

The Economics of Waste

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Decoupling the environmental impacts of material use and waste disposal from economic growth contributes to several objectives of the OECD Environmental Strategy for the First Decade of the 21st Century agreed by OECD Environment Ministers in 2001. It is also the main objective of the European Thematic Strategy on the Sustainable Use of Natural Resources.

Structural change has led to a trend of relative decoupling of material throughput from GDP and of per capita material use from per capita GDP. At high levels of GDP per capita there is evidence of saturation effects regarding material use and waste generation. When growth in GDP or final private consumption no longer drive material use, demographic factors take over such as population growth, household size and age structure. In the European Union and some other OECD countries the balance of trends in these factors may work to reduce the demand for raw materials in the future. This may lead to some absolute decoupling of material use from GDP but has not happened yet.

Nevertheless, final disposal of waste still causes environmental harm. This varies with the treatment method chosen, especially if it is mismanaged – for example, if it is dumped illegally. Certain types of waste can also harm human health if they are not managed properly. Over the last decades, increased emphasis has been placed on policies to prevent waste generation, to recover energy or materials from the waste generated and to improve the management of the remaining waste. Regarding final disposal, current regulatory standards in most OECD countries require that landfills be equipped with double-lining to eliminate prevent leachates from reaching groundwater and are capped to permit methane capture and flaring; and that incinerators operate at a sufficiently high temperature to avoid producing dioxins and furans; incinerators are also increasingly equipped for energy recovery. These policies have brought about significant environmental improvements and, in some cases, direct economic savings in parts of the waste management chain. However, they have also often given rise to considerable costs for companies, waste handlers and households.

This article offers a brief discussion of some economic issues relevant to waste policy. It is based on a recent Organisation for Economic Co-operation and Development (OECD) publication, *Addressing the economics of waste*, which brings together a number of papers on this issue presented at a workshop held at OECD in October 2003.²

Waste policy objectives

The so-called waste hierarchy plays a predominant role in waste policy in OECD countries. This hierarchy gives preference to waste prevention, followed by material and energy recovery; incineration without energy recovery and landfilling are regarded as the least desirable options. In many cases, this hierarchy is a good reflection of the environmental impacts of the different policy options. But, in itself, the waste hierarchy does not give policymakers advice on ‘how far’ one option should be pursued before other options further down in the hierarchy are ‘allowed’ to play a role. For example, how much materials recovery should one seek to achieve for different types of plastic waste?

The management of waste should be fully integrated with the management of natural resources. Environmental economics is concerned with identifying the environmental externalities associated with extraction, transportation, processing, manufacturing, use, and final disposal of materials when they become waste. Life cycle analysis (LCA) applied to various waste streams can help to identify the most appropriate intervention points and the most appropriate policy instruments to internalize these costs. When the direct and indirect costs of waste disposal are not borne by users of this service in proportion to

the waste generated, there are no monetary incentives for households or businesses to reduce the quantities of waste generated or to participate voluntarily in recycling schemes. LCA emphasizes the importance of keeping in mind the impacts of different products and processes from cradle-to-grave.

However, LCAs do not include an overall weighting of the different environmental impacts and thus do not always give a clear indication of which option is preferable from an environmental point of view. For example, if two policy options have opposing impacts on greenhouse gas emissions and water quality, an LCA does not provide a comparison that allows you to determine which option is most 'environmentally friendly'.

Analysts and policymakers should also take into account the positive and negative economic impacts of the various waste policy options. A drawback with LCAs is that they do not express the environmental impacts of an option in units that can be compared directly with the costs incurred. To most economists, the best way of making such a comparison is to undertake a comprehensive cost-benefit analysis (CBA). Such analyses can, to a large extent, build on the inventory of environmental impacts from an LCA but will also include estimates of the monetary value of different environmental impacts. This allows the environmental benefits of waste management options to be compared with their economic costs.³

It is not a trivial task to estimate the monetary value of a given environmental impact, but a number of well-established techniques for doing so are now available. These include surveys of the 'willingness to pay' for a given improvement and of the 'willingness to accept' a given deterioration, and analyses of impacts on price in related markets. For example, studies of house prices near landfills or incinerators compared with the prices of similar houses in other neighbourhoods can provide information on the economic value of the disamenities that such installations cause.⁴

Drawing on available cost-benefit analyses, environmental policy objectives should ideally be set in such a way that the economic value of a small additional environmental improvement is equal to the costs of obtaining such an additional improvement – assuming that the most cost-effective policy instruments are used to achieve the improvement.

