Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

03-Mar-2005

English - Or. English

ENVIRONMENT DIRECTORATE
ENVIRONMENT POLICY COMMITTEE

ENV/EPOC/WGWPR(2005)6/FINAL
Unclassified

Working Group on Waste Prevention and Recycling

ANALYTICAL FRAMEWORK FOR EVALUATING THE COSTS AND BENEFITS OF EXTENDED PRODUCER RESPONSIBILITY PROGRAMMES

This analytical framework was prepared by Prof. Stephen Smith of University College London.

For more information please contact Nils Axel Braathen, National Policies Division, Environment Directorate; Tel: +33 (0)1 45 24 76 97; Fax: +33 (0)1 44 30 61 79;
Email: Nils-Axel.Braathen@oecd.org.

JT00179671

English - Or. English

FOREWORD

This "Analytical Framework for Evaluating Costs and Benefits of EPR Programmes" was prepared as part of the work programme of OECD's Working Group on Waste Prevention and Recycling. It was written by Prof. Stephen Smith, University College London, and has *inter alia* benefited from comments made at a special workshop devoted to its elaboration, hosted by Canadian authorities, and held in Halifax, Nova Scotia, in March 2004. It is published on the responsibility of the Secretary General of the OECD.

TABLE OF CONTENTS

ANALYTICAL FRAMEWORK FOR EVALUATING THE COSTS AND BENEFITS OF EXTENDED PRODUCER RESPONSIBILITY PROGRAMMES

EXECUTIVE SUMMARY

EPR programmes give producers responsibility for the social costs of waste management

Extended Producer Responsibility (EPR) is an environmental policy approach under which the responsibility of producers for their products is extended to include the social costs of waste management, including the environmental impact of waste disposal. This paper sets out a framework for assessing the costs and benefits of EPR. As compared with "conventional" waste management EPR involves the collection of particular end-of-life products, product categories or waste streams. In some cases these wastes would traditionally be handled appropriately through municipal waste management programs. Packaging would be one example. In other cases they might be handled, or might need to be handled, as special wastes which would be inappropriate for a municipal waste management programme. Solvents, scrap tires, used crankcase oil, lead acid batteries and electronics fit into this category. To evaluate the costs and benefit ratio for EPR programmes, the costs of these features need to be weighed against the benefits in terms of the reduced social costs of waste management, including the various externalities associated with landfilling or incineration and the environmental risks associated with "doing nothing" by maintaining existing practices. As compared with alternative policy instruments, an attraction of EPR is the incentive it creates for producers to consider post-consumer waste-management costs when making decisions about product design and marketing. Such "Design-for-Environment" incentives are an important part of the overall assessment of EPR, but their practical evaluation could be difficult.

There is a need for more ex post evaluations of such programmes

The 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* drew attention to the need for more "*ex post*" evidence on the performance of economic instruments in practice. While many countries are now employing innovative approaches in environmental policy, including environmental taxes, emissions trading and voluntary approaches as well as EPR, there are still relatively few systematic evaluation studies of practical experiences. More extensive evaluation evidence would have a number of benefits:

- Evaluation evidence on the performance of policy instruments could help to improve the administration of current policy, and can contribute to a process of policy reappraisal, modification and improvement in the light of experience.
- Evaluations can also improve the choice of instruments in future policy, by demonstrating how different instruments perform in specific contexts. Countries may be able to learn from the practical experience of policy approaches adopted elsewhere.
- Evaluation may also contribute to better communication with stakeholders and the public about the purpose, operation and effects of policy.

In each of these ways, evaluation studies can contribute to better design and implementation of environmental policies in the countries concerned.

If evaluation research is to provide meaningful evidence about the performance of policy instruments it is important that it is well informed, objective, and based on good research practice. The 1997 report identified a number of key aspects of the design and conduct of evaluation studies of economic instruments. Some of these are also applicable to the design of evaluation studies of EPR, but in other respects EPR raises distinctive issues necessitating a more tailored framework for evaluating the costs and benefits of EPR programmes.

The suggested evaluation framework draws on practical experiences in other contexts

The purpose of the evaluation framework set out in this report is to provide a suggested methodology which could be used by individual countries as a starting point for ex post evaluation of particular EPR programmes. The framework draws on the principles of good practice in evaluation, and the practical experience of evaluation studies in other contexts, with the aim of helping countries identify an approach to evaluation that will be practicable, reasonably comprehensive, and that will yield meaningful results. The next stage in the programme will be to test the evaluation framework in the context of a number of practical applications, to identify whether the approach proves feasible and the results meaningful in a range of different countries and programme types. Testing the framework in this way will also help to identify gaps and omissions in the framework, and possible refinements to the approach which may better reflect the range of costs and benefits of different EPR programmes.

Good evaluations take specific circumstances into account

The EPR programmes implemented in individual countries differ widely, in a number of respects, including the industries and products covered, the policy context in which they have been introduced, the nature of the responsibilities placed on producers, the forms of organisation, and the economic, social and cultural context in which the programmes operate. No single approach to evaluation will be appropriate to every EPR programme. Depending on the context and nature of the programme, local conditions and circumstances, evaluation effort and attention may need to be focused on different aspects of the costs and benefits. The data and information needed for evaluation will vary widely across programmes, and, in addition, there are likely to be major differences in the availability of data. Not all forms of EPR programme will be straightforward to evaluate, but the framework identifies some forms of EPR for which evaluation is more likely to be feasible and meaningful. Moreover, for all programmes, there will be aspects of the costs and benefits that cannot be precisely quantified. Both in the evaluation research, and in the interpretation of the research findings, it is important that these unquantified elements are clearly identified, and given appropriate consideration.

The nature of EPR means that a one-size-fits-all approach cannot be adopted for *ex post* evaluation of programmes. There will be important judgements to be made designing and specifying each evaluation, and it is important that countries draw on appropriate expertise in designing and commissioning studies. It is hoped that this framework will reduce the costs and complexity of the initial stages of the evaluation process, and will provide useful guidance for those commissioning and undertaking evaluation research of EPR programmes.

The function of the evaluation framework described in this report is to provide a systematic approach to assessing how far individual EPR programmes introduced in a particular context succeed in achieving their objectives, and with what associated costs, ancillary benefits and side-effects.

For more information about the **ANALYTICAL FRAMEWORK FOR EVALUATING THE COSTS AND BENEFITS OF EXTENDED PRODUCER RESPONSIBILITY PROGRAMMES**, contact: Nils Axel Braathen, National Policies Division, Environment Directorate, OECD. Email: Nils-Axel.Braathen@oecd.org; Fax: +33 1 44 30 63 99.

To download this report for free, visit our website at www.oecd.org/env/waste. To purchase other OECD publications, visit the OECD Online Bookshop at www.oecd.org/bookshop or send an email to sales@oecd.org.

For more general information about the **OECD Environment Programme,** visit our website at www.oecd.org/env/ or send an email to env.contact@oecd.org

ANALYTICAL FRAMEWORK FOR EVALUATING THE COSTS AND BENEFITS OF EXTENDED PRODUCER RESPONSIBILITY PROGRAMMES

1. Introduction

1. Growing concern with the costs of waste management, and with the environmental effects of some of the principal waste disposal options, including landfilling and incineration, and an interest in pollution prevention and environmental risk management has led many OECD countries to develop policies designed to reduce the volume of industrial and household waste and the proportion of the waste that is disposed of in landfills or incinerated and to minimize the environmental risks associated with the lack of environmentally sound management of end of life products. A wide variety of policy instruments have been employed, including both regulatory and market-based instruments.

2. This paper addresses one group of policies, those based on Extended Producer Responsibility (EPR). EPR aims to reduce the economic and environmental costs of waste management by extending the responsibility of producers for their products (including product packaging) to include the responsibility for the full social costs of waste management, including the environmental impact of waste disposal. Many OECD countries have employed EPR policies, and the principle of EPR has been reflected in some high-profile waste management policy initiatives in the past two decades, starting with the well-known German "Duales System Deutschland (DSD)", launched by the packaging industry in response to the German Packaging Ordinance of 1991. Since that beginning EPR policies have been applied to a wide variety of municipal solid wastes, to hazardous wastes and special wastes from both the residential and from the industrial, commercial and institutional sectors. EPR programmes have thus been applied to not only packaging but to paint, batteries, electronics, cell phones, tires, used crankcase oil, appliances and end of life vehicles to name but a few. EPR programmes have been used to achieve significant diversion of waste away from landfill and incineration towards recovery and recycling, to provide greater control over the management of hazardous wastes, and to support the minimization or elimination of environmental risks associated with improper disposal. They have also aimed to promote waste-reducing innovation – under EPR firms can be given an incentive to develop products that involve lower waste disposal costs or that facilitate material and/or energy recovery.

3. The OECD work programme on EPR has covered a number of key issues concerning the design and functioning of EPR programmes. In 1994, the programme began with a review of legal and administrative aspects of EPR programmes in OECD member countries (OECD, 1995). Phase 2 of the programme included two case studies, of the German Packaging Ordinance and the Dutch Packaging Covenant, and developed a framework report. Phase 3 included a number of multi-stakeholder workshops to discuss issues identified in the earlier work. A workshop in 1997 discussed the definition of the "producer" appropriate for the assignment of responsibility in EPR arrangements. Subsequent workshops in 1998 discussed "barriers" to EPR, including issues of trade and competition policy, and the treatment of "orphan" products whose manufacturer has ceased trading, and issues of environmental effectiveness and economic efficiency. These discussions led to the publication of a Guidance Manual on EPR to assist governments in the design of EPR programmes (OECD, 2001).

4. In many countries, EPR has transferred a large part of the costs of waste management from the public sector (municipalities) to the private sector, thus transferring the responsibility to the producer to

manage post consumer products and finance their recovery or disposal. From a social point of view, of course, these costs would be justified if EPR yields greater benefits in return, whether it is the municipality financing the recovery or disposal or the product's producer.

5. The common economic question raised concerning environment policy is whether the environmental gains from the policy are sufficient to justify the costs of operation. The same question is raised for EPR policy and is a matter that cannot be resolved except through careful and objective quantitative research on the effects of actual EPR programmes. Evaluation research on the costs and benefits achieved from EPR can therefore make a key contribution to establishing the balance between total social costs and benefits from EPR policies. It can also help to identify the characteristics of EPR programmes – including the structure of the programme, and the application context - that that are most cost-effective, in the sense of yielding the highest social benefit in relation to the costs involved.

6. Recent OECD work on environmental policy evaluation (including *Evaluating Economic Instruments for Environmental Policy, 1997*) has encouraged more extensive and systematic *ex post* evaluation of environmental policy instruments, to facilitate policy learning between countries, and to stimulate reflective processes of policy re-evaluation and improvement within countries.

7. This paper proposes a framework for assessing the costs and benefits of EPR. While each EPR programme has different features and utilises different instruments to implement the policy, this Analytical Framework provides governments with a starting point for their evaluations, ultimately helping governments save resources by not having to develop a framework from the beginning. Following this introduction the paper is in four main parts. Part 2 summarises briefly the current state of knowledge about EPR, drawing largely on existing OECD work. Part 3 discusses the general issues in evaluating, *ex post*, the effectiveness of environmental policy instruments, again drawing on recent OECD work. Part 4 describes the main elements of the proposed evaluation framework, beginning (in Box 5) with a stylised hypothetical example, showing the main elements that would enter into a cost-benefit evaluation of a simple EPR programme. Subsequently, Part 4 expands the approach beyond this simple example, developing in more detail each of the principal elements of costs and benefits that an *ex post* evaluation of an EPR programme would need to assess.

8. Part 5 looks at EPR evaluation from the perspective of policy-makers with responsibility for the design or operation of EPR programmes. When presented with the findings of an evaluation study, how should its findings be assessed? What are the implications for policy of the results reported by an EPR evaluation study? A key issue for the policy "users" of the output of evaluation research is to assess the robustness and significance of the conclusions reached. Part 5 provides some checklists of questions that might be useful for policy-makers to bear in mind in reading EPR evaluation studies, and in weighing up the significance and implications of their findings.

9. Part 6 draws some conclusions, focussing in particular on the types of EPR programmes that may be most readily amenable to quantitative cost-benefit evaluation.

2. Extended Producer Responsibility: the current state of knowledge

2.1 Key aspects of EPR

10. Extended Producer Responsibility (EPR) is an environmental policy approach under which 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.

11. EPR may be applied both to industrial wastes and to packaging and post-consumer waste. While this paper addresses in a general sense these two types of applications, the focus is more on the application

of EPR to post-consumer waste from households. In many countries existing waste management policies towards industrial and post-consumer wastes differ, and consequently the effects of a shift to EPR-based policies may differ somewhat between these two components of the overall waste stream. Nevertheless the basic rationale and characteristics of EPR programmes are common to a wide range of programmes, including programmes relating to both industrial and household (post-consumer) wastes.

12. Under "conventional" waste management practices for household wastes, the collection and disposal of end-of-life products is typically the responsibility of local or municipal governments, and the costs of collection and disposal are generally financed through some form of general taxation or user charges levied on households and/or businesses. Municipal waste management programs often serve as the "court of last resort" for all sorts of wastes which in some cases, such as liquids and flammables, may be singularly inappropriate for a system which is nominally designed to handle only non-hazardous solid wastes. In comparison with this conventional system of waste management, EPR involves a number of distinctive differences:

- EPR *shifts direct financial responsibility* (fully or partially) for the costs of waste management "upstream" to the producer, and away from the municipality and taxpayer;[1]

- EPR often *involves the producer* in some physical aspects of waste management (such as waste collection, or the management of collective waste management organisations), in addition to its financing;

- EPR is designed to confront the producer with the costs of end-of-life disposal of their products, and thereby to provide *incentives* for the producer to take account of these costs in designing and marketing their products.

13. The principle of EPR, as stated in the OECD Guidance Manual, is: Producers of products should bear a significant degree of responsibility (physical and/or financial) not only for the environmental impacts of their products downstream from the treatment (recovery) and/or disposal of the product, but also for their upstream activities inherent in the selection of materials and in the design of products. The objective of EPR is to reduce the volume and hazard from products at the post-consumer stage.

14. There are several key motivating factors driving EPR policy development. One motivation for EPR is to ***reduce the overall costs of waste management***, by establishing incentives for producers to consider the end-of-life waste management costs of their products. It is important to stress here that the relevant costs are not just the direct financial expenditures incurred by those responsible for waste management, but a wider and more comprehensive concept of costs, including both monetary and non-monetary costs incurred by all parties affected by waste management policies.[2] Thus, for example, from the perspective of society as a whole, the cost of disposing of waste through incineration includes not only the monetary costs of building and operating the incinerator, but also non-monetary costs, such as the impact of the emissions from the incinerator on the health of local residents. Similarly, landfill disposal may involve a risk of

1 EPR shifts direct financial responsibility (either fully or partially) for the cost of waste management to the producer. Whether the corresponding financial burden of waste management costs is then borne by firms (*i.e.* the sense of the economic incidence of these costs) will of course depend on the impact of the EPR costs on producers' pricing behaviour. Some or all of the costs may be shifted to consumers through higher prices. The scope for this will be determined by the conditions of supply and demand in the product market.

2 The glossary to this report provides definitions of key waste management and economic terminology used here, and distinguishes a number of different notions of "cost" which are central to a comprehensive assessment of the costs and benefits of policy measures.

groundwater contamination, which would impose costs on neighbouring residents or businesses, in terms of health damage, the costs of water purification, or the costs of obtaining alternative uncontaminated water supplies.

15. The concept of costs can also be widened to include costs of improper disposal and the environmental risks thereby entailed. Improper disposal can lead to future site remediation costs and other site management and emergency response costs if the environmental risks, such as a polluting fire from say a stack of burning tires, become a reality.

16. When products can be freely discarded by consumers and waste management costs are borne by municipalities, producers can design and market products which have high end-of-life waste management costs without facing any penalty, either in terms of profits or consumer demand. In choosing what products to produce and consume, producers and consumers can ignore the implications of their choices for the financial burden of waste management borne by municipalities. Likewise, no mechanism is present to ensure that they pay attention to the non-monetary consequences of their choices, such as the selection of products that, when discarded, may expose other people to environmental pollution and the risk of health damage. Requiring producers to bear financial responsibility for the end-of-life waste management costs of their products can encourage them to take actions which reduce these costs – by, for example, eliminating excessive packaging or materials and components which are costly to recycle. Producers who can reduce these costs may benefit in higher profits, or in higher market share if they can reduce their selling prices relative to their competitors. Appropriately-designed EPR programmes can also ensure that producers pay attention to the non-monetary costs and risks associated with the end-of-life disposal of their products, including, *inter alia*, environmental damage, disamenity and health risks.

17. In many cases, concerns about the non-monetary costs of waste management have been the primary motivation for introducing EPR arrangements for particular products. Some governments have initiated EPR programmes as a way to better manage products that could create a particular hazard or health risk at their end of life stage. Removing these products from the general waste management regime can help reduce risks by separate handling of products that are potentially hazardous. Thus, for example, EPR has been used ***to provide a separate and more controlled channel for waste management*** for certain hazardous or toxic products (such as, tyres, batteries, or mercury containing products), ensuring that these are separated from general household or industrial wastes, and can be better managed through a separate, specialised regime. EPR is also used to tackle problems of illegal or improper disposal (for example of refrigerators containing CFCs), to discourage litter and dumping (for example end-of-life vehicles), etc.

18. In some cases, a further motivation has been ***to reduce the financial burden on municipalities*** and other public authorities of waste management. Waste volumes have risen sharply over recent decades in most OECD countries, and the cost of handling each tonne of waste has also risen. In some locations, the option of landfill disposal has become increasingly difficult and costly, as existing landfill capacity is exhausted, and public resistance is experienced to the establishment of new landfill sites. In addition, the environmental standards required in all forms of waste management have been raised, increasing the costs of waste recovery and disposal. In the face of these increasing costs of waste management, shifting some of the costs onto other parties may be attractive to public authorities, even if it does not reduce the overall social cost of waste management.

