PART I

Chapter 1

Extended producer responsibility – an overview

This chapter provides an introduction to extended producer responsibility (EPR) by discussing the policy rationale behind the approach, the main instruments as well as the most important trends. It finds that there has been a significant increase in the use of EPR in the past 15 years, with about 400 systems now being in use around the globe, most of them in the OECD region. This has led to important achievements, such as an increase in material recovery rates from different waste streams and the generation of significant financial resources from producers that now contribute to a market that is worth about 300 billion EUR globally. A number of areas where EPRs need to be strengthened are also identified.

1.1. Introduction

Extended producer responsibility (EPR) for the end-of-life management of products emerged in a number of OECD countries in the late 1980s. It was a response to the challenges that many municipalities were facing in managing waste that was growing in volume and complexity, and in a context where the siting of waste management facilities was often opposed by the public. EPR policy sought to shift the burden of managing certain end-of-life products from municipalities and taxpayers to producers. It was hoped that this redefinition of responsibilities, and the incentives it provided to producers to redesign products and packaging, would reduce the share of waste destined for final disposal and increase recycling.

OECD provided a platform to exchange good practices and to analyse common challenges related to EPRs. Following an extensive phase of research and policy dialogue, the OECD published a Guidance Manual on EPRs in 2001 to support Member countries to implement EPR policies (hereafter the 2001 Manual). Since then, the number and variety of EPR systems have increased significantly, not only in OECD countries but also in emerging economies. In many countries EPRs have helped to reduce the share of waste destined for final disposal and increased material and energy recovery, thereby enhancing the resource productivity of those economies. At the same time, EPRs have contributed to the development of a multi-billion dollar recycling industry.

Part one of this report provides updated Guidance on EPRs, building on the 2001 Manual and in view of the developments and lessons learnt since then. While many of the original recommendations remain valid, recent experience gained suggests that additional guidance could help to enhance the environmental effectiveness and economic efficiency of EPR systems.

The first chapter begins by providing a brief summary of the policy rationale and main instruments for implementing EPR. Some of the main recent trends in EPR systems are then described. The following chapter aims to integrate the main elements of the 2001 Guidance Document with the findings and recommendations emerging from the most recent analysis of EPRs. A concluding section examines some remaining challenges.

To support the development of more up-to-date and policy-relevant guidance, four issues were examined in more depth. These are presented in the second part of the report: design and governance of EPR systems (Chapter 3); the anti-competitive behaviour that has been observed in EPR systems, a concern that has increased with the growth and increased concentration of the waste and recycling sectors (Chapter 4); the role of EPRs in promoting more environmentally friendly design of products (Chapter 5); and the operation of EPR systems in emerging economies, particularly the important role played by the informal waste sector (Chapter 6).

1.2. EPR policy rationale and instruments

1.2.1. *Definition and policy rationale*

The OECD defined EPR as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. In practice, EPR involves producers taking responsibility for collecting end-of-life products, and for sorting them before their final treatment, ideally, recycling. EPR schemes can allow producers to exercise their responsibility either by providing the financial resources required and/or by taking over the operational and organisational aspects of the process from municipalities. They can do so individually or collectively.

EPR was not entirely a new concept; recycling markets existed well before the 1980s, particularly for end-of-life products with a market value. However, these markets were limited in scope and operated with many imperfections. As a result, they did not generate a socially optimal level of recycling and the burden of treating the residual waste fell on municipalities. By the late 1980s, the volume and complexity of waste generated exceeded the management capacity of municipalities in the most developed economies. The task of municipalities was further complicated by public opposition to the siting of landfills and incinerators: the NIMBY (Not In My Back Yard) concept. The dominant role of the public sector also meant that the opportunity to mobilise the technical and managerial skills of the private sector in managing waste products was not being realised. EPR aimed to address these challenges by shifting the financial burden of managing end-of-life products from municipalities and taxpayers to producers. It was hoped that this would reduce the volume of waste going for final disposal, increase rates of recycling, and provide incentives for waste prevention and reduction at source.

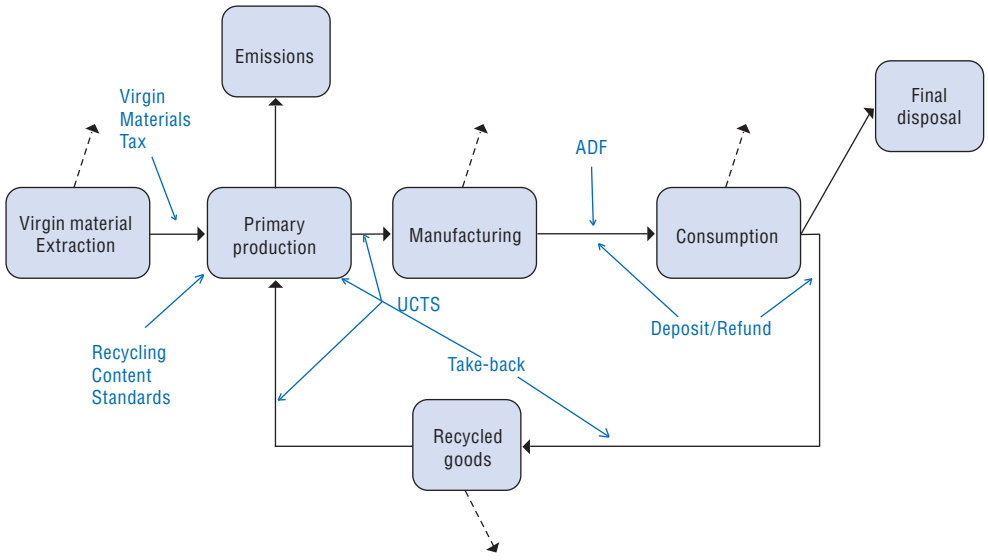
EPR policy is consistent with the Polluter-Pays Principle in so far as financial responsibility for treating end-of-life products is shifted from taxpayers and municipalities to producers and, ultimately, consumers. However, EPR policy alone does not aim to achieve a full internalisation of environmental costs; the task of establishing an environmental price for a wide range of environmentally diverse waste streams makes this impractical. EPR policy nevertheless aims to provide producers with incentives to internalise environmental costs throughout the product life-cycle, including at the design stage. EPRs seek to provide incentives to producers to (re)design products and packaging to facilitate their end-of-life management, and to avoid using materials that may pose risks to human health or the environment. Without this, some products can require significant amount of resources before they can be recycled.