In this context, it should be emphasized that it ought not, in general, to be a policy objective to minimize waste amounts in an ultimate sense of the word 'minimize', i.e. reduce to zero. Eliminating the last units of most waste streams is likely to entail costs far in excess of the economic value society would place on the benefits of doing so. Some very toxic wastes can, however, represent exceptions in this respect.

The economics of selected waste policy instruments

A number of different types of instrument can be used to achieve the targets set by waste policies. This section briefly discusses some instruments that are in frequent use. These instruments can, broadly speaking:

- tell companies or households what they should do – through legally binding regulations
- encourage them to do this – through information campaigns and 'moral persuasion'
- give them a direct economic incentive to behave in an environmentally friendly way – through changes in the prices companies or households face.

When analysing the impact of any given instrument or a mix of instruments, it is important to have an idea of what would have happened had the instrument(s) not been in place. For example, many instruments are meant to stimulate the recovery of energy or materials in various waste streams. In this connection, it must be emphasized that a number of recovery operations would take place even if no policy measures to stimulate recovery were in place because they are profitable from a 'private' economic point of view. The relevant question for a policy analyst is whether 'enough' recovery would take place from society's point of view. The answer to this question depends on a comparison of the net environmental benefits resulting from the recovery operations and the net costs they entail.⁵

Like most other areas of environmental policy, waste policy is to a significant degree dominated by legally binding regulations. For example, there are regulations concerned with:

- the responsibility of local authorities to provide waste collection services to inhabitants
- the setting up and the operation of waste disposal facilities such as landfills and incinerators
- which types of waste may be landfilled or incinerated
- the responsibilities of producers or importers to take care of the wastes generated by their products.

While many existing regulations are indispensable to ensure the environmentally sound management of waste, some could be replaced by economic incentives to stimulate companies and households to modify their behaviour or a modified regulation could be supplemented by such incentives. For example, a regulation on maximum emissions from an incinerator could, in principle, be replaced by a levy on measured or estimated emissions from the incinerators. Alternatively, the regulation could be supplemented by such a levy in order to give incinerator operators an incentive to reduce their emissions – even if they are within statutory maximum limits. One advantage of a greater reliance on economic instruments is that it can allow companies and households to use their knowledge to find the least expensive way of achieving a desired outcome.

Much of current waste policy addresses particular products or waste streams – for instance because they are found to be particularly harmful to the environment or because they cause large volumes of waste. Examples of products given such focus include various forms of packaging, batteries, waste oils, end-of-life vehicles and electrical/electronic products. While the particular attention in many cases is well founded, in some cases it is not clear whether the chosen products represent a larger problem than other similar products which are not addressed. For example, it is not clear that materials such as plastic, glass, etc. represent a larger problem when they are used in packaging than when they are used in other products.

Pay-as-you-throw schemes

With some notable exceptions, most households in OECD countries do not have to pay anything extra if they increase the amount of waste they put out to be picked up by municipal waste collection services. Nor do they save anything by reducing these amounts. Instead, the collection services tend either to be paid through general taxation or through separate fees that vary, for example, with the number of people in the household, the size of the apartments, etc., but not with the amount of waste. As a result, too much waste tends to be generated and too little waste would, in the absence of other policies, be recycled.

One way to create incentives to limit waste generation and stimulate recycling is to introduce some form of ‘pay-as-you-throw’ scheme where the collection fees paid by households depend on the volume or the weight of the garbage thrown away. These fees should both reflect the ‘private’ costs (to the operators) of collecting and managing the waste, and the environmental costs (‘externalities’) associated with the waste.