19. Another motivation for EPR is often expressed in terms of ***reduced resource use***. Although, in an efficiently-functioning market, the economic scarcity of natural resources would be reflected in their price, there are two key reasons why the prices of natural resources may understate the social costs of their use. First, in many countries resource extraction and processing activities are heavily subsidised, and as a result virgin materials are often seriously under-priced. Second, there may be significant externalities associated with resource extraction and processing that would be ignored in resource-use decisions based on market

price alone. If virgin resources were properly priced, to reflect the full costs, including external costs, of extraction and processing as well as the scarcity value of exhaustible resources, producers might be encouraged to design products to reduce material input requirements, and to make greater use of recycled materials. Thus, an appropriately designed EPR programme could encourage producers to reduce their use of virgin resources, and to make greater use of recycled materials, where there is a social case for doing so.

20. The many applications of EPR policies in recent years in OECD countries give differing weight to these various motivations. There are also differences in the type of instrument used to implement the EPR policy and how the programme has been organised. When reviewing EPR programmes in operation, there tends to be three common elements to many of the programmes:

- Obligations on the producer concerning the collection ("take-back") of product packaging or end-of-life products (these can be physical and or financial);
- Responsibility for the costs of proper waste management of the collected products and materials;
- Rules or targets governing the methods of waste management of recovered products, for example specifying minimum required rates of re-use or recycling.

21. A distinction can usefully be drawn between programmes in which these obligations are borne and carried out at the level of the individual producer, and programmes in which they apply, or may be carried out, at the level of a sector or industry (*individual or collective responsibility)*. Typically, the latter approach requires some form of collective "Producer Responsibility Organisation" (PRO) to be established. This could, for example, be a separate company, in which individual producers are shareholders. Different programmes vary concerning the rules for participation in the PRO. In some programmes, a single PRO is established, and all collection and waste management activities are channelled through this organisation. In other programmes, firms may have the option of opting out from the PRO, and carrying out their obligations such as take-back and recycling activities individually. In other cases, more than one PRO may be established, competing for business from individual firms.

22. Typically, a PRO will levy charges on participating firms to cover the net costs of its operation. Fees are also set in a manner to promote the use of different materials that are easier to recover or in a way to reduce the amount of a specific material used in a product. These costs will usually include costs of collecting waste products, and the costs of subsequent treatment. Where the waste products are to be recycled, there may be significant costs of separation, sorting and transportation. In some cases, where commercially-profitable recycling operations exist, the PRO may receive income from the sale of recyclable materials to recycling companies. In other cases, recycling may be required by the rules of the programme, but may not be commercially-viable. In these circumstances, the PRO may need to pay to have recycling undertaken. The PRO will make a trading loss if its operating costs (of collection, etc) exceed any income received from recyclers, and this will need to be covered by contributions from members. Such contributions may be related to the current and/or past sales volumes of participating firms, and could also be differentiated to reflect characteristics of the products of individual firms, especially those affecting waste management costs.

23. Beyond these general features, common to most EPR programmes, there are many differences on institutional detail. Some, such as the arrangements which are needed to cover "orphan" or historic products, whose manufacturer is no longer trading, are of practical importance, but the precise detail of these arrangements may have little impact on the costs and environmental benefits of the programme.

24. Other elements of institutional detail are of considerable importance in determining the effects of EPR. In particular, the rules governing participation and cost-sharing may affect the incentives for individual members, and the impact of the EPR programme in the pattern of competition within the

industry. There are two key aspects. First, the incentives for a producer to design products that will have low waste management costs will be sharper if the waste management costs savings translate directly into lower contributions to the running costs of the PRO. If all firms share PRO costs equally, without regard to the waste management costs of their products, the incentive for an individual firm to make waste-reducing product changes may be small. Second, the impact of the PRO on competition within the industry may be affected by the relationship between PRO charges and product volumes. These issues are discussed further in Section 4.10.

2.2 EPR and its alternatives[3]

25. The EPR programmes observed in OECD countries are diverse, and have been introduced with a number of different objectives, as discussed above. The function of the evaluation framework described in this report is to provide a systematic approach to assessing how far individual EPR programmes introduced in a particular context succeed in achieving their objectives, and with what associated costs, ancillary benefits and side-effects. An important preliminary step in assessing the impact of EPR programmes is to clarify the mechanism by which the programme would be expected to achieve its intended outcomes. Precisely how, and to what extent, do the structure and rules of a particular EPR programme ensure that producers have an incentive to reduce the costs of waste management, or to take account of environmental risks or recycling costs? The economic literature of EPR has found that one useful way of clarifying the precise channels through which EPR achieves its objectives is to compare the structure of incentives under EPR and under various alternative policy instruments, such as, for example, various types of product and waste management tax and charge levied in the context of conventional "municipal" waste management. These forms of comparison are useful in clarifying the features of EPR arrangements that are likely to be critical to the achievement of their objectives, and thus help to narrow down the set of issues that need to be addressed in evaluating the outcomes of individual EPR programmes.

26. Consideration of the policy alternatives to EPR is also of relevance to the evaluation framework for a second reason. As the next section will discuss in more detail, an assessment of policy costs and benefits is incoherent without a clear specification of the basis of the calculation: against what baseline or counterfactual are the costs and benefits measured? One approach is to measure the costs and benefits of policy against a "do-nothing" baseline, such as the continuation of the previous policy approach. Another approach is to compare the approach under discussion with alternative ways of achieving the same outcome, and to ask which of the two approaches is a better, or less-costly, approach to achieving the desired outcome. If this latter approach is to be adopted in the evaluation of an EPR programme, it is important to understand how what alternative instruments might be available, and the ways in which their impacts might differ from those of EPR.

27. EPR programmes have attracted policy-makers, because they can provide a mechanism to ensure that producers take waste management costs into account when designing and marketing products. With "conventional" municipal waste management, financed from some form of general taxation or quasi-tax user fees to households, the end-of-life waste management costs of products are of no concern to producers or consumers, and there is no incentive to design products so as to, for example, reduce their toxicity in landfill or incineration, or to increase the ease of recycling. With EPR, producers bear the costs of disposal or recycling. If the programme is well-designed, so that individual producers' contributions to these waste management costs reflect the costs incurred in waste management of their own products, EPR should encourage "design-for-environment" (DfE) innovations to reduce end-of-life waste management costs.

28. In addition, most EPR programmes are designed to achieve changes in the pattern of waste management and not just in the incentives for waste generation. Many EPR programmes stipulate

[3] This section draws heavily on the analysis in Walls (2002), and on the literature discussed therein.

requirements for rates of recovery and/or recycling, higher than the rates achieved in previous waste management systems. Recycling targets and similar provisions are such a common feature of EPR programmes, and exert such a powerful influence on the way that, in practice, EPR operates, that any comparison between EPR and alternative instruments needs to consider the attainment of these recycling goals, as well as producer waste-generation incentives. To some extent, of course, the two issues are linked. In an EPR programme demanding high rates of recycling, producers will have a particularly strong incentive to design products that are easy and cheap to recycle – so long as the programme transmits accurate financial incentives to individual producers.

29. An EPR programme involving product take-back, producer-financing of waste management costs, and recycling targets is not the only way in which these waste management objectives could be addressed. A range of possible alternative policy instruments that might be employed is set out in Box 1. Some of these instruments are viewed as being alternative ways of implementing EPR (as they enshrine the principle of EPR) rather than alternatives to EPR. For example, an advance disposal fee (ADF), under which producers pay an amount per item sold, intended to cover future waste management costs of the item, may be regarded as EPR if there is a significant shift of responsibility (financial or physical) to the producer. In some cases (but not all), there may be little difference of substance between waste management charges levied on firms as a result of an EPR programme and a statutory ADF.[4]

30. An EPR programme involving product take-back, producer-financing of waste management costs, and recycling targets, generally has the potential to secure a number of desired changes, including both changes in product design ("design-for-environment" incentives) and changes in waste management towards greater use of recycling. To achieve these outcomes through the use of other policy instruments would normally require a combination of alternative policy measures. One of the findings of theoretical research on the impact of EPR is that no single alternative instrument can be identified as a substitute for EPR. To achieve both "design-for-environment" and "recycling-rate" objectives reflected in most EPR programmes through a non-EPR route would typically require a mix of alternative instruments.[5] However, a number of instruments do exist that might affect one or other of these objectives, and might be employed as part of a non-EPR approach (such as, for example, an approach based on municipal responsibility for waste management and its costs). The remainder of this section discusses, first, those instruments which could alternatively promote "design-for-environment" incentives for producers, and secondly, instruments that could be used to raise the rate of recycling.

4 A critical issue common to both cases will be the structure of charges, and how this relates to the waste management costs for a particular producer's products. However, there may be important effects from the involvement of firms in the management of the waste disposal system under EPR that do not arise under a statutory ADF, and in some cases this direct involvement may be an important ingredient in the notion of producer responsibility.

5 See, for example, Dinan (1993), Palmer, Sigman and Walls (1997), Fullerton and Wu (1998), Palmer and Walls (1999).

Box 1. List of common waste minimization policy instruments

- ***Product take-back***

Producers are assigned the responsibility of taking-back their products at the end of their useful life.

- ***End-of-life waste management fees***

Consumers are charged all or part of the marginal collection and treatment costs of general household waste or of specific waste products through an "end-of-life" fee. This may be a charge per bag or per kilogram of general household refuse ("pay as you throw"), or a specific charge for the collection and treatment of a particular item (*e.g.* car tyres, refrigerator, end-of-life vehicle, etc)

- ***Advance disposal fee***

A tax or charge may be levied at the time a product is sold, at a level intended to reflect the end-of-life waste management costs of the product. Producers may be responsible for collecting the charge and remitting it to the public authorities, but are otherwise not necessarily involved in the collection or disposal of wastes.

- ***Mandatory deposit-refund system***

A deposit is levied at the time the product is sold, and all or part of the deposit is later refunded when the product (or its packaging - *e.g.* a bottle) is returned for reuse, recycling or safe disposal. Producers (or retailers) may be responsible for collecting the deposit, and for end-of-life collection and refund.

- ***Recycling incentives***

Measures to stimulate recycling markets could include subsidies paid for the collection of materials for recycling (or direct public provision of collection facilities), subsidies paid to reprocessing firms, or subsidies to users of recycled materials. The use of recycled materials could also be encouraged by regulations requiring minimum recycled-materials content in certain products, or by taxes on virgin materials.

- ***Disposal disincentives***

Taxes on landfill disposal or incineration may act to influence both the choice of disposal option (*e.g.* may influence the choice between landfill and incineration) and may also discourage disposal in any form, compared with recycling and waste-reduction. However, such taxes will normally only influence the disposal choices of waste management organisations (*e.g.* municipal waste management agencies), and unless supplemented by other measures will not influence consumer or producer decisions that affect the quantity or characteristics of waste generated.

2.2.1 Instruments to create "design-for-environment" incentives for producers

31. One of the chief advantages of EPR is that it directly connects producers with the waste management costs of their products. If appropriately designed, so that individual producers bear a financial burden under EPR that directly reflects the costs of waste management for their own products (fully-reflecting the characteristics of their products that would affect waste management costs), then producers have a clear incentive to modify product design in order to reduce waste management costs. In practice such cost signals to a producer may be muted by the producer's ability to pass on the cost to the consumer and this issue may need to be addressed in the EPR program design.

32. It should however be recognized that in some product areas the ability to redesign products for the environment may be constrained by the nature of the product itself. For example there is likely to be less opportunity to redesign motor vehicle oil to minimize the generation of used crankcase oil than in other product areas. In many respects the generation of used crankcase oil is likely to be more related to engine design and performance than to the engineering of the oil itself. In these cases the driver for the EPR program is the need to ensure proper end of life management for used crankcase oil and less the need for better more environmentally friendly product design.

33. Not only do producers have an incentive under EPR to consider the waste management costs of their products, but they are also in a position to weigh the benefits of any particular product innovation that reduces waste management costs, against any possible effect of the innovation on consumer satisfaction. A

new product design that makes the product less attractive to consumers will generally have to be sold at a lower price. In these cases, the producer can weigh the saving in waste management costs against the reduced selling price, and can choose the option which is most profitable. Design changes will be implemented which make large savings in waste management costs without significantly reducing the value of the product to consumers, while design changes which reduce consumer satisfaction by more than the saving in waste management costs will not be pursued.

34. Whether alternative, non-EPR, policy instruments could encourage similar "design-for-environment" efforts by producers is unclear. Without the direct link between producer and waste management costs that is created by EPR, the effects of alternative instruments need to be considered in the context of the chain of linked decisions, stretching from the producer, via the consumer, to the waste management operator (Box 2). In the course of the life of a product, key decisions affecting waste management costs are made at each stage. Producers make choices about the products that they produce and market that will affect the eventual costs of waste disposal and recycling. Consumers make decisions about what goods to purchase, and about how they are to be used, including the decision about when to throw the product away. Consumers also make choices which affect waste management - such as the decision to discard the product in general household refuse, or in waste recycling facilities, or - in some cases - simply to dump the product in the open environment. The public authorities responsible for waste management then make decisions about the waste management option for the wastes they collect - to landfill, incineration, recycling, etc.

Box 2. The chain of production and waste management for post-consumer products at the household level

EPR needs to be assessed in the context of the "chain" of decisions involved in waste management.

- Producers' decisions about the eventual waste characteristics of the products they produce
- Households' decisions about purchase and consumption
- Households' decisions about how to manage (*e.g.* reuse, recycle or dispose of) their waste
- Public authorities' choice of waste management option for waste which they collect

EPR aims to ensure the outcome that maximises social welfare by inserting incentives at the initial, "producer" end of the chain. Alternative policies could insert incentives at other points.

35. In the absence of EPR, producers are not directly confronted with the waste management costs of the products they design and market. However, some of the elements of the chain of decisions shown in Box 2 are linked in a way which might help to transmit signals from waste management to producer. Non-EPR policies could perhaps aim to strengthen these signals, and, in particular, to fill in the gaps that exist between some parts of the chain, so as to give producers, indirectly, the incentives for waste-conscious product design that they currently lack.[6] There is already a link between the first two elements - between producers' decisions about the characteristics of the products they sell, and consumer's decisions about purchasing. Changes in product design that increase costs, and hence selling price, or that reduce the desirability of the product to consumers, would be liable to affect consumers' purchasing decisions. However, changes in product specification that reduce waste management costs are unlikely to be of interest to consumers (apart from the altruistic or public-spirited), because consumers in most cases bear none of the direct waste management costs associated with their purchasing and waste-disposal choices Confronting households with the waste management costs of products (for example, through visible direct charges for waste management) would in principle give consumers an interest in the waste

6 See Calcott and Walls (2000).

management characteristics of the products they purchase, and hence give firms, indirectly, an interest in designing products which minimise these costs. This kind of link is however likely to be tenuous and not result in any significant changes in consumer purchasing decisions. The absence of a link between producer choices and waste management costs arises fundamentally because households do not bear, directly and precisely, the costs of waste management of the products they purchase and discard. because they are generally hidden in their general municipal tax.

36. So, one possible alternative to EPR, which conceivably might strengthen design-for-environment incentives for producers, would be an ***end-of-life waste management fee*** levied on households, at the point when waste is discarded. This could be a general charge for household waste, related to the quantity or characteristics of the waste collected by the public authorities, or it could be a specific charge for discarding certain products. A charge per battery for treatment of batteries containing mercury might lead consumers to buy fewer batteries, and to switch to other types of batteries, and the shift in consumer purchasing patterns might then influence producer decisions about the types of batteries to supply. Indirectly, producers would face an incentive to design and market products with lower waste management costs, through the shift in consumer purchasing. Conversely, it is possible that such an end of life fee would encourage avoidance of the charge through illegal and improper disposal. Enforcement in this kind of situation is required to increase with a resulting associated higher cost . Generally EPR programs are designed to minimize such possible barriers to encourage wide public participation and the achievement of targeted recovery rages.

37. An alternative approach, again aiming to encourage design-for-environment, would be an ***advance disposal fee*** could be charged at the time the product is sold, reflecting the scale of end-of-life waste management costs associated with the product. Again, the impact on producers would arise through the change in consumer preferences and purchasing patterns. An advance disposal fee on batteries containing mercury would encourage similar consumer substitution as with the end-of-life waste management fee.

38. In a theoretical analysis, Palmer and Walls (1999) have compared the relative effectiveness of EPR policies and these alternative instruments. If all products that are sold are disposed in a way that triggers the end-of-life waste management fee, then the incentive effects for both consumers and producers of the end-of-life waste management fee and the advance disposal fee look very similar. The taxes differ, of course, in their timing. In addition, the end-of-life waste management fee requires consumers to realise that the choices they make about purchases will have implications for the costs that they pay on final disposal, and hence for the total cost of the product. If consumers are cognisant of this, (and if all products sold attract the end-of-life fee on disposal) then an advance fee and an end-of-life fee with the same net present value will have the same effects on behaviour, and on the economic interests of producer and consumer.

39. The fact that the formal incidence of the advance fee may be on the seller, while the end-of-life fee may be charged to the consumer, does not affect where their final incidence lies. In a competitive market, the advance disposal fee may be partly passed forward to the customer in higher product prices, while the end-of-life waste management fee may be partly incident on the producer, by reducing the price which consumers are willing to pay for goods which will be later subject to the end-of-life waste management fee.

40. There is also similarity between the advance disposal fee and EPR, in the sense that the charges levied on member companies by the PRO will typically be (precisely, or approximately) related to sales volumes or market share. The per unit PRO charge will function in a similar way to an advance disposal fee. Like the advance disposal fee it may be passed forward to consumers through a higher selling price, and the extent of this shifting will be determined by the elasticities of supply and demand in the market.

41. The differences between EPR, an advance fee and an end-of-life waste management fee, in terms of their effectiveness in confronting producers with the waste management costs of their products, arise in a number of specific areas:

(a) Incentives for dumping

42. A drawback of the end-of-life waste management fee is that it creates an incentive for households to dump waste in the open environment, or in other ways that do not attract the end-of-life waste management charge.[7] Where the risks and costs of illegal dumping are significant, the end-of-life waste management fee may be less attractive than the alternatives of EPR or an advance disposal fee.

43. Where there is a significant risk of illegal dumping even if households face no direct charge for waste collection and disposal, or where the costs of illegal dumping are high (as in the case of toxic products), one option could be to give households a financial incentive to dispose of waste through the proper channels. A payment might be made for safe disposal of particularly-hazardous items to minimise the amount of dumping. One way of implementing this would be through a deposit-refund system, which levies an advance payment when the product is sold, and refunds all or part of this deposit when the used product is handed in to an appropriate collection facility.[8] The amount refunded could be set to reflect the marginal damage caused by dumping, while the non-refundable component of the deposit would reflect the social costs of disposal or recycling, whichever is lower.

