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Extended producer responsibility policy in Portugal: a strategy towards improving waste management performance

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ABSTRACT

This article provides an assessment of waste management evolution in Portugal, with a particular emphasis on the performance brought by the adoption of several EPR schemes, namely the ones developed for packaging (general, medicine and plant protection products), used tires, used mineral oils, end-of-life vehicles (ELV), waste electrical and electronic equipment (WEEE), portable batteries and car and industrial batteries. Further, a particular focus is placed on the drivers that influenced the development of such EPR schemes in the country and the challenges facing EPR schemes' development in Portugal.

The results achieved in a short period of time suggest that the evolution of the implementation of the EPR concept in Portugal was, so far, successful, not only in quantitative but also in qualitative terms (contributing for a reduction of environmental performance). However, there is still room for improving EPR impact in the long-run and this is largely dependent on policy instruments (of fiscal, information and supervision natures) that can positively influence the context in which EPR schemes operate.

1. Introduction

The extended producer responsibility (EPR) is one of the mechanisms highlighted by the EU waste framework Directive (Directive 2008/98/EC) to support its objectives, namely the reduction of waste production and management performance. In fact, more than 20 years after the implementation of this policy strategy in the EU (Forslind, 2009) – whose legislation covers actually packaging, end-of-life vehicles, waste electrical and electronic equipment and batteries – it may be stated that it has been a major contribution to shift waste management in the direction of more recycling allowing to decrease impacts from disposal of end-of-life of products (e.g. Fischer, 2011; Gerrard and Kandlikar, 2007; Barba-Gutierrez et al., 2008; McKerlie et al., 2006).

The EPR strategy has also been one of the main pillars of the Portuguese waste policy since the 1990's. Like in most of the European countries, the implementation of this waste management strategy in Portugal stems from the adoption of the EU legislation and not from a national initiative (Cahill et al., 2011).[1] The waste framework Directive was directly transposed to the Portuguese legislation and for the most part, a pooled take back approach was adopted. Producers were mandated to create a non-profit producer responsibility organization (PRO) to organize and manage the collection and recovery of specific wastes (Lifset and Lindhqvist, 2008).

Many articles have dedicated to assess the EPR approach associated to certain flows – WEEE (e.g. Hischier et al, 2005; Magalini and Huisman, 2007; Turner and Callaghan, 2007; Barba-Gutierrez et al., 2008; Manomaivibool, 2009; Walther et al., 2010; Zoeteman et al., 2010), ELV (e.g. Forslind, 2005; Ferrão et al., 2006; Forton et al., 2006; Gerrard and Kandlikar, 2007; Santini et al., 2011; Xiang and Ming, 2011), Tires (e.g. Ferrão et al., 2008; Milanez and Bührs, 2009), among others – but very few articles have dedicated to assess the EPR policy approach of a country (e.g. McKerlie et al., 2006; Nash and Bosso, 2013), particularly in Europe. Therefore, EPR based articles usually do not provide an integrated perspective of the benefits and constraints associated to implementing this strategy, or its impacts in the waste management performance of a particular country.

In this context, the research presented in this paper seeks to bridge this gap in the literature, by developing a case study within a particular context, to attempt the answer of the following research questions: 1) what is the impact of EPR implementation in waste

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[1] Exceptions are Germany, Austria, Belgium and France that developed national initiatives prior to the first EPR based Directives (Cahill et al., 2011).

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management performance?, 2) what are the main context conditions associated to EPR implementation?, and; 3) what are the potential drivers that are able to improve EPR systems' performance?

This research uses a case-study methodological approach (Eisenhardt, 1989; Yin, 1994), by which quantitative and qualitative data specifically referring to the object of the research question – EPR implementation and impact in the Portuguese context – is compiled and analyzed. This supports the characterization of the context, identification of benefits and constraints from which the potential drivers of EPR performance can be extrapolated. Moreover, the authors' own experiences in assisting the implementation of these systems, and the convergence of multilateral observations, enhances the confidence in the findings, as stated by Eisenhardt (1989).

The paper is organized according to the objectives/research questions established. Section 2 sets the context, by providing an assessment of waste management evolution and performance in Portugal up to the introduction of the several EPR schemes (e.g. packaging waste, used tires, mineral oils, end of life vehicles (ELV), waste electrical and electronic equipment (WEEE), portable batteries and car and industrial batteries). Section 3 details the context specifications associated to the EPR functioning and performance. Section 4 takes into consideration the previous results to suggest further policy instruments that may improve EPR system's performance. And finally Section 5 presents the main conclusions of the paper.

