment was carried out to complement an economic evaluation. The purpose was to see whether the existing collection and treatment strategy could be replaced by a more efficient one, both from an environmental and economic perspective. The environmental evaluation took into account impacts such as emissions of greenhouse gases and acidification, measured in tonnes of CO_2-equivalent and SO_2, respectively.

Four alternative scenarios were studied and compared to the existing strategy, which involved collection with other types of household waste, followed by incineration:

- Collection for recycling at existing glass bottle banks
- Street collection for recycling
- Centralised collection at recycling centres
- Separate collection in containers next to the existing glass bottle banks

The assessment concluded that street collection (alternative 2) is preferable from a purely environmental perspective (230 tonnes of CO_2-equivalent, and 0.6 tonnes of SO_2 saved) with collection at existing glass bottle banks (alternative 1) in second place, saving 110 tonnes of CO_2-equivalent and 0.4 tonnes of SO_2. However, a combined environmental and economic assessment showed that the collection of plastic and metal at existing bottle banks (alternative 1) proved to be the best option. This has become the new management strategy for used metal and plastic drinks packaging in Copenhagen.

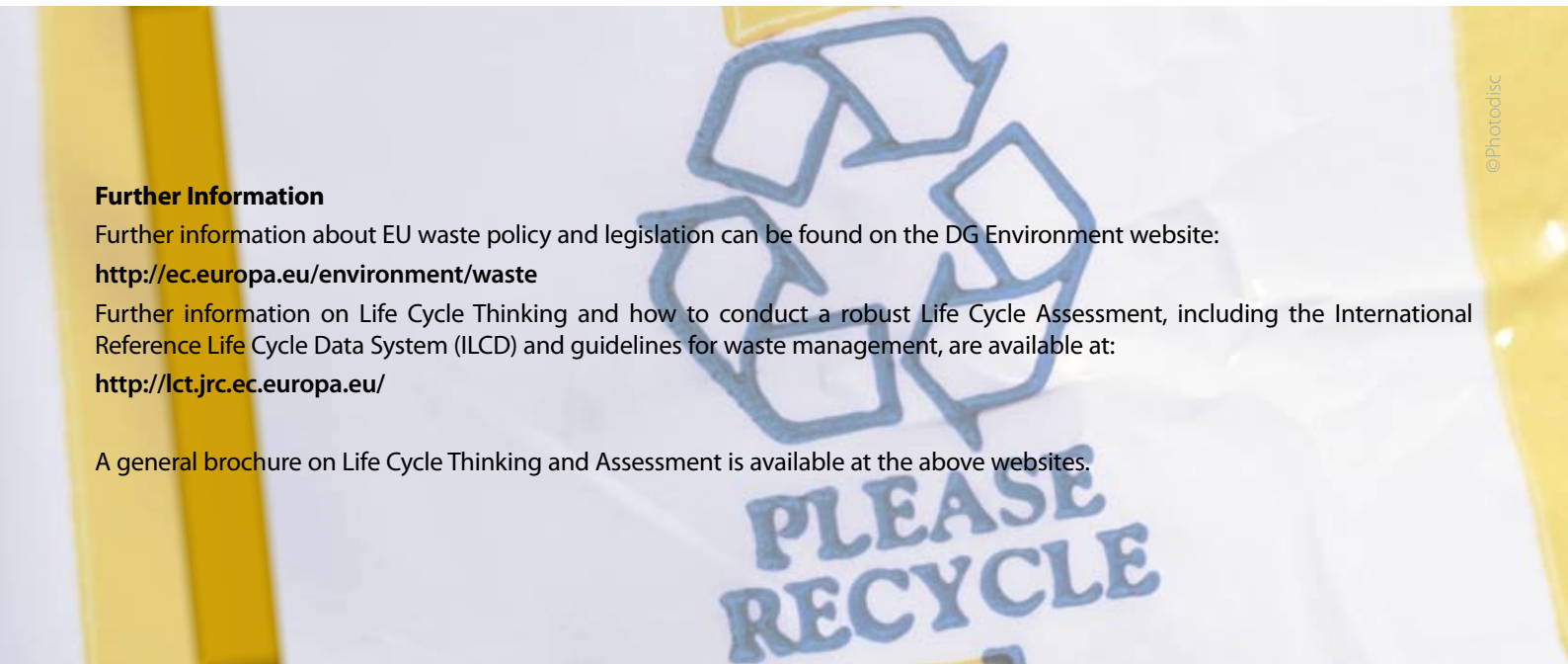
This example demonstrates that life cycle approaches can be applied to a well-defined situation at city level and illustrates how Life Cycle Assessment can be used to complement a purely economic analysis. It can help find solutions that are better for the environment while also considering financial constraints.

Alejandro Villanueva, Karen B. Kristensen and Nanja Hedal (2006). In Danish Topic Centre on Waste and Resources (Ed.): A quick guide to LCA and CBA in waste management.

Life Cycle Thinking and Assessment can be used to support decision-making in the area of waste management and to identify the best environmental options. It can help policy makers understand the benefits and trade-offs they have to face when making decisions on waste management strategies. It gives quantitative information which puts potential environmental advantages and disadvantages into perspective. A Life Cycle Assessment cannot replace a decision-making process but it can guide public authorities and businesses to make better environmental choices.

It should be noted that the examples given here are valid for their specific situation and their conclusions cannot be generalised.

The Commission will develop a detailed guidance document on how to apply Life Cycle Thinking and Assessment to waste management.



Further Information

Further information about EU waste policy and legislation can be found on the DG Environment website:

http://ec.europa.eu/environment/waste

Further information on Life Cycle Thinking and how to conduct a robust Life Cycle Assessment, including the International Reference Life Cycle Data System (ILCD) and guidelines for waste management, are available at:

http://lct.jrc.ec.europa.eu/

A general brochure on Life Cycle Thinking and Assessment is available at the above websites.