44. Deposit refund systems also arise where the aim is to recover items that have end-of-life value, either for re-use or as an input to profitable recycling or energy recovery. The purpose of the refund is then to give households an incentive to separate the item from other wastes. Such programmes may be established voluntarily by firms wishing to recover valuable items or recyclables, or they may be mandated by law.

45. Research (OECD, 2001) has shown that the creation of a convenient collection system is another way of addressing the issue. Kerbside pickup as is practiced in many municipal recycling programs has proven itself to be very effective. Many programs have proven that the general public rarely need an incentive to participate if the program is built around ease of access.

(b) Accurate differentiation of the charge

46. A common problem to each of the three instruments which aims to encourage "design-for-environment" (DfE) behaviour by producers is that the financial incentive may not accurately reflect the waste management costs of the product. Thus, for example, end-of-life waste management fees to households may take the form of a flat-rate charge per bag or per kilogram of household waste, or an amount per item (per battery, or per car tyre, for example). Where households are charged per kilogram of waste, consumer pressure might induce producers to reduce the weight of products, and hence the weight of waste, but not to make other changes in product design which reduce waste management costs. Similarly, advance disposal fees might be the same for all products of a particular type, and may not distinguish between products which will be costly to manage as waste, and competing products which have been designed so that waste management is less costly. Again, the incentive for DfE will be weak.

47. Similar issues arise in the case of EPR programmes run collectively, through a PRO. If firms share the costs of the PRO in proportion to their market share, then an individual producer will have a negligible

[7] Fullerton and Kinnaman (1996) discuss the relationship between end-of-life waste management charges and the level of illegal disposal.

[8] See Fullerton and Kinnaman (1997).

incentive to make design changes that reduce waste management costs. Any savings benefit the firms collectively, and would confer as much benefit on to the innovating firm's competitors, as on itself. Cost-saving innovation becomes an industry-level public good, and is consequently likely to be under-provided. Only if the PRO charges firms an amount per unit sold that relates directly to the costs that will be involved in disposing of that particular product, so that all design changes that reduce waste management costs are properly rewarded, will a collective EPR programme establish effective incentives for DfE. This might be difficult in do in any EPR programme which is seeking to reduce costs through the collective efficiency of a shared high volume collection program. Charging firms which separately manage their wastes would of necessity have to reflect the costs of segregating the waste of company "A" from that of the all the others in the collective programme. This exercise is likely to add cost not reduce it.[9]

48. One advantage of EPR where products are taken back and waste managed at the level of the individual producer is that producers directly benefit from their own waste reducing innovations, thus considerably sharpening the incentives for DfE.

49. An advantage of end-of-life waste management fees compared to ADFs is that they more easily can be set to reflect any geographical differences in the external costs related to waste disposal. (See the discussion in Porter (2002))

(c) Transparency of the costs

50. A third difference between the two fee instruments and EPR is in the transparency of the costs imposed on firms and households. Taxes or fees levied by the public authorities are a clear and measurable financial burden per unit of the product, while the financial burden implied by EPR is given by the costs of meeting the requirements of the programme. The additional cost per unit of the product may be unknown in advance, and may be difficult to observe, even when the programme is in operation. There must be a danger that costs which are hidden are given less weight than those which take the form of publicly-announced and precise fee rates. However, the costs imposed by EPR on firms and consumers are no less real than those imposed by either of the two fees.

51. In addition to this, it will be noted that, where the costs of the various options for waste management and waste reduction are not precisely known in advance, there will be a difference in the predictability of the costs of EPR, on the one hand, and price-based regulatory instruments such as ADF and end-of-life waste management fees on the other. The latter instruments limit the social cost of whatever is done by firms and individuals in response to the fees; waste reduction that is more costly per unit than the fee per unit will not be undertaken. With EPR, on the other hand, there is no upper limit to the potential cost of meeting the requirements of an EPR programme.[10] If meeting the targets set by the programme is substantially more costly than expected, these costs will be incurred, even if they are excessive in relation to the benefits achieved.

(d) Scope for free-riding

52. A drawback of some EPR programmes, especially those based on industry-level negotiated agreements to establish a collective PRO, is that there may be some scope for individual firms to "free ride" – in other words, not to participate in the PRO and to avoid the cost of financial contributions to the

9 A special case study of DfE impacts of EPR programmes is currently being undertaken for OECD.

10 The penalties for non-compliance may be seen as setting such an upper bound to costs, in the sense that firms can choose to pay the fine rather than comply, if this is cheaper. However, the formal penalties for non-compliance may be magnified by the impact on business reputation, especially where consumers have strong preferences for environmentally-aware producers.

operating costs of the PRO.[11] By contrast, a statutory advance disposal fee may be levied on the output of all firms, and the scope for firms to avoid the ADF may be much more limited. Free-riding behaviour may be perceived as inequitable by firms bearing the costs of the PRO, and gives a competitive advantage to the free-riding firms, which allows their output to expand at the expense of other, possibly more-efficient, firms which do participate in the PRO. In addition, free-riding firms do not face any incentives to minimise the waste management costs of the products they produce, through "DfE" innovations. As a result, the savings in the total social costs of waste management may be less with an EPR programme subject to significant free-riding, than under a universally-applied, and well-enforced, statutory ADF.

2.2.2 Instruments affecting waste disposal options.

53. Within a system of municipal waste management it would be possible to use a variety of policy instruments instead of EPR to achieve a similar shift away from disposal options such as landfill and incineration, and towards energy recovery, recycling and re-use. Taxes on landfill disposal and incineration might raise the cost of these options, and recycling incentives, either taking the form of direct subsidy or public provision of collection and recycling infrastructure could increase the profitability of recycling compared with landfill and incineration. Similar effects could be achieved by direct regulation of municipalities, setting targets for recycling percentages. These targets could be imposed rigidly, or flexibility could be allowed for municipalities through a system of recycling credits (tradable permits).

54. Further incentives for recycling could be given by measures to stimulate the demand for recycled materials. Legislation requiring a specified minimum recycled content in products would be one way of increasing the demand for recycled materials. Again, allowing flexibility through some form of tradable recycled-content credits would be possible, with the aim of reduce the overall cost of achieving the required recycled content levels.

55. As with other aspects of EPR, the recycling targets which typically accompany EPR programmes have the drawback of a lack of transparency about the costs of what is required. This is because it is not easy to establish in advance what the impact of a given recycling target will be on producers' costs, and on the prices of the products they produce.. "Steering" the choice between disposal and recycling through pricing instruments such as landfill or incineration taxes, and recycling subsidies would place limits on the costs that could be incurred, albeit at the risk of less certainty about the scale of the switch to recycling. In contrast, tradable credits could allow cost-reducing flexibility compared with targets, while guaranteeing the achievement of the required quantities, and would have some advantages in terms of transparency, because the tradable-credit price per unit can be observed.

56. While recycling targets frequently accompany EPR programmes, they are not strictly required to the operation of EPR, and a number of the incentive mechanisms described above could alternatively be used to encourage recycling within the context of an EPR programme.

11. In principle, this problem can be reduced by regulations that *e.g.* make participation in a PRO obligatory. Such regulations could, on the other hand, entail higher economic costs.

3. Evaluation of environmental policy instruments: the OECD approach[12]

3.1 The value of evaluation

57. As the 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* observes, systematic analysis, or "evaluation", of practical experience about the performance of economic instruments can provide valuable information about their performance. More extensive evaluation evidence would be beneficial within the policy process in a number of ways:

- Evaluation evidence on the performance of policy instruments can help to improve the administration of current policy, and can contribute to a process of policy reappraisal, modification and improvement in the light of experience;
- Evaluations can also improve the choice of instruments in future policy, by demonstrating how different instruments perform in specific contexts;
- Evaluations can provide evidence on the functioning of the political and policy processes, to ensure that they translate policy intentions into practice as effectively as possible. The knowledge that policies may be subject to future evaluation can act as a brake on the development of poorly-justified or cynical policy measures;
- Evaluation may also contribute to better communication with stakeholders and the public about the purpose, operation and effects of policy.

58. In each of these ways, evaluation studies can contribute to better design and implementation of environmental policies in the countries concerned. There may also be important benefits to other countries, which can learn from the practical experience of countries which have implemented particular policies. In the case of EPR policies, some of the issues concern the possible effects of EPR on the pattern of international trade and competition. Objective and transparent evaluation of the operation of EPR programmes may be able to help in identifying areas where such problems arise, so that corrective action can be taken, and may also help to reassure trading partners concerned about such possible impacts.

3.2 Ex ante assessment and ex post evaluation

59. Available methods for the quantitative assessment of the costs and benefits of environmental policy measures include both "*ex ante*" techniques, such as simulation, and "*ex post*" techniques, where the evaluation is based on the observation of experience. Cost benefit analyses – assessments of the costs and environmental benefits of policy measures – can be conducted from either perspective. The two approaches, of ex ante assessment and ex post evaluation, contribute different, and sometimes complementary, insights. In some cases, ex post evidence will shed considerable new light on the properties of a policy instrument, or on particular aspects of its costs and benefits. For example, assessing the scale of behavioural responses to a policy measure may be difficult without actual experience of the measure in practice, although sometimes the likely effect may be inferred from closely-analogous experience. In other areas – such as for example, the valuation of environmental effects, observation of practice may not significantly expand the amount of information available, or its reliability. A full assessment of the costs and environmental benefits of EPR programmes will generally need to draw on evidence of both sorts.

[12] This section draws extensively on the analysis of the 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* (OECD, 1997). While this report was concerned specifically with the evaluation of market-based economic instruments in environmental policy, much of the analysis is applicable to the evaluation of environmental policies, like EPR, more generally.

3.3 Criteria for evaluation

60. The 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* (OECD, 1997) set out a framework for ex post evaluation of market mechanisms, covering seven key categories of costs and benefits from their use:

i) **Environmental effectiveness.** The effects on the level of environmental damage. Damage may be measured quantitatively, or in terms of economic valuation.

ii) **Economic efficiency.** A central element in the case for using economic instruments in preference to "command-and-control" regulation in environmental policy is static efficiency (or "cost-effectiveness") in achieving a given level of abatement - in other words, reducing aggregate abatement costs by switching abatement to firms which can reduce pollution at least cost.

iii) **Administration and compliance costs.** From the point of view of the economy as a whole, administrative costs incurred by public-sector bodies and compliance costs borne by the private sector are both economic costs of environmental regulation, absorbing potentially-productive resources.

iv) **Revenues.** Some market mechanisms such pollution taxes generate government revenue; others may have effects on public expenditures which may affect the need for tax revenues. (EPR may, for example, reduce public expenditures on waste collection and management, with consequent fiscal-policy benefits).

v) **Wider economic effects.** This category includes macroeconomic effects (for example on the price level, and possibly the rate of inflation, employment and economic growth), effects on competitiveness and trade patterns, and income distribution effects.

vi) **"Soft" effects.** These include possible effects of the use of an instrument on attitudes and awareness, for example by affecting the willingness of households to separate waste for recycling, or by increasing consumer resistance to certain types of packaging.

vii) **Dynamic effects, and innovation.** Economic instruments are, in principle, likely to be more effective at stimulating innovation than "command-and-control" regulations which merely require a given level of compliance.

61. All of these impacts are costs and benefits that a study of the costs and environmental benefits of EPR programme might wish to address, and clearly all should, in principle, be included in any overall assessment of the balance between costs and benefits from using EPR, rather than alternative approaches.

3.4 Evaluation issues

(1) The evaluation baseline - i.e. "what would have happened otherwise?"

62. Not all of the change in producer, consumer and waste management behaviour following introduction of a system of EPR can be attributed to the effects of that instrument. Some of the changes might have occurred in any case, regardless whether policy had changed or not. In evaluating the effects of an instrument we are not interested simply in describing changes, but in ascribing cause. To do this, we need to compare the situation following introduction of EPR with an alternative, hypothetical, scenario (the evaluation baseline, or "counterfactual"), showing what would otherwise have happened, without the EPR programme.

63. One aspect of this is that we need to be clear about how we specify environmental policy in the hypothetical alternative. What, if anything, is the alternative environmental policy against which the

tradable permit programme is being evaluated? What are the pollution prevention benefits? What could have happened if an existing practice (such as the uncontrolled dumping of tires/tyres) continued? Should the evaluation of the performance of EPR be made against the likely effects of other policy instruments (*e.g.* an advance disposal fee) with equivalent effects on the waste stream, or should it compare EPR with a no-policy baseline (and, consequently, poorer environmental performance)?

64. If comparisons are to be made against a hypothetical counterfactual or "baseline", the evaluation needs to predict or model what would have been the evolution of all the relevant variables in the alternative baseline scenario. This cannot of course be observed, but various different methods are available to construct a baseline scenario (sometimes referred to as the "counterfactual"), ranging from simple trend extrapolation to sophisticated econometric modelling. The range of different approaches available is summarised in Box 3.

Box 3. Methods for constructing a baseline against which the impact of policy can be assessed

Various methods are available to construct a baseline scenario. These include:

- ***trend extrapolation***. A simple approach to constructing a policy baseline is to assume that trends visible prior to the policy change would have continued unchanged if the policy measure had not been implemented.
- ***econometric methods***. Econometric models may be estimated which, for example, link pollution levels to various economic variables (*e.g.* the level of gross national product), and which include a "dummy variable" for the date of introduction of the policy measure. The model can then be used to make a "counterfactual" prediction of what would have happened to pollution levels if everything else had remained unchanged, except that the policy had not been introduced.
- ***linear programming techniques*** can be used to indicate how the decisions of firms might change in response to different constraints and incentives; the problem with these measures is that they assume some form of optimal decision-making, which may in practice be unrealistic
- often it will be better to use ***"judgmental" methods*** than any of the other techniques to describe the baseline in the absence of policy. However, one problem with definitions of the baseline scenario constructed purely on the basis of judgment is that the outcome of the evaluation study will depend critically on the judgments made; there may easily be scope for doubts about the realism of such a baseline.

What can be done depends partly on the availability of suitable data. In turn, data availability depends partly on the institutional setting of the evaluation. Issues of commercial confidentiality may obstruct access to some of the key data needed.

Source: OECD (1997), page 97

65. Constructing the counterfactual can often be the central methodological problem to be tackled in evaluating the effects of environmental policy instruments. Ignoring the issue can lead to seriously-misleading conclusions. Thus, for example, one of the most thorough recent evaluations of the performance of a market-based environmental policy measure, the study of emissions trading in the US Acid Rain program by Ellermann et al (2000), shows that a significant part of the change in sulphur dioxide emissions that followed the introduction of the emissions trading regime can be attributed to the effects of an otherwise-unrelated policy initiative, railroad deregulation, which as a by-product made it cheaper for many US power stations to source coal from the cheap, low-sulphur mines of the Power River Basin. Because of this, a significant reduction in SO_2 emissions would have been achieved without the emissions trading regime, and to attribute all of the observed change in emissions to the trading regime is to overstate its impact.

66. Proper treatment of the counterfactual does not always reduce the size of the effect to be attributed to an environmental policy instrument. Box 4 shows that there have been circumstances where a "naive" before-and-after comparison of the market share of returnable glass bottles would suggest that the introduction of mandatory deposit-refund arrangements had been ineffective. However, closer study, based on a properly-specified counterfactual could show that it had been highly-effective in preventing further decline in the share of such bottles.

(2) "Disentangling" policy packages

67. A frequent difficulty in assessing the effects of a particular environmental policy instrument is that instruments are frequently combined in a "package" of policy measures. Often, the effects of new economic instruments are reinforced by regulatory measures, or other measures, taken at the same time.

68. In many cases, it will simply be impossible to separate the individual contribution of policy measures implemented as part of a package, and the evaluation will have to be content with evidence on the joint effect of all the elements of the package taken together. Sometimes there may be some scope for international comparisons to indicate the extent to which particular components of policy packages are responsible for outcomes, if similar policy measures are implemented in different countries along with different accompanying measures, or the same measures in different proportions, allowing the separate contribution of each component to be identified. However, such opportunities will be rare, and the evidence derived from such cross-country comparisons will depend critically on the assumption that the countries are otherwise equivalent in terms of the responses expected from the implementation of particular policies.

Box 4. Sometimes all the "action" is in the baseline

In the 1970s and 1980s, as the share of disposable soft drinks containers (cans and one-way bottles) began to rise, a number of countries introduced mandatory deposit-refund programmes, or other policy measures designed to halt the growth in the market share of disposable containers and to prevent littering. Where these measures were effective, the rising market share of disposable containers was halted.

The impact of these measures can be assessed by comparing the observed market shares with an estimated counterfactual, showing the hypothetical evolution of market shares for disposable and returnable cans and bottles that would have occurred, in the absence of policy action. This counterfactual might be constructed using data from similar countries that did not introduce mandatory deposit-refund arrangements, or other measures to restrain the growth in the market share of non-returnable bottles.

Assessing the impact of the measures by a "before-and-after" comparison of the market share of non-returnable containers would lead to the misleading conclusion that the measure had little effect, while a comparison between the market share observed and the counterfactual would show the true effectiveness of policy. In this case, all the changes occur in the counterfactual.

69. A particular issue in assessing the effects of EPR programmes is that the arrangements for producer responsibility are typically accompanied by rules requiring higher rates of recycling than in the existing municipal waste management system. In principle it would be interesting to know the separate impacts of the various components – for example, to know whether, on its own, making producers responsible for the costs of waste management has significant effects on waste levels and types, independently of the introduction of the more-stringent recycling targets. In practice, however, these effects will be difficult to disentangle in most evaluations, and assessments of the costs and environmental benefits of EPR will generally assess the joint effects of the package of policy components taken together.

(3) Timing

70. How soon after the introduction of an EPR programme should its results be assessed? Is there any point in setting up arrangements for early evaluation, with the aim of generating results that can be used to make early modifications and improvements to the programme? There are a number of factors which need to be taken into account in deciding on the timing of evaluations.

71. First, some of the behavioural responses to EPR may take some time to appear. Effects of EPR on product design may develop gradually, as the costs of waste management feed back into the process of new product design and development. In some product areas, new products take considerable time to develop, and rapid effects of EPR on product specifications may be unlikely. Effects of the product design changes induced by EPR on waste streams themselves may take even longer to become evident, especially in the case of durable goods such as consumer electrical equipment, motor vehicles, etc.