2. The evolution of waste management in Portugal

2.1. Main policies

In Portugal, waste management began to be perceived as a priority during the 1990's. This became more evident with the disclosure, in 1995, of the first performance indicators, particularly the ones related to the municipal solid waste (MSW) stream. At the time, proper treatment was only assured for 26% of the MSW generated in Portugal, mainly consisting of disposal in controlled landfills,[2] while the remainder was disposed across 340 uncontrolled dumping sites. Also, separate collection for recycling was limited to metropolitan municipalities and for paper and glass waste flows only (Pássaro, 2003).

A major shift to this scenario came in the end of the nineties, when new strategic orientations for waste management were implemented through a series of specific plans (Table 1), the most relevant being the Municipal Solid Waste Strategic Plan (PERSU, Plano Estratégico do Resíduos Sólidos Urbanos, in 1997 and reviewed in 2007), the Hospital Wastes Strategic Plan (PERH, Plano Estratégico dos Resíduos Hospitalares, in 1999) and the Industrial Waste Strategic Plan (PESGRI, Plano Estratégico de Gestão dos Resíduos Industriais, in 2001).

In seven years these policies fostered a large investment in infrastructures. For example, the most important results of the first Municipal Solid Waste Strategic Plan (PERSU I, 1997–2006) were the closure of the uncontrolled dumping sites and the implementation of composting plants, two incineration plants (in Lisbon and Porto metropolitan areas), the construction of controlled landfills, and the development of the first measures to achieve recycling targets.

[2] A "controlled landfill" is a landfill which is developed by taking into account the operational and technical requirements, measures, procedures and guidance's set by EU Directive 99/31/EC – also known as the Landfill Directive – to prevent or reduce as far as possible the negative effects on the environment during the whole life-cycle of the landfill.

Table 1
Waste management plans, Portugal, 1997–2011.

Waste category	Acronym	Name
MSW	PERSU I (1997)	Municipal Solid Waste Strategic Plan
	ERB (2003)	National Strategy to Reduce Biodegradables Landfilling
	PIRSUE (2006)	Intervention plan for MSW and equated wastes
	PERSU II (2007)	PERSU I revision
Industrial Waste	PNAPRI (2000)	National Prevention Plan for Industrial Wastes
	PESGRI (2001)	Strategic Plan for Industrial Wastes Management
Clinical waste	PERH (1999)	Strategic plan for Clinical waste
Agricultural waste	PERAGRI (in progress)	Strategic plan for Agricultural Waste
All	PNGR (in progress)[a]	National Waste Management Plan

[a] As consequence of the new framework directive (Directive 2008/98/EC) a National Waste Management Plan (PNGR) has been developed and, after a period of public discussion will be published by the government. This plan settles the national strategic objectives of the waste management policy and the guiding rules that assure the coherence of the specific plans and the creation of an adequate and integrated network of recovery and disposal infrastructures. The other plans will then be assessed and if needed changed according to the PNGR objectives and targets.

2.2. Overall waste management performance

From 1990 to 2009 the production of Municipal Solid Waste (MSW) in Portugal increased from 3.0 Mt to 5.2 Mt, and between 1998 and 2009 non-urban waste production increased from 21 Mt to 23.7 Mt (APA, 2010; IA, 2005). This represents, for 2009, an average 2.7 t/cap.year, well below the EU average of about 6 t/cap.year (EEA, 2010). Despite the registered growth in waste production, the infrastructural and organizational development of waste management in Portugal has improved considerably in these last two decades, allowing for 100% coverage of the population in terms of collection and adequate destination of their waste, against 25% in 1996.

Between 1997 and 2002, the most prominent outcome of the mentioned policies was that all the MSW generated in Portugal was disposed-off appropriately and almost 70% of the national territory was covered by glass and waste packaging collection for recycling. Between 2002 and 2009 (Table 2) the recycling and organic recovery rates developed favorably, respectively achieving 11.5% and 8.1% of the MSW destination in 2009, gradually approaching the EU average (16.4% and 9.8%, respectively) (INE, 2010).