1.2.2. *Policy instruments*

Four broad categories of EPR instruments exist, even though they are sometimes used in combinations, (also see Figure 1.1):

- *Product take-back requirements* involve assigning responsibility, for example to producers or retailers, for the end-of-life management of products. This type of requirement is often achieved by establishing recycling and collection targets for a product or material. The targets may be either mandatory or voluntary. A further approach is to provide incentives for consumers to return the used product to a specified location such as the selling point.
- *Economic and market-based instruments* provide a financial incentive to implement EPR policy. They come in several forms, including:

Figure 1.1. **EPR policy instruments in the product cycle**



Note: ADF > Advance disposal fee; UCTS > Upstream combination tax/subsidy
Source: OECD (2013), *What have we learned about extended producer responsibility in the past decade? – A survey of the recent EPR economic literature*, Paris

- *Deposit-refund*: an initial payment (deposit) is made at purchase and is fully or partially refunded when the product is returned to a specified location.
- *Advanced Disposal Fees (ADF)*: fees levied on certain products at purchase based on the estimated costs of collection and treatment. The fees may be collected by public or private entities and used to finance post-consumer treatment of the designated products. Unused fees may be returned to consumers.
- *Material taxes*: involve taxing virgin materials (or materials that are difficult to recycle, contain toxic properties, etc.) so as to create incentives to use secondary (recycled) or less toxic materials. Ideally, the tax should be set at a level where the marginal costs of the tax equal the marginal treatment costs. The tax should be earmarked and used for the collection, sorting, and treatment of post-consumer products.
- *Upstream combination tax/subsidy (UCTS)*: a tax paid by producers subsequently used to subsidise waste treatment. It provides producers with incentives to alter their material inputs and product design and provides a financing mechanism to support recycling and treatment.

- *Regulations and performance standards* such as minimum recycled content can encourage the take back of end-of-life products. When used in combination with a tax, such standards can strengthen incentives for the redesign of products. Standards can be mandatory or applied by industries themselves through voluntary programmes.
- *Information-based instruments* aim to indirectly support EPR programmes by raising public awareness. Measures can include reporting requirements, labelling of products and components, communicating to consumers about producer responsibility and waste separation, and informing recyclers about the materials used in products

The 2001 Manual noted that most of the EPR systems that had been established at that time included targets or quotas. These maybe quantitative or qualitative and could be

expressed in various ways depending on the ultimate policy objective; for example, in terms of reuse or recycling rates, the volume of waste collected or going to final disposal, performance quotas or environmental quality objectives.

1.3. Main trends and achievements of EPRs

This section examines some of the main trends and achievements in EPRs since the 2001 Guidance Document was published. It shows that the number of EPR systems in operation has increased significantly. Most have been established in the EU and US, at national and sub-national levels, often in response to legislative requirements. The established systems manage a range of end-of-life products and employ a limited number of instruments. Governance arrangements have continued to evolve and to reflect the widely differing contexts in which the EPR systems were established and the specific goals they were intended to achieve.

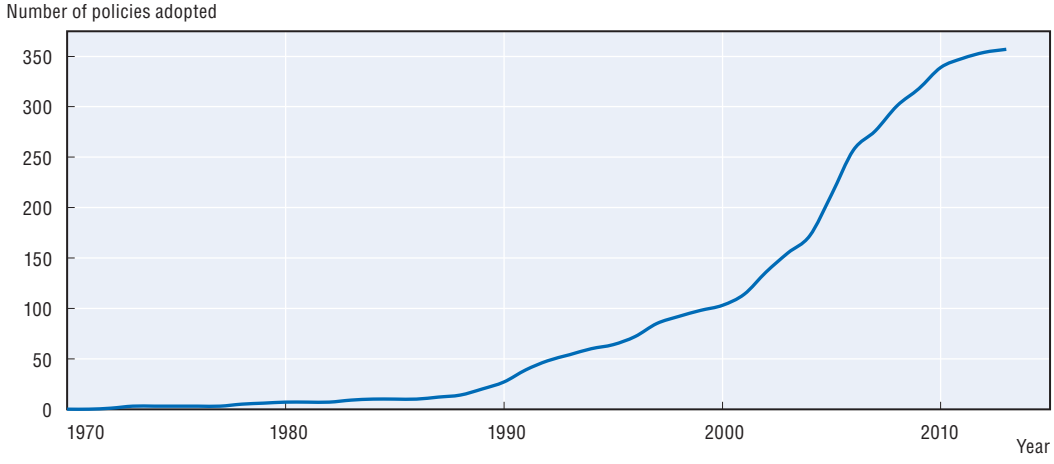
Assessing the impacts of EPR systems is hindered by a considerable lack of data, methodological difficulties in distinguishing the impacts of EPRs from other factors, and the wide variations in EPR systems which limits comparison. Nevertheless, there is some evidence that EPR systems have helped to decrease the volume of waste destined for final disposal, increased rates of recycling, and, as a result, relieve pressures on public budgets. EPR systems have also contributed to the development of a multi-billion dollar waste and recycling industry. On the other hand, the consensus appears to be that while EPR systems have contributed to eco-design in some countries and some sectors, they are seldom sufficient to serve as the triggering factor.