72. Second, however, the timing of the evaluation may also have implications for the data available for the evaluation. Evaluation too long after the introduction of a new instrument is likely to mean that some of the relevant economic actors are no longer available to survey or interview (firms go out of business, managers retire or move jobs, and so on). Also, with the passage of time the "counterfactual" may become increasingly imprecise, and the effects on waste streams and costs of an EPR programme may be more difficult to distinguish from the effects of other factors also affecting these variables.

73. Another consideration in the timing (or, more specifically, concerning the time-frame over which the policy is analysed) is the possibility that the behavioural response to an economic instrument may partly anticipate its introduction. Producers may respond to the advance announcement of EPR measures, and may make long-term product design and marketing decisions based on their assessment of future policy developments, both in the country concerned and abroad. Deciding an appropriate baseline for evaluating effects may be difficult. If anticipation effects are likely to arise, confining the analysis to the period following the date of introduction of the measure will be too late to include all of the relevant effects.

74. A special consideration concerning the timing of an evaluation is the need to allow the program to handle the back-log of historic or orphan products which will appear in the first years. These wastes will appear at the very beginning of a program because they were being stored in anticipation of the program launching.

(4) Institutional location

75. The institutional context within which evaluation studies are conducted can also have a significant influence on the success of the evaluation, and on its effectiveness in stimulating reforms and refinements to the policy. There are a range of possible models, stretching from internal evaluation conducted by the agency responsible for designing or implementing the programme (*e.g.* the PRO, or an industry organisation), to wholly-independent evaluation by "outsiders" such as independent academics, working without any involvement or support from the policy makers responsible for the programme. In between, there are a variety of possible intermediate arrangements, including external academic researchers, research institutes, and private-sector consultancy firms working with some degree of support from the relevant agency. This support might be in terms of information (such as data, access to agency staff running the programme, or to regulated firms), or financial, and it could be provided either as "untied" funding or other assistance for a wholly-independent evaluation activity, or through some form of consultancy contract, with more active agency involvement in guiding and monitoring the progress of the research.

76. These are important differences, and evaluations conducted in different ways have different characteristics, and relative strengths and weaknesses.

77. First, comprehensive evaluation studies can rarely be conducted totally independently from the relevant institutional actors involved in the policy. Studies that have the explicit support of the agency running the programme may have better access to agency staff with detailed knowledge of the system, and may be better able to obtain confidential data. The relationship with the agency may also influence the willingness of the subjects of the regulation to co-operate with the evaluation - though in which direction is not always clear. Second, the relationship between the evaluator and the institutions responsible for the policy may affect the actual or perceived objectivity of the work. Third, translating evaluation findings into future policy requires that policy-makers accept the findings of the evaluation. Wholly-external evaluations, conducted without involvement of policy-makers at each stage, may have less impact on subsequent policy developments than those which have stronger links with policy-makers (including perhaps funding). In the latter case, the relevant policy-makers may be more willing to take "ownership" of unpalatable findings, and to accept the need for policy reforms.

78. As the earlier OECD report *Evaluating Economic Instruments for Environmental Protection* (OECD, 1997) observed, these considerations do not point to a single clear conclusion about the best institutional location for evaluation research. There is a trade-off between information and objectivity which may look different, depending on the policy instrument concerned, and the research, administrative and political traditions of individual countries. Suggestions which may help to ensure that studies conducted towards the "internal" end of the spectrum maintain (and are seen to maintain) objectivity include (i) establishing a steering group to oversee the evaluation, including outside members, (ii) making data and research methods open to peer review and scrutiny, and (iii) making a prior commitment to publication, regardless of the research findings.

4. An analytical framework for evaluation of the costs and benefits of EPR

79. This section aims to set out a general framework which could be used for systematic assessment of the costs and environmental benefits of EPR programmes. As discussed in the previous section, the 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* report identified a number of key aspects of the design and conduct of evaluation studies of economic instruments. Some of these are also applicable to the design of evaluation studies of EPR, but in other respects EPR raises distinctive issues which require appropriate attention.

80. The EPR programmes implemented in individual countries differ widely, in a number of respects, including the industries and products covered, the policy context in which they have been introduced, the nature of the responsibilities placed on producers, the forms of organisation, and the economic, social and cultural context in which the programmes operate. No single approach to evaluation will be appropriate to every EPR programme. Depending on the context and nature of the programme, evaluation effort and attention may need to be focused on different aspects of the costs and benefits. The data and information needed for evaluation will vary widely across programmes, and, in addition, there are likely to be major differences in the availability of data. Not all forms of EPR programme will be straightforward to evaluate, but the framework identifies some forms of EPR for which evaluation is more likely to be feasible and meaningful. Moreover, for all programmes, there will be aspects of the costs and benefits that cannot be precisely quantified. Both in the evaluation research, and in the interpretation of the research findings, it is important that these unquantified elements are clearly identified, and given appropriate consideration.

81. EPR programmes vary widely, but many share a common core of elements, including waste-collection operations (typically run through a PRO, but in some cases by individual firms), targets or incentives to influence treatment of the waste collected by the PRO (typically targets for recovery and

recycling of the collected items), and a set of "governance" arrangements for joint financing and management of the PRO.

4.1 Defining the comparisons to be made

82. A first step in developing an assessment of costs and environmental benefits of EPR is to clarify the question that the assessment is to answer. What comparison is being made in assessing costs and benefits? Or, in other words, what is the baseline against which costs and benefits are measured: "Costs and benefits *compared to what*?" Different questions imply different comparisons and different approaches to evaluation.

83. There are three different questions about costs and environmental benefits that could be the focus of the assessment of an EPR programme:

i) How does the EPR programme compare with the previous arrangements for waste management, before the implementation of EPR, or in some cases the lack of any organized waste management in the cases of improper and/or illegal disposal?

ii) How does the EPR programme compare with possible alternatives?

iii) Could the EPR programme be modified in ways that improve social welfare?

(1) A comparison of EPR and the previous arrangements for waste management

84. The first question assesses EPR against a "business-as-usual" baseline, based on the continuation of the previous arrangements for waste management for the products(s) concerned. In the case of EPR programmes covering specific items of household waste, the "business-as-usual" baseline would usually be conventional municipal waste management. Typically this will have been the starting point prior to the introduction of EPR, and so defining the "counterfactual" of what would have happened in the absence of EPR may be relatively straightforward. In assessing EPR against the "business-as-usual" counterfactual, key elements will include:

- costs of waste collection and disposal for the PRO, and the impact of the PRO's activities on the costs of municipal collection and disposal;
- effects on the generation of waste, through the impact of EPR on producer incentives to design products with lower waste costs; and
- the social benefits (such as reduced landfill and incineration externalities, and greenhouse gas benefits from the recycling of the secondary materials recovered) from changes in the size and destination of waste streams;
- The environmental impacts of the landfill disposal or incineration of items which are inappropriate for such disposal but are captured through the municipal system. (Items such as unused paint, electronics, and batteries)

85. The latter situation may be hard to document but does need consideration because it is often a primary driver for government mandated EPR programs. Waste electronics have been found to leach lead when disposed of in landfills and this becomes a potential issue for both unengineered and engineered sites and represents a landfill site management cost and possibly a site remediation cost.

86. In the case of EPR programmes addressing certain categories of industrial wastes, the previous system of waste management might have been different. It will be necessary to document how wastes had previously been managed, and to try to obtain estimates for the various elements of the costs concerned.

This may require a survey of individual firms, both to identify how wastes were in practice handled prior to EPR, and to obtain cost information.

(2) A comparison of EPR and possible alternatives

87. The second question compares different ways of achieving similar outcomes. If the instrument comparison can be defined in such a way that the two instruments have equivalent environmental impact (*e.g.* both achieve the same effect on the percentage of recycling), then the assessment can be considerably simplified. Essentially, it becomes a comparison of the costs of achieving the same outcome through alternative routes. Assessing the social value of the outcome itself can be side-stepped, and it may therefore be possible to avoid some of the more difficult questions in evaluation, such as assessing the social benefits from changes in the pattern of waste management.

88. However, while this may be an attractive advantage of an assessment based on instrument comparison, it has two major drawbacks. One is that it does not answer the question as to whether either policy is worth doing, in the sense of having social benefits in excess of its costs. The status quo might have been preferable to either. The second major drawback is that, for the instrument comparison to work we should be able to describe the consequences of using the alternative instrument with reasonable precision. Unfortunately, in many cases we know as little about the effects of the alternatives to EPR as we do about the effects of EPR itself.

(3) A comparison of the actual EPR programme with a modified alternative

89. The third question focuses attention on the effects of possible changes in the EPR programme: would changes improve or worsen its performance? These could be changes in the overall "strength" of the policy (such as a change in the recycling rate required), or changes of detail (such as changes in the structure of financial contributions to the PRO). Here the focus is on the marginal benefits achieved by modifications, rather than on the overall benefit. Such an evaluation is probably the most policy-focussed approach, in the sense that it is likely to yield an agenda of possible policy improvements that could be implemented. However, it is unlikely to be a complete substitute for an assessment of the overall balance between costs and benefits of EPR, and is perhaps more usefully seen as a complement to such an assessment.

4.2 Identifying and measuring costs and benefits

90. The key categories of costs and environmental benefits involved in EPR will vary depending on the precise features of the programme, and on the questions which the assessment aims to address. However, in the case of a "typical" EPR programme, to be assessed against a "business-as-usual" baseline involving conventional municipal collection and treatment of wastes, the costs and benefits can be grouped into three categories: (1) operation costs (including investment costs, running costs, and after-care costs); (2) environmental benefits, in terms of reduced externalities; and (3) side effects.

(1) Operation costs

91. A common feature of most EPR programmes – and, arguably, a defining characteristic of EPR, is a separate collection system to handle source separated recyclables. This mechanism for collecting end-of-life products or the other wastes covered by the programme, can be run by a PRO, in some cases by individual firms, or in others by a municipality which receives payment from a PRO for acting as its collection agent.. This mechanism involves direct costs, incurred by the PRO or by firms, of collecting and "treating" the waste (*i.e.* costs of disposal or recycling). There may also be counterpart savings, in terms of reduced collection and disposal costs borne by municipalities.

92. The net effect may be zero, if the costs per tonne collected and treated are the same in the two systems, and if the impact of EPR is simply to divert waste from the municipal-run system to the PRO-run system. On the other hand, unit costs may differ between the two systems, either because the duplication of waste collection systems involves a higher cost per unit collected, or because the cost per tonne of waste disposal through the routes that the PRO is required to use is higher than the cost per tonne of the disposal through the municipal system (typically EPR programmes require high rates of recycling, which may be more costly to the operator than landfilling or incineration). In addition, one of the intended effects of EPR is that it encourages producers to consider the waste management implications of their products. So, if EPR works as intended, it may not simply divert some waste away from the municipal system, but may also reduce the total volume of wastes, compared with a situation without EPR.

93. These cost impacts, many of which can be directly estimated from the budgets of municipal waste management agencies and the accounts of the PRO, are discussed in more detail in a number of sections below – especially Sections 4.4 (waste disposal costs) and 4.7 (collection costs). Section 4.8 considers whether EPR imposes significant costs on households (*e.g.* of sorting different waste streams) that should be included in the calculation.

(2) Environmental benefits, in terms of reduced externalities

94. EPR programmes typically lead to significant changes in the volume of waste disposal in landfills and incinerators. This may be simply because most programmes impose requirements for much more recycling than in conventional municipal waste management, or because, once separately-collected, recycling may be the cheapest disposal option. However, the changes in waste disposal costs may also reflect the design-for-environment incentive effects of EPR, leading manufacturers to design and market products which will lead to less waste, or to more easily-recycled wastes. The environmental benefits of these EPR-induced changes in waste streams are the second major element to be included in any assessment of the costs and benefits of EPR.[13]

95. Subsequent sections discuss the two main categories of environmental externality involved. Section 4.4, on waste disposal costs, takes the broad definition of these costs that is appropriate in considering waste management, including not only the direct expenditures on waste disposal through landfilling or incineration, but also the external costs associated with these activities, including the environmental and health effects and risks. Methods for quantification of such externalities are now well-refined, and there are well-documented methodologies, and many existing results, on which EPR evaluations can draw. Section 4.5 describes the externalities arising from the substitution of recycled materials in place of virgin materials, and discusses how these might be quantified. In both cases, measurement is more difficult than for the direct collection and "private" waste treatment costs under heading (1). External costs and benefits are, by their nature, things for which transaction prices are not generally available. However, there are now well-established techniques available for quantifying these costs and benefits, and a substantial body of evidence on the external costs involved in waste management.

(3) Side effects

96. The third group of costs and benefits are described – for want of a better term – as "side effects". These include a range of effects felt in areas other than the direct costs and externalities relating to waste streams. One key set of issues, discussed in Section 4.9, concerns the impact of EPR programmes on the pattern of product-market competition between firms. These may include effects on the relative market position of large and small firms, on the possibility of new entry, and on import competition. There may

[13] These externalities are the main focus of the analysis in Sturges (2003).

also be effects on other areas of policy besides the achievement of the socially-optimal pattern of waste management (Section 4.10).

97. Typically, these side effects will be much more difficult to quantify than elements (1) and (2) above. Normally the best approach will be to document the side effects, and to calculate the net cost, or net benefit of the EPR programme, disregarding the side effects. The question may then be posed whether the side effects are felt to be large or small relative to the quantified net benefits of the EPR programme.

4.3 The basic structure of the evaluation approach

98. The evaluation approach thus requires as its first stage a fundamental decision about the nature of the comparison that the evaluation will make. What is the "counterfactual" (*i.e.* the baseline for comparison) against which the costs and benefits will be calculated? Should the evaluation compare EPR with the previous system of waste management (*i.e.* with a "do nothing" counterfactual), or with an alternative policy that would achieve the same outcome, or with EPR, but modified in different respects?

99. The choice between these three options will need to reflect the purpose for which the evaluation is being undertaken. If, for example, the evaluation of an EPR programme for a particular product is intended to inform a decision as to whether extending EPR to other products would have environmental gains greater than the costs of operation, then a comparison with a do-nothing counterfactual may be the most informative approach.

100. The basis of the comparison being made will also have a large impact on the costs and benefits that will need to be included in the evaluation. Typically, for example, a comparison of EPR against an alternative policy instrument which could achieve the same environmental outcome will tend to focus on the comparative operating costs of the two alternatives, and will not need to include any element for the environmental benefits achieved by either programme, since these are the same on both sides of the comparison. On the other hand, in comparing EPR against a do-nothing alternative, a major element in the comparison is likely to be the reduction in environmental damage and risks.

101. Sometimes only one type of comparison may be practicable. For example, if the purpose of the EPR programme is to eliminate an unquantifiable major risk of future environmental catastrophe, then it will be difficult to evaluate EPR against a do-nothing baseline (since the risk here is assumed to be unquantifiable, the benefits of EPR in terms of reduced risks also cannot be quantified). On the other hand it might be practicable to compare EPR with an alternative instrument achieving the same effect on the environmental risk. In many cases, however, comparing EPR with an alternative instrument having similar effects will be difficult, because we may have little or no evidence on which to assess the operating costs and other effects of the alternative instrument. Comparison with a "do nothing" has the major advantage that we can look to historical data as the basis for comparing costs and benefits.

102. The second stage in the evaluation approach is to identify all the relevant costs and benefits to be included. In principle, this should include all costs or benefits that might differ between the EPR scenario and the counterfactual baseline. As noted above, this will vary, depending on the counterfactual which is chosen.

103. The third stage of the evaluation involves quantification of each of the elements identified. Sections 4.3 to 4.10 below discuss the quantification of what are likely to be key elements in many evaluations of EPR programmes. Quantification of some elements may be straightforward, because the necessary data is readily available. Other elements may be more difficult, and costly, to research. In practice, the researcher will need to focus their efforts on what are likely to be the largest elements of costs and benefits, and this will require careful judgement. For example, where the nature of the EPR

arrangements in a particular case seem unlikely to impose any significant costs on households, it would be unnecessary to devote resources to researching the scale of costs borne by households. A different judgement might be appropriate, however, in evaluating a badly-designed EPR programme, which imposed onerous obligations on households to clean, separate and transport wastes.

104. In the case of some effects, quantification is very likely to be difficult, imprecise, or costly. As discussed in Sections 4.8 to 4.10 below, this is very likely to be the case with the impact on DfE innovation, the impact on competition, and in the case of some side effects. Where important elements cannot be quantified, they must not be ignored, but should be clearly identified, and their likely significance discussed. Users of the evaluation will need to be able to judge whether the net effect of the quantified elements is likely to be larger or smaller than the unknown impact of the unquantified elements.

105. The final stage of the evaluation is to draw together the various components to assess the net social benefit of the EPR programme, as measured against the specified alternative. This will be straightforward where all major elements of cost and benefits have been quantified. More commonly, as noted above, some important elements will remain unquantified. Users will need to judge whether the net quantified benefit is likely to be outweighed by the unquantified elements. For example, where the sum total of the quantifiable costs and benefits of an EPR programme is a net annual benefit of $50,000, but certain unquantifiable negative effects on competition are observed, the user will need to judge whether these adverse effects on competition are likely to be sufficiently large as to outweigh the $50,000 positive annual balance on the quantifiable elements.

106. To clarify further the nature of the assessment described above, Box 5 provides a brief outline sketch of how the method might be applied to a hypothetical, simplified, EPR programme.[14] The hypothetical analysis takes into account a limited number of points for consideration and is included to provide an example on how the framework could be applied. The programme is assumed to take the form of an industry-run EPR, required to meet a specified target for collection of the firms' products, and required to recycle all of the material collected. It is assumed (to simplify the description) that prior to the EPR programme all of the municipally-collected waste was channelled to one disposal route, landfilling. The main elements in the calculation of the total net social benefit of the EPR programme are listed, using wholly illustrative numbers. Possible side effects are not quantified. If any side effects were encountered, these could be compared with the calculated total net social benefit, to assess whether they were likely to be large enough to reverse the direction of the result.

[14] The outline suggested follows similar lines to the analyses in Radetzki (2000) and Porter (2002) Chapter 9.

Box 5. Hypothetical cost-benefit analysis of a simple EPR programme

The purpose of this box is to illustrate how the framework for evaluation of EPR might be applied to a simple, hypothetical EPR programme. The illustration is stylised and simplified, to highlight the basic structure of the evaluation method, and omits many elements that would naturally be included in any serious attempt at evaluation of a real-world EPR programme. The numbers are wholly illustrative and would not be applicable to any specific EPR programme as such.