In terms of average annual growth, the separate collection of multi-material wastes for recycling grew the most, at an annual increase rate of 15% between 2004 and 2009. However, landfilling still represents the destination for 62% of wastes arising from the non-separate collection, which is 10% above the EU average (INE, 2010) and 30% above the target established by PERSU II for 2009 (MAOTDR, 2007). According to the National Council for the Environment and Sustainable Development (CNADS, 2011) these values are the result of a waste management policy that has mainly relied on technological solutions, with the construction of a large number of infrastructure and equipment, involving large investments, often at the expense of solutions that embrace changing attitudes and social practices. This leads to high and increasing costs of collection and transport, a limiting factor to a faster progression of MSW recycling.

2.3. The impact of EPR schemes

Currently, waste streams covered by EPR represent almost 1.6 Mt of wastes, about 6% of all the wastes produced in the country

Table 2
-Treatment and disposal of MSW, Portugal 2002 and 2009.

	2002	2009
MSW production (Mt)	4.7	5.2
Landfill (%)	72.0	61.7
Recycling (%)	5.0	11.5
Organic recovery (%)	3.0	8.1
Energetic recovery (%)	20.0	18.4

Source: INE (2010); EC, EUROSTAT (2005).

(INE, 2010). The performance for the period between 2005 and 2009 is presented in Table 3.[3]

Overall, results show that there was an increase in quantity and quality of wastes recovered and recycled. In terms of collection, the numbers for 2009 demonstrate that management targets were accomplished, with the exception of batteries. Collection targets for batteries were only regulated from 2011 onward; therefore there are currently no results available.

In terms of recycling rates, the performance of the national PRO's was placed above EU targets. In some cases, such as packaging waste, the target achieved in 2009 already exceeded the EU recycling target for 2011 of 55%; and in the case of ELV, the estimated recycling rate is already complying with the future 2015 EU target of 85%.

Finally, in the case of recovery targets, the estimated rates for packaging waste, ELV, WEEE (all categories) and used tires were achieved in 2009 (the 2011 target for packaging was even surpassed). The recovery rate for waste oils was fulfilled through re-refining and recycling, which are preferable destinations to recovery, according to the hierarchy set in Portuguese law (MCOTA, 2003a).

Although Portugal's current performance in recycling/recovery rates may be considered positive, it is still not sufficient to bridge the gap from EU average performance in terms of waste management, mainly due to the fraction that is separately collected that is currently low, as mentioned. The country has a limited performance towards a "recycling society", with "medium/low levels of recycling" and "high levels of landfilling and a static or increasing reliance on this method of treatment" (IEEP et al., 2010).

Nevertheless, the numbers show that EPR based systems in Portugal have certainly provided improvements in terms of collection, recycling and recovery performances for specific waste flows. In this context, it is possible to state that PRO's, and the waste management systems they run, are, so far, a step forward towards developing a "recycling society" in Portugal.

Still, it is arguable that there is room to improve the performance and impact of current EPR based systems in the country. Thus, it is important to understand the rationale behind their functioning and the conditions to be accomplished, before assessing the potential drivers for their expansion and development.

3. EPR operational framework and conditions

3.1. Operational framework

As in many of the EU countries (Cahill et al., 2011; Queiruga et al., 2012) the implementation of EPR in Portugal has been strongly driven by European Directives addressing waste in general and also specific waste flows. It was first introduced in 1997, with the adaptation of the European Directive for packaging waste (Directive 94/62/CE) to the national law (Decree-Law n.° 366-A/97). The Portuguese "green dot society" for packaging was the first of many pooled take back schemes based on PROs, created by producers to handle special waste streams. From 2000 to 2006 eight more of these organizations were created in Portugal, addressing used tires, batteries, end of life vehicles, waste electrical and electronic equipment, and waste mineral oils (Table 4). Although in general terms, schemes have been prompted by European Directives, there were cases for which the Portuguese government developed specific waste management frameworks from its own initiative likes used tires and used oils.

Following the main European schemes (Cahill et al., 2011; Mayers, 2007; Magalini and Huisman, 2007) the Portuguese producers or importers of goods transferred the responsibility of the end-of-life management of their products to the PRO, which, in turn, must provide environmental and technical conditions to ensure that collection, recycling and recovery targets are achieved (MAET-MAOT, 2005; MAOTDR, 2009a; MAOTDR, 2009b; MAOTDR-MEI, 2009; MAOTDR-MEI, 2006a).