1.3.1. *Main trends*

Trends in the adoption of EPRs

There has been a significant increase in the adoption of EPRs since 2001, in line with an increased emphasis on waste management policies in many countries. A recent study (OECD, 2013) reviewed 384 EPR policies. Of these, more than 70% were implemented since 2001 (Figure 1.2).

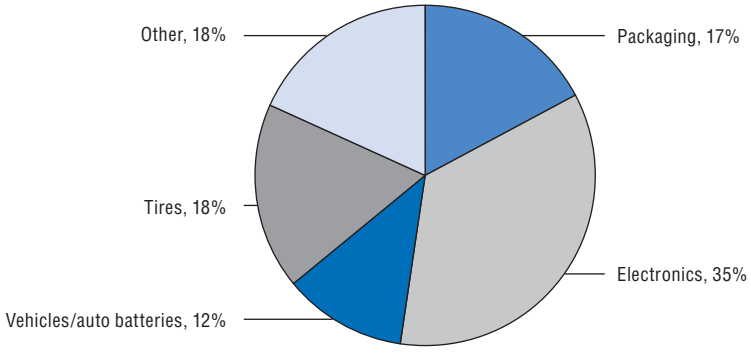
Figure 1.2. **Cumulative EPR policy adoption globally, 1970-2015**



Source: OECD (2013), *What have we learned about extended producer responsibility in the past decade? – A survey of the recent EPR economic literature*, Paris

In terms of products covered, small consumer electronics appear to be the most prevalent (see Figure 1.3). When mobile phones, renewable batteries, thermostats and auto switches are included, this category accounts for 35% of EPR policies globally. Packaging (including beverage containers) and tyres each account for 17%. End of life vehicles (ELVs) (7%) and lead-acid batteries (4%) are the next largest groups of products covered. The remaining 20% of polices cover less common products including used oil, paint, chemicals, large appliances, and florescent light bulbs. Thus it appears that products with potentially high costs of disposal and relatively high levels of consumption have been the main focus of attention in EPRs, reflecting both policy and market drivers. EPRs have been used less for products with relatively low levels of consumption.

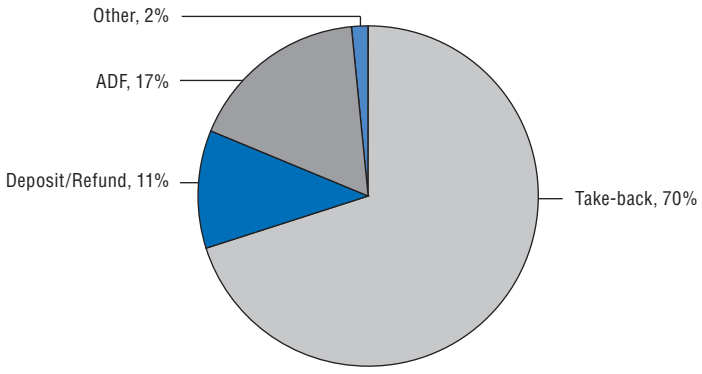
Figure 1.3. **EPR by product type, worldwide**



Source: OECD (2013), *What have we learned about extended producer responsibility in the past decade? – A survey of the recent EPR economic literature*, Paris.

Regarding the policy instruments employed in EPRs (Figure 1.4), various forms of take-back requirements are the most commonly used (72% globally), sometimes in combination with advances disposal fees (ADF). These instruments are used for a wide range of products. Advance disposal fees are the next most frequently used instrument (16%), and they have also been applied to many different products. Deposit/refund instruments (11%) are concentrated in the used beverage container and lead-acid battery markets, sometimes in combination with take-back requirements. The other possible EPR policy instruments identified in the 2001 Manual – upstream combined tax/subsidy, recycling content standards, and virgin material taxes – appear to be used infrequently, if at all.

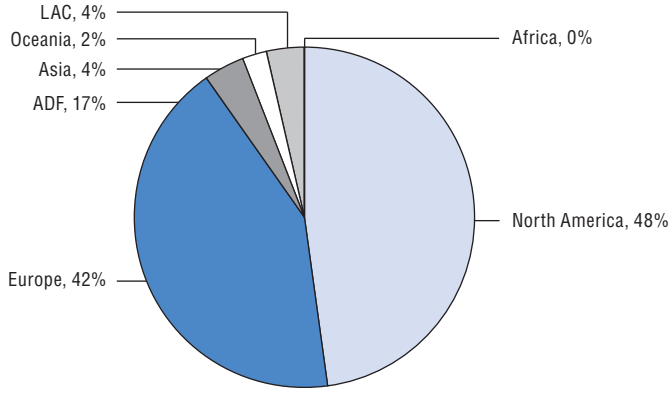
Figure 1.4. **EPR by Policy, worldwide**



Source: OECD (2013), *What have we learned about extended producer responsibility in the past decade? – A survey of the recent EPR economic literature*, Paris

Comparing the regional distribution of EPRs (Figure 1.5), 90% of the EPRs systems have been implemented in the EU and North America. EPR systems in the United States appear slightly more inclined to use instruments such as deposit/refund and ADF. These instruments were used in a bit less than half of US state-level policies compared with 21% for the rest of the world. In terms of products covered, there is some variation across regions. Within the EU, 34% of policies cover electronics, 18% packaging, 14% tyres, and 20% vehicles/auto batteries. In the US, 50% of policies cover electronics, 8% cover packaging, 24% cover tyres, and 7% cover vehicles/auto batteries.