Details of the assumed programme:

Producers in industry M are required to operate a collective PRO which collects its end-of-life products and recycles at least 80% of the collected tonnage. The annual weight of products collected by the PRO is assumed to be 1000 tonnes, and the recycling target is precisely met. Pre-existing waste is assumed to be 100% landfilled, and the PRO is assumed to landfill that part of its collection which is not recycled.

Main elements in net social benefit of the EPR programme:

Saving in municipal collection and disposal costs (waste collected by PRO reduces waste quantities collected by existing municipal waste management, and reduces the costs that have to be paid for landfill disposal of this waste).

If the reduction is 1000 tonnes, the collection cost saving is $100 per tonne, and the disposal cost saving is $20 per tonne, the total saving in municipal collection and disposal costs would be $120,000.

plus

Reduced landfill external costs (*e.g.* reduction in local disamenity, environmental costs of methane emissions, and future risks of environmental hazard). Assume this is valued in total at $40 per tonne.

Reduced landfill tonnage is 800 (1000 in counterfactual minus 200 landfilling by PRO), and total saving in landfill externalities is thus $32,000.

plus

Reduced external costs of virgin materials production.

If the 800 tonnes additional recycling per annum substitutes for exactly the same weight of virgin material, and if virgin materials production has an external cost of $20 per tonne, the EPR programme reduces these costs by $16,000.

minus

Cost of operating the PRO

Administration costs, plus collection costs, similar in nature to those involved in existing municipal waste management, are shown by the PRO's accounts to be $110,000.

minus

Cost to the PRO of recycling collected materials, and of any landfill disposal of non-recycled materials. *The PRO has to subsidise recycling costs by $5 per tonne, and pays $20 per tonne for landfilling non-recycled material. Total costs 5 x 800 plus 20 x 200 = $8,000.*

gives

Total annual net social benefit of the EPR programme equal to $50,000 (accounting for both changes in private and social costs)

Features of this hypothetical analysis:

1. What comparison is being made?

EPR is being compared to a "do-nothing" scenario. This analysis does not show whether the aims of policy could be achieved more cheaply with a different instrument.

2. What is the "counterfactual" (evaluation baseline) against which costs and benefits are calculated?

In this example the counterfactual (what would have happened in the absence of the policy) is very straightforward - it is assumed that all waste would have been landfilled. In more complicated cases it may be necessary to allow for the possibility that some change in landfilling or recycling would have occurred even without the policy, and to measure the effects of policy against a hypothetical baseline in which these changes are assumed to have taken place.

3. If the EPR programme also was judged to have adverse effects on competition, how would these be handled in the analysis?

If (as will usually be the case) these effects cannot be quantified, they should be discussed in the report in sufficient detail that the user of the results can try to form a judgment as to whether their likely scale is likely to overturn the net annual social benefit of $50,000.

4.4 The social costs of waste disposal

107. A considerable amount of quantitative research has already been undertaken for a number of OECD countries on the social costs of waste disposal to landfill and through incineration, and further work is currently being undertaken within OECD to refine these estimates. Where research of this sort is available for the country where the EPR programme is being studied, the estimates of social costs of waste disposal provide an important input to the cost-benefit evaluation of the EPR programme, in that they indicate the costs that would otherwise be incurred in managing the wastes handled through the EPR programme. Alternatives such as routine "municipal" landfilling or incineration involve both financial costs (of transport and disposal) and non-monetary social costs such as health damage, disamenity and long-term risks of environmental contamination. If, without the EPR programme, these alternatives would otherwise have been employed, the monetary and non-monetary costs thereby avoided would count as part of the benefit of EPR.

108. To clarify and illustrate the nature of the costs involved, Table 4.1 summarises estimates for five OECD countries, drawn from Porter (2002). The glossary at the back of this report may also be useful in clarifying the terms employed in this discussion. It is not intended that the particular figures in Table 1 should be employed in any, or all, evaluation studies, and it will be important for the evaluation researchers to identify the most appropriate and up-to-date estimates for the country and for the particular EPR programme concerned.

109. The total social costs reported by Porter consist of three elements:

- ***private cost***. The main elements of private cost are the financial costs incurred in operating landfill sites and incinerators (either incurred directly by municipalities, or paid through disposal fees to separate site operators). Where landfill sites are privately-owned and operated, these costs would be expected to include the user costs of consuming scarce landfill capacity - in other words, the price paid for dumping waste in a landfill will include an element to reflect the future scarcity of landfill capacity. Where landfill sites are not operated on a commercial basis, some

upward adjustment to the private costs of landfill may be appropriate to reflect the consumption of scarce landfill capacity.[15]

- ***external costs***. These include valuations of the marginal external damage, in terms of polluting emissions, disamenity to local residents, etc, caused by landfills and incinerators. Various different approaches have been used to value these external costs (Box 6), and there is an extensive literature on both valuation methods and results. Where research will be needed to estimate these cost items, OECD (1997) provides a source of detailed guidance on the methods that can be employed.
- ***energy recovery***. Some landfill sites and incinerators can be used to produce energy, as a by-product of their waste disposal function. The commercial value of this energy should be reflected in the estimate of private costs (and may act to reduce the fees charged by the site operator for landfill disposal or incineration of wastes). In addition, however, any energy produced by incinerators or landfills substitutes for the use of (mainly carbon-based) fuels, and landfill and incineration with energy recovery can thus be credited with the emissions that are avoided by reducing carbon-based fuel use.

Table 1. Private cost, external cost and energy gain per ton of waste from landfilling and incineration in five OECD countries

1997 US dollars per ton

	Private cost	External cost	Energy gain	Total cost
Germany				
Landfill	51	3-15	not estimated	53-66
Incineration	104-192	5-14	58-106	52-100
Sweden				
Landfill	16-24	3-15	not estimated	19-39
Incineration	57-65	7-15	35-42	29-37
United Kingdom				
Landfill	8-51	3-15	not estimated	11-66
Incineration	84-96	24-33	63-77	46-62
USA				
Landfill	15-57	3-15	not estimated	18-72
Incineration	69-137	11-20	49-66	31-91
Netherlands				
Landfill	49	36	13	74
Incineration	155	56	57	153

Source: Richard C. Porter (2002) *The Economics of Waste.* Washington DC: Resources for the Future. Table 5.2.

110. It will be noted that in many cases, EPR programmes have been introduced to handle components of the waste stream that are particularly costly in terms of health or environmental damage, or long-term contamination risks. In these cases, using average figures for the external costs per tonne of municipal waste disposal may be liable to significantly understate the costs and risks associated with the non-EPR waste management regime. The environmental costs of mixing toxic items in with the general waste stream may be very much higher than the cost of a similar quantity of average waste, and in evaluating EPR programmes that are directed at the safe management of particularly toxic components of the waste stream, special estimates will be required for the external costs avoided as a result of the separation and appropriate waste management for these items.

[15] Whether any significant adjustment should be made to reflect future landfill scarcity may depend greatly on the country in question. In some countries, landfill scarcity may be a growing issue, but it other countries there may be plenty of future landfill capacity available, and no scarcity premium should be included in the analysis.

Box 6. Estimating the external costs of landfill sites and incinerators

A number of different methods can be used to estimate the external costs (such as perceived health risks, odour, traffic and other disamenity costs, etc) of landfill sites or incinerators:

- ***Contingent valuation***. Local residents and others who may be affected by the site are asked to assess how much they would be willing to pay to avoid the landfill, or how much compensation they would need to be willing to accept its presence.
- ***Hedonic pricing***. The external costs are inferred from the effects of the sites on the market prices of neighbouring properties.
- ***Bottom-up methods.*** Based on estimates of the health effects, contamination costs, etc.

4.5 The external costs of virgin materials extraction and processing

111. What is the social benefit of reducing the level of use of virgin materials, through making greater use of recycled materials? In a well-functioning market economy, raw materials prices should reflect current and future materials scarcity, and the commercial decision whether to use virgin material or recycled material will therefore be based on prices reflecting the social cost of depleting the stock of non-renewable raw materials. The case for policy action to reduce the use of virgin materials, and to encourage greater recycling, rests not on its impact on the depletion of the non-renewable materials stock, but on various externalities and other market failures involved in the production of virgin materials and in the production of recycled substitutes. Since most EPR programmes are designed to achieve large increases in the rate of recycling, values reflecting these externalities and other market failures need to be included in the assessment of the costs and environmental effects of EPR programmes.

112. The external costs of the production of raw materials may include noise, disamenity and air and water pollution experienced by local residents near mines and processing facilities. Mines or quarries may also leave longer-lasting problems of groundwater contamination, physical safety (*e.g.* to children), subsidence damage to buildings and public infrastructure, etc. Likewise, some processing sites may leave a long-lasting legacy of land contamination. While it may be possible for some of these costs to be charged to the original mine operator, other costs may extend beyond the point at which this is practicable. In some cases, particularly where the costs arise well after the mine has closed, it may be difficult the recover the costs because the mining operator may have ceased trading, or may have assets less then the value of the damage.

113. Raw materials production frequently involves substantial energy inputs, and these give rise to significant externalities which extend further in geographical scope, including international externalities such as acid rain, and global climate-change externalities.

114. In the case of all of the above externalities, the values that should be reflected in the assessment of costs and benefits of EPR will need to take account of the extent to which other policy measures are already applied. If, for example, energy were already priced on a basis which fully reflects the external costs of energy consumption (through a carbon tax and other appropriate pricing adjustments, to reflect the social costs of energy use), then there would be no divergence between the social and private costs of the energy used in raw materials extraction and processing, and therefore no need to include an element for these uncharged external costs in the assessment of EPR. Similarly, policies to ensure that businesses are held liable for the future costs of land contamination will internalise these costs into business decisions, and hence into the commercial pricing of raw materials; reducing the external costs that have to be

included in the EPR assessment. The same will, to an extent, be true where "command-and-control" regulations are employed to restrict externalities generated by mining and processing operations, although such regulations may have less impact on marginal costs, and hence on raw materials prices, than optimally-set externality taxes and liability regulations.

115. No doubt mines and processing plants differ from one another in terms of the level of external damage that they cause. Those located close to centres of population, or built and operated with less concern for the impact on local residents, may generate higher than average external costs per unit produced. In assessing the external costs of raw materials extraction and processing to be included in an assessment of costs and benefits of EPR, it will in principle be the external costs associated with the marginal sources of supply that are relevant, not the average external cost. (In other words, the externalities should be those associated with the virgin materials supply that is displaced when more use is made of recycled materials). In practice, in the absence of information about the characteristics of the marginal supply, it will often be necessary to assume that average and marginal externalities are similar.

116. Frequently the supply of raw materials will be abroad, and most of the externalities (apart from the international and global energy-use externalities) will be experienced in the countries of extraction and of processing, not in the country of consumption and waste disposal. This raises two questions. The first is whether, in an analysis of costs and benefits of policy in a particular consuming country the external costs experienced abroad should be given any weighting at all. Are environmental costs incurred abroad of concern to policy-makers and the public, and if so, should they be weighted equally with similar domestic externalities? A second question concerns the extent to which the valuations should reflect local conditions and, especially, local standards of living, in the country where the damage occurs. Typically, valuations for environmental damage, like valuations for any other good, should be derived from the satisfaction or dissatisfaction they give to the individuals who experience them, and this will vary depending on the individuals' incomes. Nevertheless, the implications of this line of argument – that pollution matters less if it occurs in poorer countries – have been controversial, and some have suggested that the valuation of pollution damage caused in poorer countries should be raised to reflect considerations of equity.

117. In addition to the external costs involved in raw materials extraction and processing, there will also be external costs incurred in the recovery of materials through recycling, and these need to be valued appropriately, and included in the assessment of overall costs and benefits of EPR. The collection and transport of waste for recycling uses motor fuel, and may contribute to transport congestion (although the issue will be whether it generates more of these costs than municipal collection for landfill disposal or incineration). Recycling collection facilities such as bottle banks may cause noise and nuisance for local residents, and if the noise and nuisance of waste disposal is included in the assessment, then so should these costs. Furthermore, there may be substantial pollution and energy-use externalities associated with recycling. In particular, reprocessing of glass, paper and metals can involve significant energy requirements, although these are lower than those involved in processing virgin materials and in the case of aluminium are substantially lower.[16] All of these costs clearly need to be included in the EPR assessment.

118. A valuable source of data on the resource inputs to production processes, and the environmental implications of the production of these resource inputs, is the growing number of "Life Cycle Analyses" of

[16] However, a greater proportion of the external costs of recycling will tend to be incurred domestically, in the country whose EPR programme is being studied, than is the case with the external costs of raw materials extraction and processing, both because of the costs of international transport of recyclables, and because of the increasing stringency of international measures to restrict international movements of waste. Consequently, in an EPR evaluation which focuses only on the national costs and benefits of the programme, and gives a reduced or zero weight to effects in other countries, the external costs of recycling activities may be a more prominent item than the external costs of virgin materials extraction and processing.

product design and waste management options (Box 7). Such analyses provide a description of the physical flows of resources and environmental effects involved in the complex chain of production of particular commodities. They are especially suited to analysing the consequences of product re-use and recycling, as compared with "one-way" or "disposable" alternatives. Many LCA studies report the data for individual elements of the analysis, and this data may then be used as a starting point, in conjunction with appropriate resource and environmental valuations, for an assessment of the social value (cost or benefit) of these effects.

Box 7. Life cycle analysis

Life Cycle Analysis (LCA) provides a systematic account of the resources used and environmental impact in the course of production, consumption and post-consumption disposal of a product. LCA is frequently used to compare the resource and environmental effects of alternative strategies offering equivalent "functionality" (*e.g.* different products that can be used for the same purpose, such as soft drink cans versus bottles, or recycled versus virgin paper).

The key feature of LCA is its emphasis on the whole product life-cycle. LCA thus includes three main categories of resource use and environmental impact:

- ***resource and environmental impacts of production***, including both direct and indirect resource inputs to the production process. The concept here is similar to that of input-output analysis, in which the production of a commodity can be traded back to include the production of the various physical inputs (materials and components) used in its manufacture.
- ***resource and environmental impacts of consumption***, such as the energy used to run domestic electrical appliances, and the polluting emissions associated with the generation and use of that energy.
- ***resource and environmental impacts of post-consumer waste management***. Where energy or materials of value are recovered at this stage, this can be deducted from the energy and materials used in production.

A common feature of LCA studies is the intention to produce a thorough and comprehensive inventory of the use of physical resources. Standardised "good practice" methodologies for this inventory include the recommendations developed by the Society of Environmental Toxicology and Chemistry (SETAC) and by the International Organisation for Standardization in ISO 14040. Despite the development of these standard methodologies (which have the clear advantage of achieving a good degree of consistency and therefore comparability across different studies) there remain a number of difficult methodological issues. A key issue is how to aggregate or weight of the different resource and environmental effects. In some cases, there may be some straightforward scientific basis for aggregation (such as the weighting of different greenhouse gases by their global warming potential), but in other cases there is less consensus about weighting. Recognising this, many studies report data for the different individual effects.

LCA analyses of product design or waste management options can provide valuable quantitative data on the full life-cycle resource requirements and polluting emissions of alternative products or alternative approaches to waste management, which can be used as inputs to an analysis of the costs and benefits of EPR programmes.

The two key steps taken in cost-benefit analysis, which go beyond the scope of LCA are:

- ***Weight the various resource and environmental effects***. The valuation of environmental effects which CBA employs provides a way of translating physical quantities (of resources and emissions) into a single set of values that are directly comparable, and can be added up to assess the overall effect of each option on the underlying objectives of policy - the effect on the living standards of the population.
- ***Include other elements of cost and benefits.*** The objective of life-cycle waste minimisation, or resource use minimisation, cannot be adopted as the goal of policy, regardless of cost. Different waste management options may have different costs as well as environmental effects, and this needs to be brought together an assessed in a consistent and comprehensive framework.

A review of life-cycle analyses of waste management options is provided by Denison (1996). Further detail on life cycle analyses can be found on the websites of SETAC, the European Environment Agency, the US EPA, etc.

4.6 Collection costs

119. A common feature of EPR policies is that producers are involved in providing, financing or managing a separate, collection mechanism for certain categories of waste. This may take a number of forms, such as

- a house-to-house "kerbside" collection;
- a "***bring system"*** where households are required to take certain categories of waste to collection facilities such as kerbside containers for recyclable glass or a special depot for refrigerators;
- a ***retailer-collection*** system, where retailers take back such items as packaging, used product containers, or end-of-life products.

120. In some cases, these arrangements are run by individual firms, recovering and managing their "own" wastes. In other cases, collection may be handled by a Producer Responsibility Organisation (PRO), covering a group of firms, or run by an industry organisation. *If* these mechanisms are run in parallel with existing municipal garbage collection services, there is an element of duplication. The municipal waste collection arrangements could, in principle, collect the wastes covered by the EPR programme, and prior to the EPR programme will usually have done so. The EPR programme diverts these wastes into another collection arrangement, either by banning such wastes from the normal municipal collection, or by encouraging households to channel their wastes into the appropriate separate waste systems. Deposit-refund programmes may be used to encourage households to return waste items to collection points.

121. The second system of collection and waste management and the diversion of wastes away from the existing system will have implications for the overall costs of waste collection and management. On the one hand, the PRO will incur costs of waste collection and subsequent waste management. On the other hand, the diversion of wastes away from the municipal system should reduce the costs of operating this system. The net effects of these two opposing effects should be included in the overall assessment of the costs of EPR.

122. How much impact will establishing the new EPR collection programme have on the costs of waste collection? This is a matter that will need to be determined on the basis of the precise collection arrangements for the EPR programme being studied. However, it may be useful to define two extreme positions:

- ***If the costs of a collection system are entirely per-household costs***, and unrelated to waste volumes, then adding a second collection channel in parallel to the municipal system will, as it were, "double" the costs. More precisely, the net effect on collection costs would be given by the costs of operating the PRO-run programme; there would be no offset in terms of reduced costs for the municipal system.
- On the other hand, ***if the costs of collection are directly proportional to volumes***, with no fixed element, the costs of the PRO programme would be exactly matched by a reduction in costs of the municipal system (assuming no difference in efficiency between the two programmes). The net effect on collection costs would then be zero.