However, there are certain caveats to the use of pay-as-you-throw schemes.^{6,7} A study by Fullerton and Kinnaman (1996) measured the weight and volume of the waste and the recycling of 75 households by hand over four weeks before and after the implementation of a price-per-bag programme. They found only a slight drop in the weight of waste, thus suggesting that a price-per-bag system is not very effective in reducing waste generation. On the other hand, countries such as South Korea and Switzerland have seen significant reductions in waste volumes after introducing pay-as-you-throw schemes.

One other potential problem is the possibility that a collection fee that depends on waste amounts could make some citizens dispose of their waste in illegal or particularly harmful ways, such as dumping it in the countryside or burning it in their backyards. The evidence on this issue is mixed. The study by Fullerton and Kinnaman points to increased illegal dumping as one of the explanations of the (limited) reductions in measured waste amounts.⁸ But in 2003, in its communication *Towards a thematic strategy on the prevention and recycling of waste*, the European Commission stated that ‘most communities that have

introduced PAYT [pay-as-you-throw] schemes have not experienced large and sustained increases in illegal dumping'.⁹ It is important to do more work on this issue.

A third problem is the fact that some pay-as-you-throw schemes are relatively costly to administer and can increase collection costs. This is in particular true for schemes based on the weight of the waste. These could otherwise be a better type of scheme from a theoretical point of view as 'private' waste management costs are more closely related to the weight than the volume of the waste.

Advance disposal fees

One way of getting round some of the problems associated with pay-as-you-throw schemes and still provide incentives to limit waste generation, is to make producers and importers pay an advance disposal fee (ADF) that reflects the costs of recycling the products they place on the market (including their packaging). These fees are then included in the prices charged to consumers. Whereas consumers can avoid the ADF by buying less of products that cause a lot of waste that is difficult or expensive to recycle, they cannot avoid the charge by dumping their waste illegally.

Porter (2004) discusses the similarities and differences between advance disposal fees and waste collection charges that vary with the amounts generated.¹⁰ He points out that, while it would be extremely difficult to vary an ADF according to where the product (or its packaging) will end up being thrown away, a variable charge on households can readily take account of these differences. In addition, collection and disposal costs also differ for different products. An ADF can vary according to the cost of collecting and disposing of the product, but a waste collection charge – unless it is prohibitively costly to operate – must be uniform across products (i.e. so much per container or per bag or per kilogram). Hence, a waste collection charge will tend to be too low for materials that are expensive to dispose of and too high for those that are cheap to dispose of.

Take-back requirements and extended producer responsibility schemes

Over the last decade, a number of so-called extended producer responsibility (EPR) schemes have been put in place in OECD countries. Under these schemes, the responsibility of producers for their products and product packaging is extended to include the social costs of waste management, including the environmental impact of waste disposal. These policies shift the financial responsibility for waste management 'upstream' to the producer and away from the municipality and taxpayer. They also often involve the producers directly in waste collection through so-called take-back requirements, which can be fulfilled individually or collectively through a producer responsibility organization (PRO).

One often-quoted motivation for EPR schemes is to reduce resource use. There are two main reasons why the current market prices of natural resources may understate the social costs of their use, and hence contribute to a too high extraction of virgin materials. In many countries, resource extraction and processing activities are heavily subsidized, causing virgin materials to be seriously underpriced. Secondly, resource extraction and processing have important environmental externalities, which are ignored in resource use decisions based on market prices alone. With appropriate design, EPR schemes can encourage producers to reduce their use of virgin resources and to make greater use of recycled materials, if that is desirable.

On the other hand, reducing existing subsidies and reflecting relevant externalities in the price of raw materials (e.g. through environmentally related taxes) could provide a better solution.⁹ To the extent that this is done, the case for a particular focus on resource use *per se* in waste policy is limited.

The targets for take-back and recovery set in some EPR schemes can seem rather high. In this connection, it is interesting that the recent amendment to the EU Packaging Directive includes a statement that 'recycling targets for each specific waste material should take account of life-cycle assessments and cost-

benefit analysis, which have indicated clear differences both in the costs and in the benefits of recycling the various packaging materials ...'.¹⁰

Giving producers responsibility for physically taking back the products and/or the packaging they have placed on the market can lead to a duplication of infrastructure and services for waste collection. Even if the collection costs for municipalities, etc. to some extent could be reduced, it is unlikely that this would outweigh the additional costs associated with such duplication.