Figure 1.5. **Regional Distribution of EPRs**



Source: OECD (2013), *What have we learned about extended producer responsibility in the past decade? – A survey of the recent EPR economic literature*, Paris

Another recent survey (Tasaki et al., 2015) examined how various stakeholders in different countries perceived the concept of EPR.[1] Respondents were asked what they thought EPRs should achieve. Out of 16 responses, the top three were: to increase the possibility of disassembling or recycling a product; to reduce a product's environmental impact; and to promote recycling or recovery. The bottom three were: to reduce the costs of waste management; to promote recovery; and to promote new business models. Responses varied among regions and stakeholders. While it is difficult to draw any general conclusion, the results of the survey help to underline stakeholders' and countries' different expectations in regard to EPRs, as well as the diversity of EPRs.

Legal and policy drivers of EPRs

Within the European Union (EU), all Member States have established take back EPR systems for the four waste streams identified in EU Directives: packaging, batteries, ELVs and Waste Electrical and Electronic Equipment (WEEE). Some of the recycling targets are currently under review as part of a broader review of EU waste management policy. While European waste legislation provides the enabling framework, national legislation by Member States specifies the operational aspects of EPR systems. As a result, EPR policies have been designed and implemented in a very heterogeneous manner across EU members. Some EU Member States have also put in place EPR systems for products not directly addressed in EU legislation e.g. for tyres, graphic paper, oil and medical waste.

In North America, EPR programmes in the United States and Canada cover a wide array of products and are primarily designed and implemented at sub-national level, by states and provinces. The 2009 Canada-wide action plan for EPR, emphasises a

Box 1.1. **Legal frameworks for Extended Producer Responsibility in Australia and Canada**

Australia's National Waste Policy sets a comprehensive agenda for national and co-ordinated action on waste and marks a fundamental shift in the national approach to waste management and waste resource recovery in that it aims to provide a common approach across the country, where responsibility for waste management is essentially located at the state level. The National Waste Policy was endorsed by the Australian Government, and state, territory and local governments in 2009. The policy identifies key areas of focus for all governments to pursue. Product stewardship was identified as one of these areas which lead to the development of the Product Stewardship Act 2011 (the Act), with end-of-life televisions and computers identified as the first products to be regulated under the Act. The Act provides a national framework to support voluntary, co-regulatory and mandatory product stewardship schemes. The scheme commenced in May 2012 with industry funded recycling services gradually becoming available around Australia. The scheme accepts all televisions, computers, printers and computer peripheral products (such as keyboards, mice and hard drives) for recycling. The Australian Government led the development of the scheme across all levels of government and with industry stakeholders. (See Annex A)

In Canada, the responsibility for managing and reducing waste is shared among federal, provincial, territorial, and municipal governments. EPR programs are regulated under the jurisdiction of provincial and territorial authorities, each using varying approaches to reach common EPR objectives. A national picture of EPR in Canada, therefore, accounts for these provincial variations. In 2009, the Canadian Council of Ministers of the Environment (CCME), a body that brings the environmental ministers of federal provincial, and territorial governments together, developed the Canada-wide Action Plan (CAP) for Extended Producer Responsibility (EPR). Through the CAP, the CCME and its member jurisdictions committed to working towards the development and implementation of EPR programs to provide guidance on how to strengthen the use of EPR and promote the harmonization and consistency of programs across the country. The goal of the CAP is to increase diversion and recycling of municipal solid waste through the harmonization of provincial EPR programs. Phase 1 of the CAP calls for a number of commitments from provinces and territories, including the implementation of EPR programs for electrical and electronic products by 2015. The jurisdiction for EPR programs rests with the provinces. (See Annex C)

Source: Case studies prepared for OECD Global Forum on Extended Producer Responsibility, 17-19 June 2014, *www.oecd.org/env/waste/gfenv-extendedproducerresponsibility-june2014.htm/*.

harmonised, outcome-driven model that has mostly resulted in systems where producers discharge their responsibilities collectively with oversight by provincial governments. In the US, there is no federal law regarding EPR; individual states have developed and implemented their own policies, reflecting local conditions and each state's specific political dynamics. Between 1991 and 2011, US states enacted more than 70 EPR laws generally requiring manufacturers to implement EPR programmes, but without specifying recycling targets. In parallel, producers themselves have implemented voluntary and stewardships programmes for the collection and recycling of their products.

In Latin America and the Caribbean (LAC), several countries including OECD members Chile and Mexico, but also Brazil, Argentina and Colombia, have recently taken steps towards implementing their first EPR systems. Their main focus is the large markets for potentially hazardous electronic waste (e-waste). In 2013, Chile submitted draft legislation on EPR to the Congress in response to a recommendation made in the context of its accession to the OECD

to strengthen its waste management policies. Legislation was approved by the Chamber of Deputies in 2015 and is now discussed in the Senate. Most EPR policies in the LAC region are at an early stage of implementation and require further efforts to be fully operational. In some cases they are complemented by voluntary initiatives by the private sector.

The current landscape of EPR in Asia varies significantly across countries and between OECD and non-OECD members. OECD economies like Japan and Korea have well-established, legally-based EPR systems, supported by a solid monitoring and enforcement. Some rapidly emerging economies, such as India and Indonesia have started to develop EPR programmes, though they are generally not yet fully operational. Malaysia and Thailand are working towards EPRs for e-waste, although these initiatives generally rely on the voluntary participation of producers. China put in place an EPR for e-waste in 2012, which is now beginning to show first results.

In Africa, EPR, and waste management policies in general, remain at a less advanced stage. E-waste is a growing concern on the whole continent. In some countries, informal recyclers play an important role, mostly for valuable waste fractions. Concerns have been raised about the health and environmental impacts of their operations (see below). In South Africa, a broad waste management act was introduced in 2009 which empowers the environment minister to require EPR measures on a product-by-product-basis. Although EPR initiatives in South Africa have been mostly initiated by industry, the government has enacted regulations to ensure enforcement of some of these initiatives, for example for an industry-led tyres recycling initiative.