123. Which position is likely to be closest to the actual position? In theory, as, Porter (2002) argues, there are likely to be good reasons for the outcome to be closer to the second case than the first, because the costs of waste collection will depend on the ***frequency*** of collection. If the municipal system had previously made collections from households twice a week, and EPR halved the volume of waste going to

the municipal system, the collection frequency could be halved too,[17] reducing collections to one per week, and all other aspects of the collection would remain the same. Each trip by the garbage truck would cover the same number of houses, in the same time and collect the same amount of waste on average from each house, as before (Porter, 2002, page 136). Since most of the costs of municipal collections are likely to be related to these factors and unit costs are unlikely to be greatly affected by the number of garbage trucks being run. (If there were large economies of scale, these could be attained by co-operative arrangements between municipalities, or by subcontracting waste collection to firms operating at the efficient scale.)

Box 8. What are the additional costs of duplicating waste collection systems, by having PRO-run collections operate alongside municipal collection systems?

- The additional costs of waste collection could be zero, if the costs of the PRO collection are exactly offset by savings in municipal collection and disposal costs. This would be the case if the frequency of the municipal collection can be adjusted so that the same average quantity of waste is collected from each household visit as before.
- The additional costs will be larger if there are fixed cost elements in waste collection. If collection frequencies are left unchanged, the municipal system will collect less waste from each household visit. The total costs of the municipal system might be the same as before (and the cost per tonne of waste collected will rise). There will be no municipal collection-cost savings to offset the costs of the PRO-run collection.

124. So the key question is whether changing collection frequency has any cost implications. It seems likely that any cost effects from reduced frequency would be largely borne by households, rather than by waste collectors. Less-frequent collection may require household wastes to be stored for longer. There is a cost to households of the use of this additional space for storage, and there are also costs (in terms of smell, health risks, risks of vermin, etc) if food wastes have to be stored for longer periods. The inconvenience of infrequent collection might induce some households to try to dispose of wastes in other, less socially-desirable, ways, such as in public litter bins, or through dumping in the open environment. Some of these cost items may be difficult to measure.

125. However, the elements in the costs of two collection systems are in principle straightforward to measure:

- municipal accounts, or the tender price for subcontracting waste collection, provide a straightforward measure of the cost of municipal collection, and the impact of EPR on municipal collection costs can be assessed from a before-and-after comparison of these costs.
- the accounts of the PRO can provide data on the costs of the PRO-run collection.

126. It may well be more difficult to assess the costs of collection, where EPR is implemented through take-back by individual firms. It is conceivable that individual firms may have this data, but may be unwilling to release it, because of its potential commercial value to their competitors. In other cases, where the collection operation is integrated with other aspects of the business, it may be difficult to disentangle costs of collection from other costs of business activity. (For example, where a carpet firm supplying carpets direct to households implements take-back by requiring its installers to collect and return old carpets, the costs of this may be fully-integrated with the costs of running the installation business, and it may not be practicable to attribute costs reliably between collection and other aspects of the business.)

[17] As noted below, this will not always be practicable, due to hygienic considerations, etc.

Box 9. Specific versus collective deposit-refund

Common-return deposit-refund (bottles of standard design, accepted back by all sellers)

- Can lead to high rates of return
- No sorting costs for sellers, so low cost per bottle returned
- Limitations on bottle design may exclude importers, and inhibit product innovation
- Some sellers may act as return agents for other sellers' bottles, and programme payments to sellers need to reflect seller costs of operating the programme. (*e.g.* consumers may buy beer in bulk in supermarket, but return bottles to local convenience stores)

Collective differentiated deposit-refund (sellers accept all bottles, but bottles are of different designs and must be returned to original supplier)

- High sorting, storage and return costs for sellers
- Low inconvenience costs for consumers
- No disadvantage to small-volume suppliers, importers, etc. But sellers may be reluctant to collect some types of bottle (*e.g.* may discard inconvenient bottles), so collective programme may be hard to enforce.
- Return imbalances problem even greater than with common-return system. Full compensation for collecting other sellers' bottles would require different payments per bottle from different manufacturers - difficult to ensure that these charges are adequate but non-discriminatory.

Specific deposit-refund (sellers take back only the bottles, or brands, they have sold)

- High inconvenience costs for consumers, who must return bottles to original seller (or another selling same brand)
- Due to high inconvenience costs to consumers, return rates may be lower than with collective programmes
- Costs of operation lower than collective system with differentiated bottles. Cost per bottle returned may be similar to common-return collective system
- Risk of unequal impact on firms with different market share - large firms may gain competitive advantage, and new entrants and low-volume importers disadvantaged.

127. There are also potentially important cost items in sorting collected waste. Door-to-door recycling collections frequently collect a variety of recyclables in each visit, and these are then sorted. Typically these costs will be borne by the PRO in an EPR programme. The PRO may also separate different grades of the same recyclable material, in order to achieve higher prices from reselling these materials to recyclers. In other cases, recyclers may pay less for the materials and undertake the sorting themselves.

128. Sorting costs can be particularly significant where EPR programme involves the return of each manufacturer's products to that manufacturer. An example of this is in the various possible types of deposit-refund programme that might be envisaged for glass bottles (see Box 9). If bottles are of a standardised design, collection arrangements within a deposit-refund programme may be considerably cheaper, but there may be issues about how the different cost burdens on retailers should be shared. One problem, for example, is that households might use local convenience stores to return bottles, but may make their purchases in bulk from more distant, but cheaper, supermarkets. In these circumstances, it cannot be assumed that retailers will bear costs of collection in proportion to their profits from the original sale of the product.

4.7 Household time and other household costs

129. The EPR programmes introduced in different countries vary widely in terms of their impact on individuals and households. Some have very little effect on the actions that households are required to take, compared with “conventional” municipal waste collection and disposal, and therefore the issue of costs or benefits experienced by households does not really arise. Others programmes may deliver benefits to

households. An example is an EPR programme in the US, under which carpet fitters are required to collect the old carpet from the household when they fit the new one. If previously some householders had had to make their own arrangements to dispose of the old carpet, the EPR programme may save them both time and trouble, and these benefits to households should, in principle, be included in the cost-benefit analysis. On the other hand, some EPR programmes may impose obligations on households that might involve costs in terms of money, time or inconvenience, although careful design of the EPR arrangements may help to limit such costs. For example, some programmes require households to separate and clean wastes, and households may also incur costs of storage, and costs of transport to "bring-system" collection facilities. How far should these costs be reflected in assessments of the overall costs of the EPR programme concerned, and how should they be assessed?

130. In principle, both monetary and non-monetary costs incurred by households should be included in any assessment of the total social cost of policy measures. Although costs incurred by industry and by government bodies typically involve money expenditures, there is no reason to confine the estimate of household costs to those involving money expenditures (such as motor fuel to transport wastes to collection points). Other effects on households, such as the use of time, may reduce household welfare, and where this is so, should be appropriately valued and included in the overall estimate of costs. The fact that unpaid household work is not included in national accounts statistics such as GDP is no reason for it to be ignored in an assessment of the effects on household welfare, any more than a cost-benefit analysis should ignore the value of environmental externalities (which are also omitted from GDP).

131. However, household time and household direct expenditures on cleaning, sorting and transporting waste products should not be included in an assessment of the overall costs and benefits of EPR, where households undertake these actions on a voluntary basis. Where household costs are incurred voluntarily, the inference might be drawn that the household experiences counterpart benefits, in the form of satisfaction – or a "warm glow" – from their environmentally-responsible behaviour, that that are at least as large as any costs incurred. If this view is taken, then the costs incurred voluntarily by households should be omitted, so long as the "warm glow" benefits too are omitted. The implication is that, in the case of an EPR programme where households voluntarily choose to participate (and where they can, instead, choose to discard their waste in other ways), there is no need to include any estimate of household costs in the cost-benefit analysis of the programme.

Box 10. Motives for sorting waste

I sort partly because...	Percentage of respondents who "agree" or "partly agree"
...I perceive it as a requirement imposed by the authorities	63
...it is a pleasant activity in itself	38
...I want to contribute to a better environment	97
...I want to think of myself as a responsible person	73
...I should do what I want others to do	88
...I want others to think of me as a responsible person	41

Source: Bruvoll, Annegrete, Bente Halvorsen and Karine Nyborg (2002), "Households' recycling efforts", *Resources, Conservation and Recycling*, 36: 337-354, Table 3.

132. On the other hand, there is a case for including at least some measure of household costs, where households do not incur these costs voluntarily. Where households are compelled by law to separate their wastes, or are required to transport their wastes to inconveniently-located collection facilities, some, at least, may perceive this as an onerous task, from which they gain no corresponding "warm glow". Others may be happy to do this without compulsion, and may perceive no cost. It is then a matter, in principle, for research to determine what proportion of the population perceive the programme as imposing onerous requirements, and how large the perceived costs of the programme are to these individuals. The only

household costs that should be included in the analysis are those borne by households who would not act in the absence of compulsion.

133. A careful study of this issue by Bruvoll, Halvorsen and Nyborg (2002), who use survey data for a sample of households in Norway, shows the importance of recognising that some households do not perceive the obligations on them as significantly costly, even in a compulsory programme requiring a considerable amount of work to be undertaken by households in sorting, cleaning and transporting wastes. Their data (Box 10) show that households differed in their motivations for waste separation activities, with some two-thirds perceiving it as a requirement imposed by the authorities. Even in this case, however, nearly all respondents identified public benefits from their actions as part of their motivation.

134. It is clear from the analysis of household costs by Bruvoll, Halvorsen and Nyborg ((2002), summarised in Box 11) that on average households do not regard these obligations as very costly, despite the amount of time and other costs involved in performing them. Box 11 shows that the average time cost involved in cleaning, sorting and transporting waste for recycling in Norway was some 41 hours per household per year. In addition, there were some (relatively small) expenditures on energy for cleaning and transporting waste. In other contexts, a cost benefit analysis might value the time costs involved by the average marginal hourly wage (reflecting the opportunity cost of the time used), but it is clear that in this case this would greatly over-estimate the costs perceived by the households. When the researchers asked about households' willingness-to-pay to leave waste cleaning and sorting activities to others, the average willingness-to-pay was only $20 (for 41 hours of unpaid work). This would seem to bear out the indication from Box 10 that only some households perceive these activities as burdensome. In conclusion, household costs, in the form of time and expenditures, may be incurred in certain EPR programmes, especially those which impose significant sorting and cleaning obligations, or which require wastes to be transported to separate collection points. Not all EPR programmes will impose significant costs of this sort; programmes that allow households to drop their wastes off in the supermarket car-park on their weekly shopping trip may, for example, involve no significant travel costs for households. Some EPR programmes may even make life easier for households than under the earlier non-EPR arrangements. However, even where the EPR programme does require households to spend time and/or money in cleaning, sorting and transporting wastes, this does not count as a cost if households undertake these activities voluntarily. Household costs only need to be included in the cost-benefit analysis if households are compelled to use the EPR route, and to perform these activities. Even then, their perception of these costs may be relatively small, as the Norwegian study has shown.

4.8 DfE impact: Does EPR stimulate waste-reducing innovation?

135. A key part of the rationale for EPR instruments is that, if well-designed, they have the potential to stimulate low-waste innovation by producers. Many changes in product design and specification can have implications for the level of waste management costs. The incentives for low-waste innovation established by an EPR programme might act to encourage innovations which reduce waste management costs, and to discourage product waste-increasing product changes that might otherwise be made.

136. It cannot be assumed that all EPR programmes will encourage innovation in the form of DfE. Whether such innovation is stimulated by EPR will depend, among other things, on the way in which the programme structures the incentives for DfE.

137. The incentive is relatively straightforward where the programme requires producers to take back, individually, the products that they themselves have produced, and to bear the full cost of managing the wastes from these products. In this situation, a producer who redesigns products in a way that reduces the subsequent costs of waste management will reap the benefits of this innovation, in terms of reduced waste management costs at a later date.

Box 11. Household costs of cleaning, sorting and transporting waste for recycling

	Average per household per year	Per tonne of waste
Time use		
Cleaning sorted waste	13 hours	
Folding, sorting, carrying	19 hours	
Transporting to collection point	9 hours	
Total time use	***41 hours***	***186 hours***
Energy and water use		
	48 kWh	218 kWh
Energy use (cleaning waste)	$US 2.70	$US 12.20
Water consumption (washing)	1 600 litres	7 300 litres
Petrol (transporting to collection point)	3 litres	16 litres
Willingness-to-pay to leave sorting to others	**$US 20**	**$US 89**

Source: Based on data in Bruvoll, Annegrete, Bente Halvorsen and Karine Nyborg (2002), "Households' recycling efforts", *Resources, Conservation and Recycling*, 36: 337-354

138. The DfE incentive may be less straightforward, and possibly blunted, in systems where a PRO manages the wastes on behalf of many different producers. If the producers contribute to the financing of the PRO through some straightforward financial formula (such as a levy per unit sold), that does not exactly reflect the costs of managing the wastes from each individual producer, then the benefits from innovation by one producer that reduces the waste management costs in respect of that manufacturer's products will be shared across all of the firms that co-finance the PRO. The innovating firm will reap only a small fraction of the benefits from their innovation, and will thus have a much reduced incentive to devote resources to innovations of this sort.

139. The incentive would, on the other hand, be restored if the charges levied by the PRO are calculated on a basis that fully reflects the waste management costs associated with the individual producer's products. If this can be done, a producer who succeeds in redesigning the product in a way that reduces future waste costs could expect to be rewarded in due course through lower PRO charges. However, it may be difficult to calculate PRO charges for individual producers that precisely reflect the costs of handling that producer's wastes unless those producer's products are segregated and this will likely add cost. It is also likely to be controversial among the firms contributing to the PRO, since firms may disagree about the appropriate charges for particular products, and may be worried that their competitors obtain an unjustified competitive advantage through lower charges that are not clearly warranted in terms of waste management cost savings.

140. EPR programmes can however be structured to allow individual producers the opportunity to try and capture the environmental and cost benefits of their more environmentally friendly products. The common legal obligation established by the government mandating or supporting the EPR programme is for the producer, brand owner or importer to have and to implement a stewardship plan to meet certain requirements such as a recycling target. If the company chooses to "go it alone" separate from the common PRO they have the ability to do that as long as they meet the same common obligations set out in the backstop legislation. For example a number of leading brand owners in Europe have opted out of the established common PROs for electronics.

141. Assessing the extent to which a particular EPR programme has led to low-waste innovation, and the extent of the saving in waste management costs from this innovation, are important elements of an overall evaluation of the costs and benefits of the EPR programme. However, making an assessment of the scale of the DfE impact is also likely to be very difficult, for a number of reasons.

- First, it would require detailed data on the waste management costs for individual products. As noted above, this may be difficult to assess with any objective precision.
- Second, it requires an assessment against a counterfactual alternative; in other words, a judgement must be made of innovations that would have taken place in the absence of the EPR programme in the country concerned. Since innovations are typically "one-off" events, it is particularly difficult to devise a robust method for forecasting or modelling the level and pattern of innovation in any particular set of circumstances, and hence it is difficult to project a reliable counterfactual.
- Third, innovations in waste management are likely to be a function both of incentives in the particular country in question, and also of the policies adopted in other countries. A firm that innovates to meet policy pressures and incentives in one country may well employ the same technology in its production for other markets (because there may be economies of scale for example), rather than retaining special "dirty" technologies for those countries that did not encourage the original innovation.
- Fourth, it may be difficult to disentangle waste-reducing innovations from other product design changes. Typically, waste-reducing innovations will have implications for other aspects of the product design (including some that may be adverse, as noted in Section 4.11). The decision to adopt the low-waste innovation may have been taken as part of a decision to make a series of linked product changes, and it may not be practicable or meaningful to consider the low-waste innovation on its own.

142. Nevertheless, the impact of EPR on DfE is an important issue, and an evaluation of EPR that neglects DfE aspects is clearly partial and incomplete. What, in practice, can be said about this aspect of EPR?

143. First, there is a certain amount of research evidence about the impact of EPR in general on DfE. One important study conducted for Environment Canada by Lura Consulting (2002), looks across 25 EPR programmes to analyse the relationship between the level of DfE innovation within these programmes and the characteristics of the programme. Individual EPR programmes were scored on a scale of 1 to 3 for the assessed level of DfE within each of five categories of innovation:

- Reduction in resource use in production,
- Extended product life,
- Increased Recyclability,
- Increased recycled content,
- Reduction in toxicity.

144. These scores were then related to factors that might influence the scope for DfE, including the complexity of the product, and the strength of the policy-induced incentive for DfE. In particular, three categories of EPR programme were identified:

i) fixed fee programmes, in which producers contribute to a PRO on a basis that does not reflect the specific potential waste management costs of their products;
ii) variable-fee EPR programme, where the costs charged to producers reflect the costs of managing the wastes from that company's products or packaging; and
iii) corporate responsibility programmes, where the programme is set up and managed by an individual producer.

145. It was suggested that these three types of EPR programme differ in terms of the financial incentive to try to control EPR costs through DfE, with the strength of the incentive increasing across types i) to iii).

Statistical analysis of the 25 EPR programmes found evidence of DfE effects, in particular in the form of product and process changes that increased recycled content, increased recyclability, and reduced resources used. It was also found that DfE levels were positively associated with features of the programmes that led to greater levels of producer responsibility, including the policy-induced financial incentive to control EPR-related costs though DfE activity. (Lura Consulting, 2002, page ES-5)

146. Second, although it may be unlikely that an individual EPR evaluation could pin a precise figure on the economic cost savings from waste-reducing DfE induced by the EPR programme, there may be a lot that can be done to indicate the waste management implications of product innovations that have taken place in a particular sector over the lifetime of an EPR programme, and it may be possible to come to a broad (although perhaps imprecise) judgement about the extent to which these savings might be attributed to the incentive effects of the programme. One important element in an assessment of this sort is to ***document clearly the mechanisms by which the programme transmits incentives*** for waste-reducing innovations to producers. As noted above, a key element in this is the extent to which the programme "individualises" the contributions to the costs of a collective PRO through differentiated charges reflecting the waste management costs associated with the products of a particular firm. Where charges for individual firms do not reflect the waste management costs associated with the products they produce, it is perhaps implausible that a high level of waste reducing innovations can be attributed to the EPR programme.