In all cases, prior to the publication of legislation regulating the PRO activities, there are consultation periods where stakeholders are invited to provide feedback about the proposed framework. Once the legislation is adopted, producers are given a period to comply with all the norms, procedures and demands of the EPR legal framework (i.e. establishment of the PRO and the pooled take back system process).

The public authority on wastes (APA) then issues the special license for PRO operation, which is usually valid for a 5 year period, after which it can be renewed. The license includes collection and recovery targets, the value of financial incentives for different stakeholders (eco-fees and collection incentives), the responsibilities and rights of stakeholders, the requirements for the organizational information system and the financial and management obligations for information and R&D activities (see Ferrão et al., 2008 for a full description of Valorpneu's – the used tires PRO – establishment process). During the period of implementation of the waste management system, the PRO's have to provide reports to the APA that is responsible for monitoring and supervising their performance (Cruz et al., 2012). Additionally APA directly monitors the waste management companies' operational performance, by assessing the data that these also have to issue on a regular basis to a national web platform (SIRAPA[4] – APA's Integrated Registration System).

Although there are two information sources, which may lead to disparities in results, so far, the results reported by PRO's have been always validated by the APA and have been reported as the national results.

The national legal framework that was developed for each specific waste flow provides some flexibility regarding the way producers could organize the waste management, allowing them to create either individual or collective take-back schemes. By giving this choice to producers, the government wanted both to prevent business barriers and take advantage of producers' willingness to collaborate with each other. The intention was to speed up the development of take-back schemes while ensuring that all producers fulfill their responsibilities. However, like in the majority of the EU countries (Lifset and Lindhqvist, 2008) the Portuguese government encouraged the development of EPR systems based on the collective pooled take back approach. This could decrease the number of interlocutors, could prevent the number of free-riders (Mayers et al., 2011; Queiruga et al., 2012), but specially would free the state from managing the "orphan waste".[5] More that fifteen

[3] This is the period with more data available, allowing to compare more systems.

[4] http://sirapa.apambiente.pt/SIRAPA_Ext_Org/Principal.aspx (in Portuguese).

[5] This designation includes wastes of products placed in the market years before the corresponding OPR system has been implemented (waste stock or historical waste) and wastes of a producer that was an associate of an OPR but meanwhile left the market (e.g. by bankruptcy or change of business focus).

Table 3
Overview of generation and recycling of EPR-related waste flows in Portugal, 2005 and 2009.

Waste stream	Generation (kt)		Collection rate (PT)		Collection targets (EU)	Recycling rate (PT)[c]		Recycling targets (EU)	Recovery rate (PT)		Recovery target (EU)
	2005	2009	2005	2009	2009	2005	2009		2005	2009	
Packaging waste	1498	2,055[a]	–	–	–	44%	66%	55% (2011)	51%	72%	60%
Waste mineral oils	41 (2006)	37	71% (2006)	80%	85%	52% (2006)	88%	50%	100%	100%	[f]
Used tires	79	87	98%	103%[b]	95%	69%	98%	65%	98%	100%	[g]
WEEE	4	45	1.0 kg/ capita.year	4.94 kg/ capita.year[i]	4 kg/ capita/year	94%[d] (2007)	88%[d]	50–75%[e]	–	–	70–80%[h]
ELV	127 (2006)	108	–	–	–	82% (2006)	85%	80%	86% (2006)	88%	85% (in mass)
Batteries	2.5[a]	2.4[a]	17%	21%	–	–	–	–	–	–	–

[a] Estimation considering the amount of products placed in the market (assuming they have a short lifetime).
[b] Collection = 90 kt (due to waste stock – see endnote 4).
[c] Recycling rates are not comparable between flows since the regulated accounting basis differs.
[d] Average from recycling rates of 10 categories of products.
[e] Recycling and recovery rates vary according to the type of WEEE collected.
[f] Recovery of the total amount of waste oils collected and not subject to recycling.
[g] Recovery of the total amount of used tires collected and not subject to retreading.
[h] Percentage of the average weight of a unit, depending on the type of appliance.
[i] Data provided by the PRO – Amb3E.
Source: APA (2010b).

years later the result was that only one individual take back scheme was ever established in Portugal, by a producer of water, in 1997, which set up his own collection and recovery system for glass bottles (APA, 2008).