Developments in governance arrangements

The governance arrangements that are being used for EPR schemes have evolved and converged to some extent of the past decade.

Many EPR systems are mandatory, while the use of voluntary schemes remains limited. There is little systematic, quantitative information available on the proportion of end-of-life products managed through voluntary or mandatory EPRs. However, the evidence that is available suggests that voluntary programmes are confined to a few, specific products or product categories where firms have an incentive to take back products because it is profitable to do so (see Chapter 2). For example, voluntary EPR programs, often known as "product stewardship" schemes, for consumer electronics, rechargeable batteries, mercury thermostats and auto switches were reviewed in the US. Despite a potentially large number of potential product categories that could be covered, the review indicated that voluntary EPR systems were limited to a range of products with high visibility, such as TVs and computers (see Chapter 4). There is also some evidence that voluntary programs have tended to achieve low collection rates (see Chapter 4). However, business-led voluntary schemes have had some effect in developing countries where mandatory EPR is not yet on the policy horizon (see Chapter 5).

There is a sizeable literature on voluntary environmental initiatives, though EPRs have not been a particular focus (OECD, 2003). Doubts have been raised about the effectiveness of such initiatives for various reasons including failure to progress beyond business-as-usual, regulatory capture, lack of transparency, poor monitoring and free riding. Their effectiveness appears to be contingent on a credible threat of regulation and on the establishment of a robust governance system.

Most EPR systems are organised collectively rather than individually. EPR schemes can be designed so that producers may discharge their EPR obligations individually or collectively. However, in some countries, there is no clear distinction between the two, and individual and collective responsibilities are designed to be mutually reinforcing (e.g. in Japan's EPR for home appliances). Individual responsibility systems have been established for some waste streams examined in a recent study for the European Commission, particularly when the product market is concentrated and it is viable for producers to operate a take-back system (e.g. German car producers [European Commission, 2014]). However, in a great number of cases, producers have established collective systems managed by Producer Responsibility Organisations (PROs, see Box 1.2; and Chapter 2).

Box 1.2. **Producer responsibility organisations**

Under take-back programmes, it could be impractical and not particularly economically feasible for each producer to take back its own products. Therefore, third party organisations are often formed allowing producers to collectively manage the take-back (and most often arrange for the treatment) of products. These organisations are often referred to as Producer Responsibility Organisations (PRO) and can be an effective structure for managing and collecting post-consumer products. The need to create a PRO depends on the policy instrument selected and other factors such as the product group, number of producers and importers, and secondary materials to be collected. The advantages of a PRO as a means to implement the EPR programme should be examined in the design stage. Most PROs in operation to date collect a fee directly from the producers based on a specific fee structure and the revenue is used to pay for the costs of waste collection, sorting and treatment.

Source: OECD, 2001, *Extended Producer Responsibility: A Guidance Manual for Governments,* OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264189867-en*.

Several reasons have been advanced to explain the greater use of collective systems: they generate economies of scale (or density) and hence reduce costs for participants; they help to share risk among participants, particularly in the difficult start-up phase; they can help to reduce free-riding through collective action by producers and peer pressure; they can simplify operations and reduce administrative burdens for consumers, retailers and municipalities; and they provide a means for governments to manage waste generated by orphan products.

Collective EPR systems may have one or more PROs. EPR schemes can be designed so that product markets may be served by individual or multiple PROs. Since the publication of the 2001 Manual, concerns about anti-competitive behaviour by monopolistic PROs has fostered the development of more multiple-PRO EPRs. Among the 36 EPR systems in the European Union that were reviewed (European Commission, 2014), all of the EPR systems for e-waste were managed by multiple PROs. Batteries were also frequently managed by multiple PROs. In contrast, ELVs were always managed by a single PRO. EPR systems for other product categories did not show a clear pattern.

The legal status of PROs also varies widely. PROs can be non-profit organizations (typically), government agencies (rarely), quasi-governmental non-profit organisations (occasionally) and for-profit firms (occasionally). In the study of EPRs in the EU, 13 of the 36 systems involved were for-profit PROs.

An important trend in markets with multiple PROs has been the establishment of clearinghouses. These are neutral bodies that help to co-ordinate the work of PROs by ensuring that collection is provided everywhere that it is needed, that "cherry picking" is avoided, and that there is a level playing field for all competitors. Co-ordination can enhance efficiency by ensuring that competing PROs do not duplicate each other's' activities. Clearinghouses often collect data from producers or service providers and provide a mechanism for managing proprietary data.

The role of municipalities is changing and has generally diminished

In some countries, the increased roles and responsibilities of PROs has led to a redefinition of their relations with municipalities. This is the case for product groups such as packaging and e-waste, where municipalities play an important role.[2] While in many EPRs, municipalities continue to have an active operational role in the collection and treatment of waste, in some systems they do not necessarily have any role. For example, in the packaging EPRs in Austria, Germany and Sweden, full operational and financial responsibility for collection, sorting and recycling has been passed to producers. PROs and municipalities manage separate collection systems – "dual systems". Municipalities may serve as contractors to the PROs, providing local services, but they have no automatic role in the EPR system.

New governance arrangements have emerged since 2001. Since the 2001 Manual, two new governance systems for EPRs have emerged: tradable certificates and government-run EPR systems (see Chapter 3).

In a tradable credit system, a producer's compliance with EPR obligations is accomplished when it collects its allocated number of credits for collected and processed end-of-life products. To date, the United Kingdom packaging EPR is the only tradable credit system in operation. Firms are allocated a share of the relevant obligation according to their position in the supply chain and the recovery target for the specific material used for packaging. The governance arrangement resembles that of a multiple-PRO system, but the role of producers is more modest as they finance only about 10% of the costs and are not involved in operations. Also, unlike in EPR systems involving PROs, the government plays a role in verifying that recycling has occurred. Given the limited experience with this instrument, it is difficult to assess whether it could be more widely deployed. Nevertheless, in view of the theoretical advantages of such market-based approaches, future assessments of the performance of the United Kingdom packaging system will be of interest beyond the United Kingdom.