The sorting, cleaning and delivery of waste to the collection facilities – either at the kerbside or, more importantly, at separate collection centres – can entail significant costs and time use for households. It is important to include these impacts in a cost-benefit analysis of the schemes in question.

Design for environment (DfE)

An important purpose of EPR schemes is to provide incentives for the producer to take account of the social costs of waste management when designing and marketing their products: the aim is to limit the amount of waste generated and to increase its recyclability. In this respect, EPR schemes are used as tools to promote what is often called design for environment (DfE).

The actual DfE impacts of a particular EPR scheme will, however, depend largely on how the collection of the products is organized and financed. If each producer collects and recycles their 'own' products, they will have a relatively strong incentive to limit the amounts of waste and increase its recyclability. If the collection and recycling is left to a PRO, the financing of this organization's operations is vital to the strength of the incentives provided to the producers. When each member of the PRO pays a fee reflecting (only) its market share, there is hardly any incentive to modify the design in an environmentally friendly manner. Only if the membership fees reflect the recycling costs of the different products (e.g. depending on the materials used in their production) will the producers have a strong incentive to modify their designs. Such fees could closely resemble the advanced disposal fees discussed above.¹¹

Taxes on the final disposal of waste

Another way of addressing the environmental problems caused by waste generation is to levy taxes on final disposal options such as landfilling or incineration. Along with others, Austria, the Slovak Republic, Sweden, the UK and several US states have introduced taxes on landfilling, while Denmark and Norway have also introduced taxes on incineration.

Davies and Doble (2004)¹² and Martinsen and Vassnes (2004)¹³ discuss the final waste disposal taxes introduced in the UK and Norway, respectively. The tax rates on landfilling were, in both cases, initially based on estimates of the value of the externalities related to landfilling. However, there is a surprisingly large difference in these estimates. For 'active' waste, the UK estimate is about €10/tonne, while the estimate for waste delivered to a landfill with a high environmental standard in Norway is about €40/tonne. The tax rate in the UK is, however, set to increase significantly over the coming years towards approximately €50/tonne in the medium to longer term – in order to trigger sufficient behavioural responses for the UK to fulfil its obligations under the EU Landfill Directive.

The Norwegian waste tax also addresses incinerated waste. Until now, there has been a tax per kg incinerated with a supplementary rate depending on the level of energy recovery that takes place. However, a change in the tax has been prepared in order to instead tax the measured or estimated emissions of a number of pollutants from the incinerators, combined with subsidies to stimulate energy production at the incinerators. This will give incinerator operators a useful incentive to find better ways of reducing the environmental harm caused by their activities and thus represent an important improvement to the tax. However, one could ask why similar taxes are not levied on the same types of emissions from other sources (e.g. manufacturing enterprises) and why subsidies for energy production – if they should be given at all – should be limited to waste incinerators.

A common feature for all taxes on final waste disposal is the important issue of whether or not they are passed on to those that generate the waste. In most OECD countries, industrial and construction companies, etc. have to pay a tipping fee when they deliver waste for disposal. These tipping fees are likely to reflect any taxes on landfilling or incineration. However, as discussed above, most households in OECD countries do not pay waste collection fees that vary with the amount of waste they generate. This is particularly the case in the UK where there are no separate waste collection charges at all. This partly explains why it has been found necessary to increase the landfill tax rate in the UK to a level several times higher than the estimated value of the externalities caused by landfilling in order to secure compliance with the EU Landfill Directive.¹⁴

Conclusions

Depending on how it is managed, waste can cause significant harm to the environment and human health. There are also important economic issues related to waste management. Some policy options can entail considerable economic costs and it is important to ensure that a proper balance is struck between the benefits and costs to society as a whole.

To limit waste amounts to 'optimal' levels, economic incentives should be introduced that properly reflect the damage different types of waste cause while ensuring that these measures do not trigger increased illegal dumping of these wastes. Waste collection fees that vary with waste amounts and/or advance disposal fees can provide 'the right' incentive.