3.2. Key operational conditions

When assessing the legal framework, the decisions of public authorities and the relations between the actors of EPR (PROs and operators), it is reasonable to state that, Portuguese EPR policies and practices developed to provide:

- The establishment of an effective collection, transport and recovery network;
- An improvement of environmental performance of waste management, including the treatment of "orphan waste";
- An attractive and competitive market for wastes under the scheme.

3.2.1. An effective network

1. In order to guarantee the collection, transport and treatment of the waste and the achievement of the respective targets in Portugal, PRO's were mandated to assure throughout the country networks of collection centers and logistical and treatment partners. Like in many EU countries the recovery and recycling networks (e.g. for packaging) have been developed and implemented in coordination with municipalities (Cahill et al., 2011; Cruz et al., 2012).

In the case of used tires (PRO responsible – Valorpneu) the regional collection centers were implemented with a geographical distribution pattern that considered population density, the average distance travelled by final holders and regional influence areas. It eventually minimized management/logistics complexity and costs, while simultaneously assuring higher collection and recovery rates: from 28 collection centers in 2003, Valorpneu went up to 48 centers in 2010. The amount of tires collected increased, from the initial 60.974 tons in 2003, to 98.016 tons in 2010, with management cost evolving from an initial 104.4 euro per ton in 2003 to 111.1 euro per ton in 2010 (Valorpneu, 2011). Two more examples of logistics' development are presented in the next subchapter ("Improving environmental performance").

The government allowed some exceptions though, by not establishing minimum requirements for the collection infrastructure for medicine and plant protection product packages. The waste management infrastructure in these cases was developed based on reverse logistics, taking advantage of the product distribution chains (e.g. pharmacies and agriculture products stores) (ME-MA, 1999; MAOTDR-MEI, 2006b). The PRO's only had to ensure the

Table 4
Management responsibility for each main typologies and special waste streams in Portugal.

Waste stream	Waste sub-type	Approach	PRO organization	Implementation year (first license)	Current legal framework (reference)
Packaging	General packaging[a]	Pooled take back	SPV – Sociedade Ponto Verde	1997	MAET-MAOT, 2005
	Medicine packaging[b]	Pooled take back	VALORMED	2000	ME-MA, 1999
	Plant protection product packaging	Pooled take back	VALORFITO	2006	MAOTDR-MEI, 2006a
Used tires		Pooled take back	VALORPNEU	2002	MAOTDR-MEI, 2009
Batteries	Portable and industrial batteries	Pooled take back	ECOPILHAS	2002	MAOTDR, 2009a
	Automotive and industrial batteries	OEM take back	VALORCAR	2009	MAOTDR, 2009b
End-of-life Vehicles (ELV)	–	Pooled take back	VALORCAR	2004	MEIDOPTH – MAOT, 2010
Waste Electrical and Electronic Equipment (WEEE)	–	Pooled take back	AMB3E EPR Portugal	2006	GSEA, 2010 MAOTDR-MEI, 2006b
Waste mineral oils	Mineral oils	Pooled take back	SOGILUB	2005	MEID-MAOT, 2011

[a] General packaging terminology is used here in order to differentiate medicine and plant protection product packaging of the main packaging flow, which is in the scope of the Portuguese "green dot society" - SPV.
[b] VALORMED is also responsible for the collection and treatment of unused drugs, but this waste flow is beyond the scope of this document.

Table 5
Regulated targets for wastes covered by PRO, Portugal. Source: APA (2010).

Waste stream	Target year	Collection targets	Recycling targets	Recovery targets
Packaging	2005	n.a.	25% (total)	55%
	2011	n.a.	55% (total): 60% (glass, paper and cardboard) 50% (metals) 22.5% (plastic) 15% (wood)	60%
Waste mineral oils	2006	85% of the used oils produced yearly[a]	50% of the collected oils not subject to regeneration	All the collected oils not recycled
Used tires	2007	95% of the tires sold yearly[b]	65% of the collected tires not retreaded	All the collected tires not recycled
WEEE	2006	4 kg./hab/year	75% (Categories 1 and 10)[c]	80% of the average weight per equipment (categories 1 and 10)
			65% (Categories 3 and 4)[c]	75% of the average weight per equipment (categories 3 and 4)
			50% (Categories 2, 5, 6, 7 and 9)[c,d]	70% of the average weight per equipment (categories 2, 5, 6, 7, 9)
ELV	2006	n.a.	Reuse and recycling of at least 80%, in average, of the weight per vehicle per year of all the ELV produced (85% in 2015)	Reuse and recovery of at least 85%, in average, of the weight per vehicle per year of all the ELV produced (95% in 2015)
Batteries	2011	25% of used portable batteries (45% in 2016)	65% (in mass) of lead-acid batteries (assuring the maximum recycling of lead technically possible) 75% (in mass) of nickel-cadmium batteries (assuring the maximum recycling of cadmium technically possible) 50% (in mass) of other battery wastes	n.a.