The concept of EPR implies that producers take responsibility for the end-of-life treatment of their products. Nevertheless, some governments play a direct role in fee collection and disbursement. For example, these types of systems have been established in China for e-waste, Chinese Taipei for all products subject to EPR, and in several US states and Alberta, Canada. The role of the governments in these countries appears to be more interventionist than in countries like Denmark, Hungary and Iceland which levy a tax on products and/or packaging. The revenues from these taxes are only partly allocated to cover the costs of end-of-life treatment of products, with most going to the treasury. EPRs where governments play a leading role may have advantages in economies where industry does not have the capacity to establish and manage its own system. However, they may also delay or prevent producers from taking on the responsibilities implied by the concept of EPR.

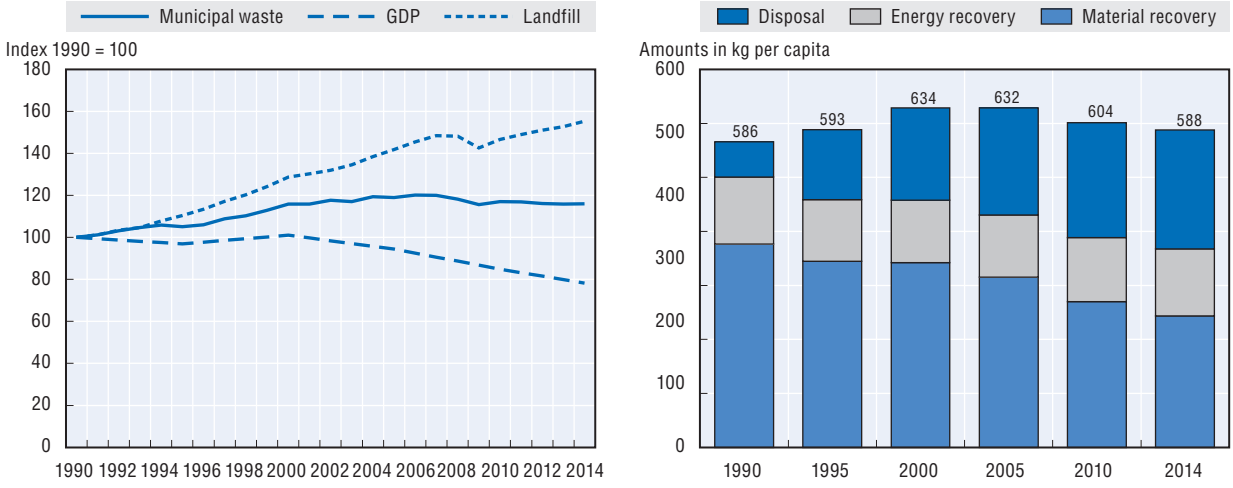
1.3.2. Impacts of EPR schemes

With more than 20 years of experience with some of the earliest EPR schemes, there is now some evidence available that allows assessing the environmental and economic performance of these approaches.

Evidence that EPRs have contributed to reducing waste disposal and increasing recycling

Despite data limitations and methodological challenges in attributing trends to specific policy initiatives, there is evidence that levels of waste disposal have decreased and recycling has increased in OECD countries. Figure 1.6 shows that between 1995 and 2011, the amount of municipal waste generated per capita in the OECD area increased from 520kg to 530 kg (OECD 2015). However, the 2011 figure shows a decrease from 560 kg, the level recorded in both 2000 and 2005. Moreover, the amount of material recovery in OECD countries increased from 19% in 1995 to 33% in 2010. Energy recovery increased from 17% to 18% in the same period. Figure 1.7 indicates that the levels of material recovery varied widely among OECD countries. This suggests that there is further scope in many OECD countries to increase recycling levels. Well-designed EPR systems could contribute in this regard.

Figure 1.6. **Trends in municipal solid waste management in the OECD**

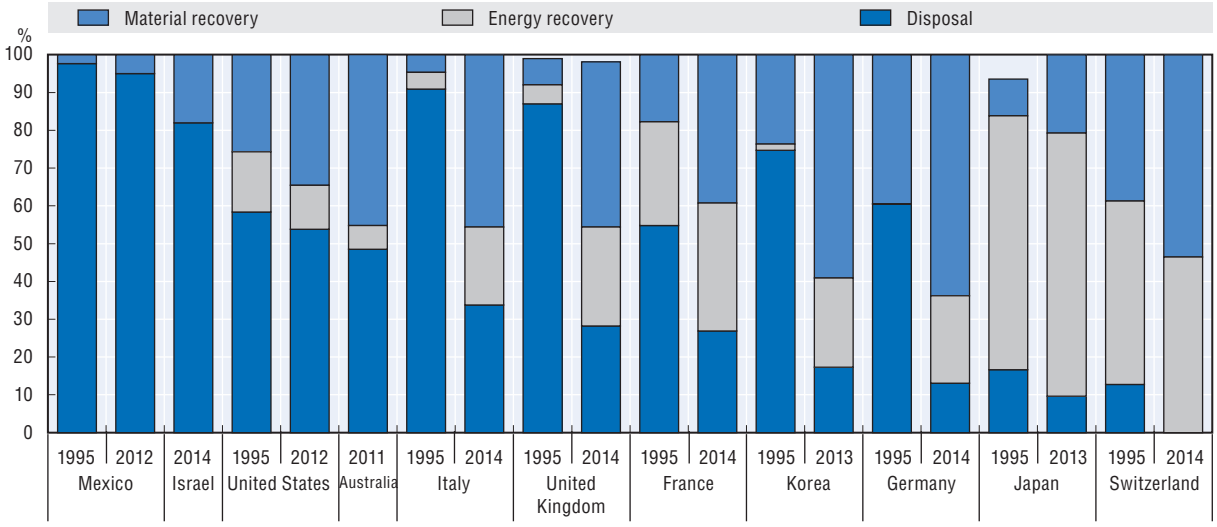


Note: Municipal solid waste only covers packaging and e-waste, but other types of waste covered by EPR, such as ELVs and tyres are not reflected in these numbers.
Source: OECD (2016), "Municipal waste generation and treatment", *OECD Environment Statistics* (database).