4.9 How should competition issues be reflected in an assessment of costs and benefits of EPR?

147. Potential effects of EPR on competition have been the subject of considerable discussion. There is an extended discussion in the OECD's Guidance Manual (OECD, 2002, chapter 5), which discusses a range of competition issues and competition-related trade policy issues that might arise from EPR programmes. In principle, these competition policy aspects of EPR need to be addressed in any attempt at a comprehensive assessment of the economic costs and environmental benefits of EPR. In practice, however, it is unlikely that they can be assessed in a way which provides a precise quantitative estimate of competition "costs", that could be included in the overall assessment of the net social benefit of EPR. The same will generally be the case with the effects of EPR on DfE (section 4.8) and other policy objectives (section 4.10). In these cases, it is suggested that an attempt should be made to identify the likely nature and significance of any effect (on competition, DfE or on other policy objectives), and then to compare these effects with the net social benefit of EPR, calculated including all directly-quantifiable elements. The test will then be whether the size of the net benefit, excluding these items, is sufficiently large to outweigh the likely size of the competition and other costs. Even if these costs cannot be precisely quantified, there may be cases where this judgement can be made reasonably clearly. At all events, presenting the data in this way makes clear the nature of the judgements that need to be made about the significance of the residual unquantified effects.

148. As a starting point for this process, the range of possible ways in which a particular EPR programme might give rise to effects on competition need to be identified. Many of the potential competition issues raised by EPR arise as a result of the terms on which firms participate in the programmes. There are three main aspects:

- ***the decision to participate.*** Is participation voluntary or compulsory? If participation is voluntary, the possibility of free riding arises, by firms which choose not to participate. This is a particular issue where EPR programmes are established as a result of a voluntary agreement between government and an industry organisation. Pressure for the voluntary agreement may come from some explicit or implicit threat of government sanctions against the industry as a whole, but it is possible that firms that decline to participate in the agreement may not face individual sanctions for free-riding. Statutory EPR programmes in which participation is required by law avoid this form of free riding although they may still need to address free riding as an enforcement issue.

- ***the range of options open to firms.*** Are firms required to participate in a single PRO, or do they have a choice as to how they discharge their EPR responsibilities? For example, some programmes may allow firms to choose whether to take back products individually or through a PRO, and in other programmes firms may have more than one PRO that they can join. Where firms have no choice but to participate in a single PRO, they are more vulnerable if the PRO operates in a way which is to their competitive disadvantage. On the other hand, where firms can choose between a range of different arrangements, the decisions taken by some may have implications for the competitive position of others.
- ***the tariff of charges in collective programmes.*** Even though all firms may face the same set of charges for membership of the PRO, the effect of these charges may differ across firms. Any fixed cost element in PRO charges would be liable to have an adverse effect on the competitive position of small firms relative to large firms, and for this reason a flat-rate PRO charge per unit sold might seem the best way of avoiding effects on the pattern of competition. On the other hand, the costs of the PRO may not simply be a function of the number of units sold, and may include a significant element related to the number of producers (or product specifications) involved. In cases where PRO costs take this form, some large firms might choose to leave the PRO and operate individually, or by setting up a new PRO organisation which excludes small, costly-to-handle producers.

149. Other competition issues arise through the level and pattern of enforcement of the programme. In particular, the pattern of competition may be affected by post-contractual free riding, which arises where firms which have agreed to participate in the programme nonetheless subsequently evade some of their responsibilities under the programme. Firms might, for example, understate their sales volume, in order to reduce their contribution to the costs of the PRO, or they may fail to meet individual obligations regarding take-back, recycling, or the use of recycled materials. Post-contractual free-riding through non-compliance would generally give the free-riding firms a competitive advantage over those which comply with their obligations under the programme.

150. Further competition issues of a different nature arise through the effect of EPR on product innovation and waste disposal technology development in the industry. Firstly, there will be an incentive to develop products that are favoured by the rules and charging tariff of the programme.[18] This will tend to lead to greater convergence in the design of products by different producers, and hence to a reduction in competition through product differentiation.[19] The rules of the programme may have further effects on competition by inhibiting certain types of product innovation. New products might be discouraged or penalised, not because of their waste characteristics per se, but because, given the products that other firms produce, the new products would increase the costs of waste management.

4.10 Conflicts with other policy objectives

151. Finally, an assessment of the economic costs and environmental benefits of EPR needs to take account of the wider policy context in which EPR policies operate. Policies such as EPR which are intended to encourage firms to reduce waste management costs are also liable to have implications for other policy objectives, some of which may be beneficial, others of which may involve costs. As an

18 EPR may increase the value of certain key patents, which are necessary in order to produce the products favoured by the rules of the EPR programme, and this may strengthen the competitive position of firms holding the rights to the patents, as compared with those that have to license these rights.

19 One side effect of greater design convergence might be the development of a larger market for generic components and spare parts than would previously have been the case, and this might facilitate greater use of recycled spare parts and components.

example of the kinds of spin-offs that can be experienced, Box 4.9 illustrates some of the potential conflicts between measures to increase recyclability of motor vehicles, and other desirable policy objectives. Thus, for example, reducing waste management costs might point in the direction of changes in vehicle design that reduce the amount of material used in each vehicle. On the other hand, heavier, more rigid vehicles built using thicker materials may be less vulnerable in a collision than light, low-material vehicles, and innovations that reduce waste management cost by reducing materials inputs may act against the objective of vehicle safety.

152. As with DfE and competition effects, it is unlikely that a quantified effect on other objectives can be included in the analysis of economic costs and environmental benefits of an EPR programme. The nature of any such conflicts will vary greatly between different EPR programmes, and it is not practicable to give detailed and generally-applicable guidance as to how they should be handled in individual evaluations of particular programmes. It will, however, be important to investigate and document any effects of this sort liable to have arisen from an individual EPR programme as fully as possible, so that they can be considered, and weighed up against, the quantified elements of the analysis.

Box 12. End-of-life vehicles: possible conflicts between recycling objectives and other policy aims

- ***Safety***. Weight, rigidity, material choice affect safety.
- ***Emissions***. Plastics and composite materials may allow lighter, more fuel-efficient, vehicles
- ***Durability.*** Hexavalent chromium is used in rust proofing, but may cause problems when materials are landfilled or recycled

4.11 What adjustments would improve the balance between costs and benefits?

153. A key issue in evaluating an EPR programme is whether the parameters of the programme have been set so as to achieve the maximum social benefit. In particular, the variables that will affect both the costs and environmental outcomes of EPR can be adjusted within a wide range, so as to alter the balance between costs and benefits. Most EPR programmes involve specified targets to be met by the programme for:

- the percentage recovery required. *i.e.* what proportion of the total waste from particular products is collected through the EPR channel; and/or
- the percentage recycling for wastes collected through the PRO; or
- the overall percentage recycled.

154. What are the costs of requiring a higher percentage of recovery and recycling through an EPR programme?

i) greater collection effort will typically be required, and this could tend to increase the cost per unit collected, compared with a programme aiming at lower collection rates. Conversely increasing the quantities of used-oil collected at a depot may result in lower unit costs for haulage to a re-refiner. High rates of collection would, for example, require the parallel collection programme to cover a higher proportion of households, including those in out-of-the-way locations, or that are otherwise difficult to reach. It may also require a greater density of bring-system collection facilities, such as containers for collecting used bottles, and the marginal collection rate per facility will be likely to be lower than the average (assuming that these facilities are sited in the most promising locations first).

ii) more onerous burdens will be placed on households. To stimulate higher rates of return through the PRO-run programme will require greater effort by the PRO, or by firms in the industry, to encourage households to separate their wastes, and to dispose of relevant wastes through the PRO, rather than through the normal municipal waste collection. High rates may also be achieved by mandating disposal of certain wastes through the EPR programme, although this is liable to impose costs of unknown severity on those households who would otherwise not to do this.

iii) higher recycling volumes may reduce the costs of recycling per tonne of material. It is likely that there would be significant economies of scale in recycling, as in other industrial processes involving heat, and capital investment in vessels and containers. These economies of scale arise from the higher rates of heat loss from small-scale processes, and from the relationship between capacity (usually a function of volume) and construction costs (usually a function, in part, of surface area).

iv) higher volumes of recovery and recycling may depress the price per unit obtained for recycled materials. There are indications that the short-term impact of Germany's DSD was to increase the supply of recyclables faster than the ability of European industry to absorb the recycled material. For a period the value of recycled material was depressed, reducing the value of the material recycled through DSD, and adversely affecting existing recycling operations, including those in other EU member states. Although in the case of DSD this effect seems to have been quite dramatic, it is in general likely to be a relatively minor consideration in evaluating the consequences of higher or lower recycling targets for a national EPR programme, because its effects on the market are likely to be mainly temporary rather than permanent, and because the relevant market for recyclables will generally be international, thus allowing changes in exports and imports to damp the market effects of abrupt changes to domestic supply.

v) an offsetting element to increased costs of collection and recycling for the EPR will be any collection cost and treatment cost savings (including reduced landfill and incineration externalities) for the conventional system of waste disposal.

5. Assessing the results of an evaluation: key questions to ask

155. The primary purpose of evaluation is to contribute to policy improvement. An evaluation may identify ways in which the policy instrument studied in the evaluation could be modified to improve the balance between costs and benefits. Also, evaluations of an instrument applied in one context may provide results which may be useful in assessing the potential for similar measures in other contexts. Thus an evaluation of EPR applied to one category of waste in a particular country may help to assess whether EPR would be an appropriate policy for other categories of waste, or in other countries.

156. Effective communication of research findings is as important as high research standards in this process of evidence-based policy development and improvement. This section of the paper attempts to provide some guidance to potential non-technical “users” of evaluation research on EPR programmes, about how to appraise and interpret evaluation evidence. It suggests in particular three groups of questions that need to be considered in assessing how much weight to place on the findings of a piece of evaluation research. These questions concern:

i) the coverage of the study;
ii) the reliability of the estimates;
iii) the interpretation of the results.

5.1 Coverage of the study: a "user's" checklist.

157. Which of the main effects of EPR have been included in the assessment of costs and environmental benefits? In general, an evaluation of the costs and benefits of EPR would be expected to include a quantitative assessment of the following major items:

Net impact on waste collection costs

- ***EPR waste collection costs***. The collection costs for post-consumer waste products collected through the EPR programme,

minus

- ***Reduction in municipal waste collection costs***. The collection of waste by the PRO will reduce the waste volumes to be collected through the municipal system, and this may reduce the costs of the municipal system (see section 4.6 above)

Net impact on waste treatment costs

- ***Reduced municipal spending on waste disposal***. The EPR programme will reduce the amount of waste that has to be disposed of through landfill or incineration. There will be a reduction in the private costs of the municipal system, in the form of lower spending on fees to landfill and incinerator operators, etc.
- ***Costs of waste treatment by the EPR operator***. If the programme requires higher rates of recycling than are commercially-viable, the costs of the subsidy necessary to pay for non-commercial recycling should be included.

Externality effects

- ***Reduced external costs due to lower volumes of landfilling and incineration*** from municipal waste management (reduced health effects, disamenity effects, etc from landfill and incinerator pollution).
- ***Reduced external costs of virgin materials extraction and refining***. If EPR leads to higher recycling rates, and if the prices or virgin materials do not already reflect upstream externalities, then the evaluation should consider the value of reduced virgin materials use in terms of the reduced externalities from the processing of virgin materials. A separate valuation for the scarcity value of using virgin materials will not normally be needed, since this should be reflected in the market prices of materials. But if virgin materials extraction and processing is heavily-subsidised, the price of using raw materials will be lower than the social cost, and the study should include an element to reflect this.
- ***Reduced risks of environmental impairment associated with improper disposal.*** EPR programmes are often targeted at hazardous or special wastes which while they may historically have been handled by a common municipal solid waste program, are singularly inappropriate for landfill disposal or incineration.

Other effects

- ***Impact on Design-for-Environment***. What evidence is there that the programme is inducing product design changes that will facilitate future re-use and recycling, and reduce the costs of future waste management?
- ***Impact on competition.*** Has the programme affected the relative position of producers of different sizes, or of importers vis-à-vis domestic producers?

- ***Side-effects on other policy objectives***. Are there any other relevant items to be considered in the assessment of costs and benefits of the EPR programme?

5.2 The reliability of the estimates: a "user's" checklist.

158. How robust are the estimates of the various costs and benefits? Key considerations include the following:

- ***Data on collection and disposal costs within the EPR programme***. Are these costs based on data from an independent PRO, or are they data from individual producers about the costs they have incurred? If the latter, how well have EPR costs been separated from the costs of other operations of the firm?

- ***Methods used to value externalities***. What methods have been used to value landfill and incinerator externalities or pollution prevention benefits? Are the estimates based on valuation research for the country / locality concerned, or have they been drawn from other international research? Do the estimates draw on the full range of existing studies and information? What is the range of variation in the estimates available for these values?

- ***Collection costs***. How much of the data relies on information supplied by stakeholders who may have an interest in the outcome of the evaluation? What efforts have been made to obtain independent verification of such data?

- ***Unquantified effects***. Some effects simply cannot be quantified. Is the study clear about which possible effects have been omitted, and which are included? Are the results presented in such a way as to permit a judgment of whether the net costs of the unquantified effects might be likely to exceed or fall short of the net calculated benefits?

- ***The counterfactual***. What is the baseline against which costs and environmental effects have been assessed? Is this a realistic description of what would have happened in the absence of EPR?

- ***Stakeholder engagement***. How far has the study made use of the advice, knowledge and experience of relevant stakeholders, both in ensuring that all relevant information has been available, and in testing the robustness of findings against stakeholder knowledge?

- ***Peer review***. How far has the evaluation study been exposed to independent peer review, to check that best practice has been employed in the methods used, and to highlight areas where conclusions drawn may not be fully justified by the results?

5.3 The interpretation of the results: a "user's" checklist.

159. What conclusions can be drawn from the assessment of costs and environmental benefits? The following headings identify some issues in interpreting the results of an ex post EPR evaluation.

- ***Net social benefit***. What is the "bottom line" of the analysis, in the sense of the net social benefit of the EPR programme, *i.e.*, total social benefits minus total social costs? Does the study show that the level of recycling achieved by the programme is socially beneficial?

- ***The counterfactual***. With what is EPR being compared? is EPR being compared with a "do-nothing" baseline (*e.g.* a business-as-usual scenario, based on the continuation of pre-EPR policies), or is some other comparison being attempted?

- ***Alternative policies***. How far is the study able to assess whether EPR has been more or less cost-effective than alternative instruments directed at the same objectives?

- ***EPR "stringency".*** What can the study tell us about the benefits of changes to the EPR programme that would either increase or reduce the targets for recycling rates?

- ***Other modifications***. Evaluations frequently identify other modifications that would improve the functioning of policies.

- ***Making things happen***. Where lessons have been learned about modifications that would improve the balance between the costs and benefits of EPR, what arrangements are in place to ensure that these lessons can be carried through into effective policy reform?

6. Conclusions and recommendations

160. This paper sets out a suggested framework for evaluating the costs and benefits of waste management policies based on extended producer responsibility (EPR). Many OECD countries have implemented EPR programmes for certain categories of wastes, and much can be learned from evaluation of this practical experience

161. Evaluation evidence on the performance of policy instruments can help to improve the administration of current policy, and can contribute to a process of policy reappraisal, modification and improvement in the light of experience. Evaluation studies may also contribute to better communication with stakeholders and the public about the purpose, operation and effects of policy.

162. Of course, the performance of EPR programmes in a particular country will reflect many factors specific to the country concerned, including important cultural factors governing individuals' attitudes to waste and the environment, and business attitudes to issues of social responsibility. Nevertheless, there is considerable scope for other countries to learn from the practical experience of those that have implemented particular EPR policies. Systematic evaluation studies, based on a clear, consistent, methodology, will help in this process of cross-country communication.

163. The methodology suggested in this paper is designed to be applied to EPR programmes characterised by:

- obligations on the producer concerning the collection ("take-back") of product packaging or end-of-life products

- producers bearing financial responsibility for the costs of proper waste management of the collected products and materials

- rules or targets governing the methods of waste management of recovered products, for example specifying minimum required rates of re-use or recycling.

164. Other policy approaches, such as those based on a statutory advance disposal fee (ADF), or a mixture of ADF and other instruments, are sometimes characterised as EPR policies. However, they would

require a different approach to evaluation than that outlined in Section 4 of this paper, although with many of the elements described in Section 4.

6.1 Evaluation issues

165. A key issue that is central to meaningful evaluation is a clear definition of the "baseline" or "counterfactual", against which the experience of the EPR policy can be compared. In general, this should not simply be the pattern of waste management costs at the date when the EPR policy was introduced, because, for many reasons, waste management patterns and costs might have in any case changed, even without the introduction of EPR. The "counterfactual" should describe what would have happened in the absence of EPR, so that the contribution of EPR can be assessed as the difference between the counterfactual and what was observed in practice. The counterfactual should thus also consider the environmental risks and the associated costs of continuance of the status quo if the risk becomes a reality.

166. How soon after the introduction of an EPR programme should it be evaluated? There are a number of factors affecting the optimal timing of evaluation studies. Defining the counterfactual will generally be more straightforward where an evaluation is looking at the performance of an EPR programme after only a few years of operation, than where longer-term performance is being assessed. In the former case, a simple "before-and-after" comparison may be a reasonable approximation to the impact of EPR. However, there are other important considerations affecting the timing of evaluation. Some also point in the direction of conducting evaluations early: for example, information will typically be easier to obtain, etc. Others, however, suggest that evaluating an EPR programme too soon may miss some important effects. It may take some time for the costs of operation to fully settle down. The development of the necessary collection infrastructure may for example take some time. Hence an early evaluation may not reflect the long-run operating costs of an EPR programme. Also, one of the key goals of EPR – to stimulate waste-reducing "design-for-environment" (DfE) – is only likely to be achieved over a period of time, and early evaluation may miss significant DfE responses.

167. Another consideration regarding the timing of an evaluation is the need to allow the program to handle the back-log of historic or orphan products which will appear in the first years. These wastes will appear at the very beginning of a program because they were being stored in anticipation of the program launching. In the case of electronics the public are generally loath to discard equipment which although outdated may have cost a significant amount upon purchase. Basing an evaluation on the very large early volumes of such older and orphan products should be avoided.

168. For evaluations to be informative, and to carry weight and achieve influence, it is important that they are undertaken objectively, according to "best practice" research techniques. As section 3 has discussed, the issue of "Who evaluates?" may have an important bearing on the value of the finished product. Internal evaluations may be better-informed, and may therefore be more influential with those responsible for the design and operation of the EPR programme. But for there to be wider confidence in the findings, some arrangements for external input and scrutiny will generally be desirable.