[a] Regeneration of all the used oils collected, as long as these respect technical specifications to that operation. In any case, it must be assured a regeneration rate of at least 25% of the collected used oils.
[b] Of these, at least 30% must be retreaded.
[c] According to Decree Law 230/2004: Category 1 (Big electric appliances) and 10 (Vending machines); Categories 3 (Informatics and telecommunications equipment's) and 4 (Consumption equipment's, e.g. radios, TVs); Categories 2 (Small electric appliances), 5 (Lighting equipment), 6 (Electric and electronic tools), 7 (Toys and Sport and Leisure equipment's) and 9 (Monitoring and control instruments).
[d] 80% for gas discharge lamps.

final destination for the wastes that were collected, which they did by signing contracts with waste treatment and recovery operators.

Exception made to waste oils, the results of collection, recycling and recovery expressed in (Table 3) suggest that the current networks have a dimension that allows the fulfillment of management targets in all EPR schemes.

2. As in the UK (Turner and Callaghan, 2007), Portuguese PRO's are mandated by the environmental authority to report up to date and detailed information on the waste management operations. This includes evaluating the waste quality as well as the treatment and recovery performance of their network partners. As consequence, most PRO's in Portugal have developed information systems to collect operational data from the respective partners network, which is complemented by frequent auditing activities, to check the accuracy of the data.

It can be argued in this context that, to some extent, this has turned PRO's into information hubs and allowed the environmental authority to have a closer and sharper eye on the operations that take place in the terrain. For instance, SOGILUB, the waste mineral oils PRO was required to adopt a complex and exhaustive system to collect samples and make physical-chemical analysis of all collected waste oils, in order to detect the presence of any PCB and chlorine compounds (MEID-MAOT, 2011). Whenever the concentrations of those substances in the oil are above a defined limit, the PRO is obliged to report the contamination and its origin to the authority (MCOTA, 2003a).[6] With more than 26.000 samples taken since 2006, this system helped characterize used oils generated and collected in Portugal, identifying any contamination and penalizing the organizations responsible for it. Ultimately this promoted the reduction of inadequate practices within the collection infrastructure, namely the mixture of contaminated oil with non-contaminated oil.

3. As mentioned, the environmental authority has simultaneously developed a data registry system, SIRAPA. The SIRAPA is the online national waste information reporting system and requires that producers, waste management operators, PRO's and waste traders report the annual accounting of the type and amount of wastes produced, the designation of the company(ies) that accept the waste and the recovery/disposal operations that were conducted. It also keeps records of product manufacturers and importers subject to EPR regulations, allowing cross-checking information with PRO's databases.

Over the years, the SIRAPA and the PRO's databases together have identified manufactures and importers that sold products in the Portuguese market and didn't comply with EPR, contributing to minimize the number of free-riders operating in the country. These monitoring systems together have also identified bad waste management practices, like illegal waste transfers or simply the lack of respect for the hierarchy of waste recovery operations, and those responsible for it, which helped increase the amounts of waste managed according to legal requirements and recovered. For instance until recently (2009) all the collected medicine packaging was incinerated since there was no sorting system for these wastes (Valormed, 2010). The development of a sorting system allowed that in the first year 55% of the collected packaging was recycled. However in the second year this fraction decreased to 31% leading the PRO to end the contract with the operator responsible for sorting and hiring another for the purpose (Valormed, 2011).

[6] SOGILUB and the operator must warn APA 24 h at most after detecting PCBs concentration in waste mineral oils above the legal limit (50 ppm).

3.2.2. Improving environmental performance

1. All EPR regulations in Portugal include objectives, targets and procedures towards reducing environmental burdens associated to managing each specific waste flow. One of the most significant examples is the already mentioned quality control procedure for managing waste mineral oils.

Target values and timelines for compliance set nationally in line with EU legislation (Table 5) required immediate action by producers/PRO's in Portugal and prompted the quick development of the waste management systems' ability to fulfill the respective targets.