Waste collection rates vary between countries and across product types. In Western Europe the annual collection rates for e-waste are below 10 kg/capita; the Australian scheme for television and computer recycling collects about 2 kg/capita/year; while in the US between 0.3 kg and 4 kg e-waste per capita per year is collected (see Chapter 4). This compares with average annual purchases of electric and electronic equipment per inhabitant of 25 kg in Western Europe, close to 30 kg in Australia and above 30 kg in the US.

Another study focused on EU Member States also concluded that collection rates for oils, batteries and WEEE varied significantly among countries (see Table 1.1 below and European Commission, 2014). The rates generally did not reach more than 80%, apart from oils where 100% collection was not unusual. The same study concluded that EPRs had helped to achieve variable but reasonably high recovery targets. Evidence from Japan also

Figure 1.7. **Trends in municipal solid waste management by country**



Note: The sum of the categories presented here might not add up to 100% because "Other recovery" and "Other disposal treatments" are not presented. Germany and Italy, break in time series.
Source: OECD (2016), "Municipal waste generation and treatment", *OECD Environment Statistics* (database).

Table 1.1. **Performance features of selected EPRs in the EU**[3]

	Collection (C) or recycling and recovery rates (R)	Average producer fees
Batteries	5-72% (C)	240-5400 EUR/t
ELV	64-96% (R)	0-66 EUR/Vehicle
Oil	3-61% (C)	42-231 EUR/t
Packaging	29-84% (R)	20-200 EUR/t (average 92)
WEEE	1.2-17.2 kg/cap (C) (average 6.6)	68-132 EUR/t

Source: European Commission (2014), *Development of Guidance on Extended Producer Responsibility (EPR), final report.*

suggests that EPRs contributed to increased rates of recycling of containers and packaging waste; a 27% increase between 1997 and 2000 from1.25 to 1.59 million tonnes (OECD, 2014).

Although inter-country comparisons are fraught with methodological problems, these data suggest that there is probably scope in many countries to boost collection and recycling rates, for example through more ambitious targets and better product monitoring.

Reduced waste disposal and increased recycling will have helped to mitigate a range of environmental problems traditionally associated with waste management such as air pollution from waste dumps or incinerators, and contamination of land and water. More recently, evidence has emerged that improved recycling can also contribute to mitigating other environmental problems such as the generation of greenhouse gases (Menikpura et al., 2014). A broader analysis of the environmental benefits of EPR policies would be a useful contribution to the assessment of these policy instruments.

The impact of EPRs on eco-design has been less than originally hoped for

One of the objectives motivating the establishment of EPR systems was to encourage producers to design their products in a way that reduces their environmental impact. This can be achieved in several ways, including by: reducing the environmental impact of materials used (e.g. avoiding hazardous substances or using recycled resources), reducing

the amount of material used (e.g. development of lightweight products or reducing packaging), optimising the potential lifetime of products (e.g. increasing durability or re-using components), and reducing environmental impacts at the end of the product cycle (e.g. design for disassembly or producing mono-material goods).

Many academic and policy reviews have examined this issue and, despite the methodological challenges involved, generally concluded that the impact of EPRs on eco-design has often been limited (see Chapters 2 and 4). The consensus appears to be that EPR systems contribute to eco-design but that other factors sometimes have a more important triggering role.

In theory, EPR systems organised by individual firms provide better incentives for eco-design than collective systems: since the waste management costs accrue exclusively to the individual company, that company has a stronger incentive to reduce these costs through eco-design than firms participating in collective systems. However, there does not appear to be any empirical information shedding light on the relative effectiveness of individual and collective EPR systems in promoting eco-design. In Japan, some positive experience has been gained with combining collective systems with elements of individual producer responsibility as well as developing improved communication between upstream and downstream actors in the value chain (e.g. Japan's EPR for household appliances, see Box 1.3 and Annex H).

Box 1.3. **Japan EPR for home appliances**

The Act for Recycling of Specified Kinds of Home Appliances was enacted in June 1998 and enforced in April 2001. It aims to achieve a reduction in the volume of waste and to improve material recovery from this source. The Act covers four categories of home appliances: air conditioners; TV sets; electric refrigerators and freezers; and electric washing machines and clothes dryers.

Under the act, each home appliance Manufacturer has the obligation to set up designated collection sites for taking back and recycling their products when they become waste. To implement their obligations, Manufacturers have set-up two competing groups, each of which brings together three or four of the most important producers and represents a similar share of the market. One of the groups has set-up its own recycling facilities, while the other contracts with existing operators.

Consumers and businesses that dispose end-of-life home appliances have to pay both, the collection/ transportation and the recycling fee. Traceability is ensured by the use of home appliance recycling tickets (manifests) that are issued to consumers who paid the recycling fee. This manifest system ensures that waste home appliances are delivered to the original Manufacturers of the products.

While there is no differentiation between the costs to manage individual brands within each of the producer groups, potential cost savings through efficient processing or product design remain with producers. Hence, there is competition between the two manufacturer groups over the minimisation of recycling costs.