169. In all evaluations there is an important trade-off between accuracy and cost. Thorough evaluation research involves a substantial commitment of resources, and while the gains from improving poorly-designed policies may be large, it may be impracticable to subject all programmes to comprehensive evaluation. Often, however, even limited small-scale evaluations may be informative, and may shed useful light on the overall balance between the costs and benefits of an EPR programme.

6.2 When will EPR evaluation be feasible?

170. Not all EPR programmes will be amenable to accurate quantitative evaluation. Evaluating the operating costs of EPR programmes will be relatively straightforward in the case of those programmes where the arrangements for parallel collection and waste treatment are made through a separate Producer Responsibility Organisation (PRO). So long as there is a clear, arms-length relationship between producers in the industry and the PRO, so that any services provided by producers to the PRO are properly priced, the net operating deficit of the PRO, before any charges or contributions from the participating firms, provides a measure of the costs of operating the parallel collection and waste treatment arrangements. These costs will typically include costs of the PRO-run collection activities, and also the net cost of disposal (*i.e.* payments for landfill, and the net costs of sending materials for recycling). In the case of some wastes, the PRO may be able to generate income by selling the collected items to commercial recyclers. In other cases, the PRO may be obliged by the rules of the EPR programme to recycle materials which cannot be recycled on a commercial basis. In these circumstances, the payments (subsidies) made to recyclers, to induce them to take items for recycling, will add to the operating costs of the PRO.

171. On the other hand, where EPR operates without a separately-constituted PRO, the costs of EPR will be more difficult to assess. This will be particularly the case where the recovery and disposal of end-of-life products is undertaken by individual producers. Take-back at the individual level will often integrate selling activities with the recovery of old products, and it may be difficult, both in principle and in practice, to identify separately the costs of the recovery activity alone. Even where sales and recovery are separately managed, the costs of the recovery operation may not be the subject of separate accounts, financial data may be difficult to obtain because it is regarded as commercially-sensitive, and there may be various hidden cross-subsidies within the firm.

172. PRO costs will not, of course, be the only element in an assessment of the net costs of EPR programmes. The existing waste collection arrangements, such as those run by municipalities, may make savings, to the extent that diversion of wastes to the EPR collection will reduce the volume of wastes handled by existing arrangements, and hence reduce the costs of these arrangements. There will also be environmental gains to be considered, in terms of the reduced externalities from landfill and other disposal, and any environmental gains from reduced use of virgin materials (such as reduced externalities from materials extraction and processing).

173. What light would evaluation evidence from PRO-based programmes shed on the net benefits of EPR more generally? Clearly there are similarities, but there are also some differences which may be of significance.

- Costs of collection and treatment per unit of waste may well be higher under single-firm arrangements for EPR than under PRO-run programmes, though the difference in costs will be difficult to assess, because of the likely lack of transparency in accounting for EPR costs incurred by individual firms.
- Programmes of both sorts involve some risks for the maintenance of vigorous and effective competition between producers in the industry. On the one hand, the governance arrangements for PRO-based programmes (including the basis for collective financing of the PRO) will be critical in determining the impact on the competitive position of different firms. On the other hand, while individual programmes, or arrangements for opt-out from the PRO, avoid the risk that firms cannot escape an unfair charging burden, there will be a general tendency for smaller firms and new entrants to be disadvantaged by EPR, if there are any fixed costs in its operation.

- While there is a noted difference between countries and cultures on whether these costs are applicable in the programmes, household costs (such as transport costs) may well be higher in some programmes, such as those where wastes have to be returned to the original producer.

6.3 Suggestions for further work

174. Areas where further work would be useful to develop more robust methodologies for assessing EPR will include:

- ***The treatment of upstream costs*** in EPR assessments. How should the externalities associated with raw materials extraction and processing be valued?
- ***Quantifying pollution prevention and environmental risk avoidance.*** Many EPR programs have been established to address risks associated with the improper management and disposal of hazardous and special wastes. How should hard to document externalities such as this be addressed?
- ***Design-for-Environment effects***. The encouragement of design changes to reduce waste management costs is a central part of the case for EPR. These effects on product design may however be easier to assess through comparisons of programmes than for individual programmes in isolation.
- ***The costs of marginal changes in recycling rates***. How does the cost per unit of recycling vary with the proportion of materials collected and recovered? If increasing the rate of recycling requires more costly-to-recycle wastes to be recycled, this could mean, for example, a higher cost per unit in increasing recycling from 80% to 85% than from 10% to 15%.
- ***The assessment of household costs*** of waste transport. *Household costs are assessed (and viewed) differently across OECD countries. Different* approaches to the measurement of these costs should be compared, and it would also be useful to investigate how these costs vary across different types of EPR programme (PRO-run versus single firm, especially). *In addition, any special factors or conditions in the policy should be identified and taken into consideration.*

175. The purpose of the evaluation framework set out in this report is to provide a suggested methodology which could be used by individual countries as a starting point for ex post evaluation of particular EPR programmes. The framework draws on the principles of good practice in evaluation, and the practical experience of evaluation studies in other contexts, with the aim of helping countries identify an approach to evaluation that will be practicable, reasonably comprehensive, and that will yield meaningful results. The next stage in the programme will be to test the evaluation framework in the context of a number of practical applications, to identify whether the approach proves feasible and the results meaningful in a range of different countries and programme types. Testing the framework in this way will also help to identify gaps and omissions in the framework, and possible refinements to the approach which may better reflect the range of costs and benefits of different EPR programmes.

176. The nature of EPR means that a one-size-fits-all approach cannot be adopted to ex post evaluation of programmes. There will be important judgements to be made designing and specifying each evaluation, and it is important that countries draw on appropriate expertise in designing and commissioning studies. It is hoped that this framework will reduce the costs and complexity of the initial stages of the evaluation process, and will provide useful guidance for those commissioning and undertaking evaluation research of EPR programmes.

REFERENCES

ACKERMAN, Frank, and Kevin GALLAGHER (2002), "Mixed signals: market incentives, recycling, and the price spike of 1995", *Resources, Conservation and Recycling*, 35: 275-295.

BRUVOLL, Annegrete, and Karine NYBORG (2002), *On the value of households' recycling efforts*, Discussion Paper 275, Oslo: Statistics Norway.

BRUVOLL, Annegrete, Bente HALVORSEN and Karine NYBORG (2002), "Households' recycling efforts", *Resources, Conservation and Recycling*, 36: 337-354.

CALCOTT, P., and Margaret WALLS (2000) "Can Downstream Waste Disposal Policies Encourage Upstream 'Design for Environment' ?", *American Economic Review: Papers and Proceedings*, 90: 233-37.

CALCOTT, P., and Margaret WALLS (2001) *Waste, Recycling and 'Design for Environment'. Roles for Markets and for Policy Instruments.* Working Paper, Resources For the Future, Washington DC.

DENISON, Richard A. (1996) "Environmental Life-Cycle Comparisons of Recycling, Landfilling, and Incineration: A Review of Recent Studies", *Annual Review of Energy and the Environment*, 21, 191-237.

Dinan, Terry M (1993), "Economic efficiency aspects of alternative policies for reducing waste disposal", *Journal of Environmental Economics and Management*, 22: 242-256.

EICHNER, Thomas, and Rüdiger PETHIG (2001) "Product design, and efficient management of recycling and waste treatment", *Journal of Environmental Economics and Management*, 41: 109-134.

European Commission (1997), *Cost-benefit analysis of the different municipal solid waste management systems: objectives and instruments for the year 2000*. Document. Luxembourg. Office for Official Publications of the European Communities.

ELLERMAN, A. Denny, Richard SCHMALENSEE, Elizabeth M BAILEY, Paul L JOSKOW, and Juan-Pablo MONTERO (2000) *Markets for Clean Air. The US Acid Rain Program.* Cambridge University Press.

FULLERTON, Don, and Tom KINNAMAN (1995) "Garbage, recycling and illicit burning or dumping", *Journal of Environmental Economics and Management*, 29: 78-91.

FULLERTON, Don, and Tom KINNAMAN (1995) "Household Responses to Pricing Garbage by the Bag", *American Economic Review*, 86(4), 971-984.

FULLERTON, Don, and Ann WOLVERTON (1997), *The case for a two-part instrument: presumptive tax and environmental subsidy*. NBER Working paper 5993. National Bureau of Economic research, Cambridge, MA.

FULLERTON, Don, and Ann WOLVERTON (2000) "Two generalisations of a deposit-refund system", *American Economic Review: Papers and Proceedings*, 90: 238-242.

FULLERTON, Don, and Wenbo WU (1998) "Policies for Green design", *Journal of Environmental Economics and Management*, 36: 131-148.

GLACHANT, Matthieu (2004), "Changing products characteristics to reduce waste generation". In OECD (2004), *Addressing the Economics of Waste*, OECD, Paris.

GODDARD, Haynes C (1995), "The benefits and costs of alternative solid waste management policies", *Resources, Conservation and Recycling*, 13: 183-213.

HORNIK, Jacob, Joseph CHERIAN, Michelle MADANSKY and Chem NARAYANA (1995), "Determinants of Recycling Behavior: A Synthesis of Research Results", *The Journal of Socio-Economics*, 24(1): 105-127.

JENKINS, Robin R, Salvador A MARTINEZ, Karen PALMER and Michael J PODOLSKY (2000), *The Determinants of Household Recycling: A Material Specific Analysis of Recycling Program Features and Unit Pricing*. Discussion Paper 99-41-REV (April), Resources For the Future, Washington DC.

Kondo, Yasuo, Ko-suke Hirai, Ryota Kawamoto, and Fumio Obata (2001), "A discussion on the resource circulation strategy of the refrigerator", *Resources, Conservation and Recycling*, 33: 153-165.

LINDERHOF, Vincent, Peter KOOREMAN, Maarten ALLERS and Doede WIERSMA (2001), "Weight-based pricing in the collection of household waste: the Oostzaan case", *Resources and Energy Economics*, 23: 359-371.

Lura Consulting, with Gardner Pinfold Consulting Economists Ltd and Jacques Whitford Environment Ltd (2002), *The Relationship between Extended Producer Responsibility and Design for Environment.* Study submitted to Environment Canada, August 2002.

MACAULEY Molly, Karen PALMER, Jhih-Shyang SHIH, Sarah CLINE and Heather HOLSINGER (2001) *Modelling the costs and Environmental benefits of disposal options for end-of-life electronic equipment: the case of used computer monitors*, Discussion Paper 01-27 (June), Resources For the Future, Washington, DC.

MACAULEY M K, and Margaret WALLS (2000) "Solid Waste Policy", in P Portney and R Stavins (eds) *Public Policies for Environmental Protection*, 2nd Edition, Resources For the Future, Washington DC.

OECD (Organisation for Economic Co-operation and Development) (1995) *Extended Producer Responsibility in the OECD Area. Phase 1 Report. Legal and Administrative Approaches in Member Countries and Policy Options for EPR Programmes.* OECD, Paris.

OECD (1997) *Evaluating Economic Instruments for Environmental Policy.* OECD, Paris.

OECD (2001) *Extended Producer Responsibility. A Guidance Manual for Governments.* OECD, Paris.

OECD (2003) *Proceedings of OECD Seminar on Extended Producer Responsibility: EPR Programme Implementation and Assessment. Part 1 "Taking Stock of Operating EPR Programmes" and Part 2 "Assessing EPR Policies and Programmes.* ENV/EPOC/WPNEP(2003)10/FINAL. OECD, Paris.

OECD (2004), *Addressing the Economics of Waste*, OECD, Paris.

PALMER, Karen, H SIGMAN and Margaret WALLS (1997) "The cost of reducing municipal solid waste" *Journal of Environmental Economics and Management*, vol 33: 128-50.

PALMER, Karen, and Margaret WALLS (1997) "Optimal polices for solid waste disposal: taxes, subsidies and standards", *Journal of Public Economics*, vol 65: 193-205.

PALMER, Karen, and Margaret WALLS (1999) *Extended Producer Responsibility: An Economic Assessment of Alternative Policies.* Discussion Paper 99-12, Resources For the Future, Washington DC

PALMER, Karen, and Margaret WALLS (2002) *The Product Stewardship Movement. Understanding Costs, Effectiveness, and the Role for Policy*. RFF Report, Resources For the Future, Washington, DC.

PORTER, Richard C. (1983) "Michigan's Experience with Mandatory Deposits on Beverage Containers", *Land Economics*, 59(2), 177-194.

PORTER, Richard C. (2002) *The Economics of Waste*, Washington, DC: Resources for the Future.

RADETZKI, Marian (2000) *Fashions in the Treatment of Packaging Waste: An Economic Analysis of the Swedish Producer Responsibility Legislation.* Brentwood, UK: Multi-Science Publishing Co.

RESCHOVSKY, James D. and Sarah E STONE (1994), "Market incentives to encourage household waste recycling: paying for what you throw away", *Journal of Policy Analysis and Management*, 13(1): 120-139.

STERNER, Thomas, and Heleen BARTELINGS (1999), "Household Waste Management in a Swedish Municipality: Determinants of Waste Disposal, Recycling and Composting", *Environmental and Resource Economics*, 13: 473-491.

STURGES, Michael (2003), *Evaluating the Environmental Effectiveness and Economic Efficiency of Extended Producer Responsibility.* in OECD (2003), pp 150-211.

WALLS, Margaret, Molly MACAULEY and Soren ANDERSON (2002), *The Organization of Local Solid Waste and Recycling Markets: Public and Private Provision of Services*, Resources for the Future Discussion Paper 02-35REV.

WALLS, Margaret and Karen PALMER (2001), "Upstream pollution, downstream waste disposal, and the design of comprehensive environmental policies", *Journal of Environmental Economics and Management*, vol 41: 94-108.

WALLS, Margaret (2002) *EPR Policy Goals and Policy Choices: What does Economics Tell Us?* Paper presented at the OECD Workshop on Extended Producer Responsibility, 10-11 December, Tokyo International Forum

GLOSSARY OF WASTE MANAGEMENT AND ECONOMIC TERMINOLOGY

(i) Waste management terminology[20]

Waste prevention (waste avoidance, reduction at source) means strict avoidance of waste generation both qualitatively (elimination of hazardous substances) and quantitatively, *i.e.* reducing material and energy intensity. Prevention includes: i) strict avoidance; ii) minimisation of hazard substances, and material and energy intensity; and iii) re-use of products.

Waste management means collection, transport, recovery and disposal of waste.

Recovery means energy recovery (in EU part of energy recovery is considered final disposal) and material recovery (= recycling).

Disposal means landfilling, physical-chemical destruction and incineration (without energy recovery) of waste.

Treatment covers recovery and disposal.

(ii) Economic terminology

Cost-benefit analysis An economic technique for assessing the full social costs and benefits of a particular policy decision or course of action. Cost-benefit analysis aims to assess all of the consequences of the action on a consistent basis. Except where externalities arise, marketed goods and services (including resources used) are valued in terms of their market prices. Other costs and benefits (such as the effects of externalities) are then valued on a basis which allows their value to be compared to goods and services which are priced by the market.

Externality The effects of a production or consumption decision which are experienced by individuals or businesses which did not consent in the initial decision. Externalities may be either "positive" or "negative". A negative externality is one in which costs are imposed on other people (as when a person dumps litter in the countryside, imposing costs on others whose aesthetic sense is disturbed by the litter, or imposing clean-up costs on the landowner or public authorities). A positive externality is one in which benefits are experienced by others. For example, if patent protection is incomplete, many firms may be able to benefit from the results of research expenditures by one firm.

Cost The economist's notion of cost, which is used in cost-benefit analysis, goes wider than simply the lay person's notion of monetary expenditure. Economic cost could include both monetary and non-monetary costs. (Thus, for example, the cost of disposing of waste through incineration could

[20] The OECD's terminological conventions for discussing waste management issues are set out in ENV/EPOC/PPC(97)17/REV2, page 15.

include both the monetary costs of building and operating the incinerator, and non-monetary costs, such as the impact of the emissions from the incinerator on the health of local residents.)

Private cost The costs incurred by the individual decision-maker. These are the costs which would be taken into account by individuals motivated by self-interest, of by businesses aiming to maximise profit. Private cost may be contrasted with a wider measure of costs, such as social cost, which includes costs ("external costs") borne by individuals other than the decision-maker.

External cost Costs incurred as a result of individual decisions, but which are borne by an individual other than the person making the decision. (For example, a private landfill operator which allows the site to contaminate groundwater may impose costs on neighbouring residents or businesses, in terms of health damage, the costs of water purification, or the costs of obtaining alternative uncontaminated sources).

Social cost The sum of private costs and external costs

Marginal cost The cost of an *additional* unit of some commodity.

Opportunity cost A powerful economic concept, meaning 'what has to be foregone in order to have some specified commodity", or "what alternative has to be foregone if some commodity or resource is used for a specified particular purpose". For example, the workers employed to collect waste for recycling have an opportunity cost, in the form of the goods and services that they would produce in an alternative employment.

Net cost Total cost of some course of action, minus benefits which act to reduce the cost. (For example, the costs of recycling may be partly or completely offset by revenues from selling the recycled material). Depending on the context, "net cost" may refer to private costs only, or to other cost concepts such as social costs.

Net benefit Total benefits from some course of action, minus the cost. Depending on the context "net benefit" may be the "bottom line" of a cost-benefit analysis, or may refer to a more restricted set of costs and benefits. Frequently, "net cost" and "net benefit" are used as interchangeable terms, differing only in terms of the sign. Thus a course of action with a "net cost" of one million dollars may equivalently be described as having a "net benefit" of minus one million dollars.

Price Generally used to mean the *monetary expenditure* needed to obtain one unit of a commodity. Occasionally wider concepts of "price" may be used. For example, we may "impute" a price for some commodity which is not usually bought and sold. In doing this we are estimating what the price would be if the commodity was, in fact, traded for money.

Value Economists use "value" to mean the level of human happiness, satisfaction or "utility" derived from the consumption of particular commodities. It should be noted that "value" is not a synonym for "price". Some commodities, such as those that give rise to substantial externalities, may have a value which is very different from their price. Nevertheless, given the difficulties of defining a unit of measurement for human happiness, value is typically assessed with reference to the prices of marketed commodities. The value of non-marketed commodities or commodity attributes is then expressed in terms of the monetary expenditures which would achieve an equivalent impact on human happiness ("utility").