Fig. 1 show that for several waste flows the recovery rate greatly increased after the implementation of EPR systems and the establishment of the respective recovery targets. The increase was significant right from the first years of EPR and evolved to the achievement of high levels of recovery.

In the context of EPR implementation, one can argue that, for Portugal, setting ambitious targets was one important factor contributing to improve waste management performance overall, namely leading to the improvement of national recovery rates. It is clear that for specific waste flows like waste oils and WEEE there was a significant improvement in the recovery rates, in the case of used tires the improvement was also important but for ELV it was moderate. The performance associated to the latter stems from the fact that before the establishment of the PRO the amount of products recovered was already high – around 80% – though in many cases in an informal and uncontrolled way by scrap collectors. Prior to the ELV Directive, voluntary agreements with car producers, like in other 9 European countries, was also an important driver for this performance (Gerrard and Kandlikar, 2007).

The performance related to WEEE and waste oils is consequence of a very low recovery rate before PROs establishment followed by a fast implementation of logistics immediately after the establishment of the PROs. For instance, in 2006, some months after the establishment of SOGILUB there was already a network of 16 transport and treatment operators for waste oils for all the country (SOGILUB, 2006). This number only increased to 18 until 2010 although the performance has been maintained (SOGILUB, 2011).

As for WEEE the logistics' numbers associated to one of the PRO show that one year after the establishment (2007) the amount of collection points was 100 and treatment and recovery units were 5. In the next three years these numbers increased to 500 collection points and 20 units (Amb3E, 2012a).

Other factors that contributed to the improvement of the collection and recovery of waste were the development by the PRO's of information and communication campaigns, targeted most significantly to domestic waste producers, and the support to research projects developed by waste processors, universities and research institutions. The first has helped raising awareness among citizens to the importance of separation and delivery of the waste and to better inform on the locations where that could be done. The latter provided the financial means to develop new technologies and operational practices among waste processors and other stakeholders contributing to improve the efficiency of waste management along the value chain.

Considering the waste streams of waste oils, WEEE, ELV, tires and packaging, for a period between 2006 and 2012, the total investment in communication and information campaigns and in research and development projects represents on average respectively more than 7 times and more than 23 times the annual investment done in the first year (e.g. Amb3E 2007, 2008, 2009, 2010, 2011, 2012a).

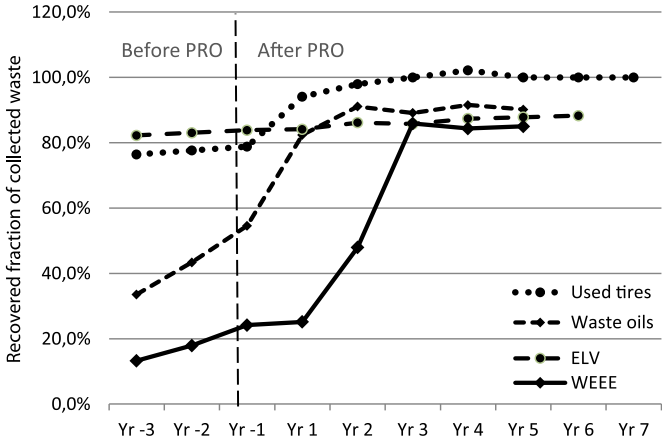

Fig. 1. Evolution of waste recovery rates, Portugal. Source: APA (2010).

The figures show a sustained investment done by PRO's in both the referred areas since the beginning of their activity strongly contributing to increase waste collection and recovery. During the same period, the total amount of the waste streams collected and treated increased to an average of more than 10 times the amount collected and treated in the first year of activity.

2. Another relevant issue associated to the improvement of environmental performance is the waste stock, which accumulated for years due to lack of management solutions. Although the government sought to compel PRO's to deal with waste stock collection and recovery at once, producers negotiated a gradual collection and processing of the orphan waste safeguarding them from economical and recycling capacity constraints. This issue was particularly important in used tires, with an estimated amount of waste stock of 60.354 tons at the time of Valorpneu's establishment (Valorpneu, 2002). This amount corresponded to approximately 2/3 of the entire collection for one year (including tires from non-waste stock) and as a result this fraction is still being processed, though having decreased from a maximum of 14.406 tons in 2004 to 3.643 tons in 2010 (Valorpneu, 2011).
3. Following the provisions of European Directives to ban the use of specific hazardous materials in manufacturing since 2003, automotive materials in Portugal cannot include lead, mercury, cadmium or hexavalent chromium (MCOTA, 2003b) and since 2006, electrical and electronic equipment's cannot contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers (MAOT, 2004). In this context Portuguese authorities consulted the respective PROs – Valorcar, AMB3E and ERP Portugal – as part of the process of definition of the restrictions. The concerns of PROs affiliates were mainly associated with the fact that the Portuguese market is mostly characterized by importers rather than manufacturers making the role of the industry representatives somewhat limited as to the effective integration of the requirements in the production chain (e.g. Røine and Lee, 2006, argue the same for Norway). Nevertheless, the responsibilities remained, and producers/importers should assure that any vehicles and electrical and electronic products sold in Portugal respect the bans on hazardous substances.