It is also important to analyse carefully, before implementation, whether a policy is actually likely to provide the intended outcomes – amongst other things by looking closely at the incentives that would be generated for the various stakeholders involved – and whether its benefits are likely to exceed the costs.

In addition, in-depth evaluations should be performed some time after a new policy has been put in place to see if it has worked as expected and, if not, to find out why. Such evaluations can facilitate a modification of policies that might not be working well and provide useful lessons to draw on when developing policies in other areas. The economic instruments discussed above will have greater impacts in situations where markets for secondary materials exist and function well, where businesses are motivated to improve the eco-efficiency of their operations, and where households' concerns for the environment translate into support for recycling schemes.

The OECD encourages its Member countries to implement environmentally effective and economically efficient material and waste management policies by providing policy guidance through its country-specific Environmental Performance Reviews and OECD Council Acts—a form of "soft-law".

Notes

1. Nils Axel Braathen is Principal Administrator, and Kenneth G. Ruffing is Deputy Director, at the Environment Directorate of the Organisation for Economic Co-operation and Development, Paris, France. The opinions expressed in this article are their own and do not necessarily reflect those of OECD or its member countries.

2. In its communication *Towards a thematic strategy on the prevention and recycling of waste* [COM(2003) 301 final], the European Commission states: 'Although there continues to be debate about certain methodological aspects of CBA ... the Commission considers that this technique provides the best available basis for the assessment of targets in the field of waste management policy'.

3. *Recent developments in environmental cost-benefit analysis*, which is being prepared for OECD by David Pearce (University College London), Susana Mourato (Imperial College London) and Giles Atkinson (London School of Economics), will include a discussion of various techniques for estimating the economic value of environmental impacts. *Analytical framework for evaluating the costs and environmental benefits of extended producer responsibility* has recently been prepared for OECD by

Stephen Smith of University College London. Another discussion of cost-benefit analysis is given by R.L. Revesz and R.N. Stavins in their chapter, 'Environmental law and policy', from *The handbook of law and economics* (edited by A.M. Polinsky and S. Shavell) to be published by Elsevier in 2005.

4. In 'PVC waste in Denmark – costs and benefits of alternative treatments', Niels Buus Kristensen suggests that the current treatment system in Denmark, which combines landfilling and incineration, is together a better option than different alternative scenarios with chemical treatment of PVC waste. In 'Targeting lead in solid waste', Hilary Sigman concludes that, for countries with already high recovery rates of lead from batteries, the environmental gains of reduced lead disposal may not be high enough to merit the cost and environmental consequences of several of the potential additional policy measures analysed. Both papers are from *Addressing the economics of waste* (OECD, 2004).¹

5. Fullerton, D. and Raub, A. Economic analysis of solid waste management policies. In: *Addressing the economics of waste*. OECD, 2004.

6. Porter, R. Efficient targeting of waste policies in the product chain. In: *Addressing the economics of waste*. OECD, 2004.

7. Fullerton, D. and Kinnaman, T.C. Household responses to pricing garbage by the bag. *American Economic Review*, 86(4), 971–984. 1996.

8. European Commission. Towards a thematic strategy on the prevention and recycling of waste. COM(2003) 301 final. 27 May 2003.

9. Environmentally harmful subsidies are a key issue in OECD's work on sustainable development.

10. See Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste. It is also of interest to note that while the word 'cost' does not occur in Directive 94/62/EC, Directive 2004/12/EC contains several references to cost-benefit analysis. It is, however, not clear to me that all the specific targets included in Directive 2004/12/EC would pass a cost-benefit test.

11. For a closer discussion of DfE impacts, see the paper 'Changing product characteristics to reduce waste generation' by Matthieu Glachant from *Addressing the economics of waste* (OECD, 2004).¹

12. Davies, R. and Doble, M. The development and implementation of a landfill tax in the UK. In: *Addressing the economics of waste*. OECD, 2004.

13. Martinsen, T.H. and Vassnes, E. Waste tax in Norway. In: *Addressing the economics of waste*. OECD, 2004.

14. Another part of the explanation could be that the objectives set in the EU Landfill Directive are 'too strict' compared with the environmental problems caused by landfilling.