The advantage of the vertical integration that results from the implementation of Japanese EPR for Household Appliances is that it creates a strong link between downstream management of end-of-life products and the producer. There is some empirical evidence that the system does provide tangible incentives for eco-design.

Source: See Annex H, Case study: Japan EPR for home appliance; Dempsey et al. (2010) and Tojo (2004).

The way in which the PROs of collective systems establish fees can have an important bearing on incentives for eco-design. PROs are financed either on a variable- or fixed-fee basis. Fixed-fees are typically used in PROs for complex goods such as electronic equipment, cars or furniture where it would be difficult to link the fee to the product's environmental impact. In such cases, it is easier to apply a common fee. However, this results in the lack of a link between the fee and waste management costs associated with specific products and it provides only weak and indirect incentives for eco-design.

Variable-fee PROs are mainly used for mono-material products with limited durability, such as packaging or graphic paper. Typically they calculate the fee by weight which provides a financial incentive to make products lighter. Some systems also aim to provide incentives to simplify recycling, for example by charging higher fees for multi- as opposed to mono-material products, or by targeting other design parameters. In Eco-Emballages, France's packaging PRO, incentives for eco-design were provided by increasing the fee for glass packaging with ceramic caps and other material mixes that were difficult to separate by 50%.

Table 1.2 below shows that the weight of food packaging in Europe decreased, 2000-10. The variable fee structure may have influenced this trend, but it is difficult to disentangle the contribution of EPRs from other factors (e.g. the financial gains from less packaging material).

Table 1.2. **Reduction in food packaging weight in Europe, 2000-10**

Packaging and product	Weight 2000 (kg)	Weight 2010 (kg)	% change
PET bottle of 1.5 L still water	0.0318	0.0280	-12
Aluminium can of 330 ml for soft drinks	0.0158	0.0131	-17
Glass bottle of 250 ml for olive oil	0.2236	0.2002	-10
Tin can of 125 gr for fish	0.0343	0.0319	-7
Plastic bag for 1 kg of pasta	0.00903	0.00785	-13
Cardboard box for dry food	0.01388	0.01132	-18

Source: http://proeurope4prevention.org/packagings-trends.

Some evidence that EPR systems have helped reduce financial burdens on public budgets and taxpayers

One of the main objectives of EPR is to shift the financial responsibility for treating end-of-life products from local public authorities to producers (and ultimately consumers), thereby reducing the burden on public budgets and taxpayers. There is some evidence that this has occurred. For example, in France in 2012, total spending on municipal waste management was estimated at EUR 9.7 billion. In the same year, EUR 630 million of collected "eco-contributions" were allocated to local authorities to cover the costs of collecting and treating waste products. In addition, producer organisations spent EUR 230 million on the treatment of used products.

While EPRs appear to have reduced the burden on public budgets, assessing their cost effectiveness is more challenging. This task is hampered by a considerable lack of data. PROs generally do not publish financial data, sometimes on the grounds that it is commercially sensitive (for the PRO or its members). The most extensive analysis on this issue was carried out in the EU (European Commission, 2014). It found that, to the extent that information was available, the fees paid by producers varied greatly for all product categories (see Table 1.1 above). This reflected differences in scope, cost coverage, and the actual costs of collection

and treatment. The study concluded that the best performing schemes, in most cases, were not necessarily the most expensive. No single EPR model emerged as the best performing or the most cost-effective.

The cost-effectiveness of EPRs can also be viewed from the point of view of instrument selection. OECD (2013) reviewed the economic literature related to EPRs and concluded that "for a given target of waste reduction, the deposit/refund is the least cost policy followed by the advanced disposal fee, both of which were calculated to perform better than the non-EPR recycling subsidies. Comparing the marginal costs of waste reduction against the social benefits, … modest increases in waste reduction would be efficient." These two policy instruments together accounted for just over one-quarter of EPR systems surveyed; deposit refund, 11%, and advanced disposal fees, 16%. However, the paper indicates that there is a gap in the academic literature regarding the cost-effectiveness of other instruments such as take-back which accounted for 72% of the instruments reviewed. Empirical analysis of the cost-effectiveness of the various EPR instruments in practice could provide useful guidance to policy makers.

Some evidence that EPRs generate economic opportunities as well as environmental benefits

In addition to environmental benefits, EPR programmes generate a range of economic opportunities. Again, information is sparse, but they include increased technological and organisational innovation, a diversification of sources of material supply and, hence, resource security, and a better organisation of supply chains. Given the lack of economic analysis of EPR systems, including their cost-effectiveness, it is not surprising that no attempt appears to have been made to assess their costs and benefits. Given the importance of EPRs as instruments for achieving waste management and resource productivity policy objectives, such analysis would clearly be of value for policy makers (OECD, 2005).

The economic opportunities associated with environmentally sound waste management and recycling can support green growth. One study (Chalmin and Gaillochet, 2009) estimated that at the global level, the waste sector, from collection to recycling, represented a market in excess of EUR 300 billion. Of this, municipal waste accounted for about EUR 150 billion, with non-hazardous industrial waste accounting for the remainder. A study by the European Environment Agency (2011) suggested that in the period 2004-08, turnover in the European recycling sector increased by 100% and reached at least EUR 60 billion. These sectors also create and sustain thousands of jobs, though, again, the data is patchy. Further analysis of EPR systems' contribution to the recycling sector would be a valuable contribution to discussions on green growth.

Notes

1. About 420 responses were received, mostly from people with a long experience of working with EPRs in both the public and private sectors. About 30% were from Japan, 28% from Europe, 11% North America (Canada and US), and 9% from Asia (excluding Japan).
2. Municipalities usually do not play a role in the collection of other waste streams, such as used oil, end-of-life vehicles and lead-acid batteries.
3. Data presented in the table is mostly from 2013-14.

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