For the purpose, the government and PRO's agreed to establish systems to monitor the products sold in Portugal and register evidence on their compliance with the legal requirements. Producers are then mandated to make available to the authorities and general

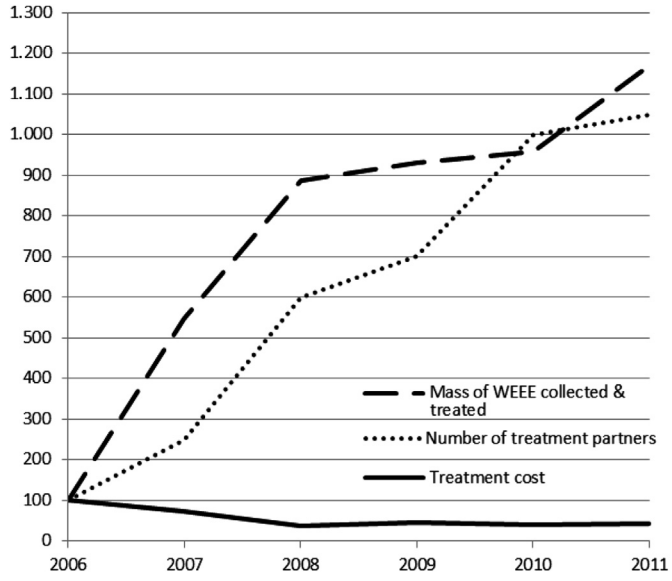

Fig. 2. Evolution of WEEE collection and treatment, Portugal (index 100 = performance in year 2006). Source: Amb3E (2007–2012b).

2. According to the legal responsibilities of producers in Portugal, the service expenses should only account for the deficit between the cost and the revenue associated to the management of waste. Therefore, the Eco-value requested to producers may in the end have to cover only the administrative costs of the PRO, if the waste has a positive market value. For instance, the management of ELV by waste management operators within the Valorcar network is fully financed by the revenue of the recovery of the vehicles (Valorcar, 2011). The same applies for automotive and industrial batteries (also responsibility of Valorcar) and industrial packaging waste (responsibility of Sociedade Ponto Verde). In this case the PRO does not have to pay any compensation to the waste management operators – they benefit from being part of the network receiving an input of ELV's from which they profit. In the last two cases, the mass flows and commercial operations were already in place when the PRO was licensed by the APA for these particular waste flows and the approach was to pay a small economic compensation to waste management operators if they signed up for the waste management system and provided information on the amounts of waste managed and also allowed be audited by the PRO.

public technical documents describing their products composition. Portugal was one of the EU Member States to adopt a stricter approach on this matter (Martin et al., 2007). With this approach the implementation of EPR was eventually broadened to the upstream activities of manufacturing and, although under constraints, promoting the reduction of hazardous substances in wastes, reducing the risks of environmental damage (Gerrard and Kandlikar, 2007). However, being recent provisions and most of the products associated having medium to long lifetime periods it is not possible yet to assess the level of success of these measures.

3.2.3. Attractive and competitive market

1. The cost model for EPR schemes in Portugal falls under the Reimbursed Compliance Cost (Magalini and Huisman, 2007) or Insurance system (Forslind, 2009). The producer pays a contribution per manufactured product, to cover the costs of end-of-life management when the product has reached its end of life. The transfer of responsibility from producers to the PROs is established through the payment of this monetary value based on current sales in volume or weight (e.g. WEEE, Batteries, Packaging, Waste mineral oils) or units placed in the market (e.g. Tires, Car batteries, End-of-life vehicles), known in Portugal as the Eco-value. In some cases (e.g. WEEE, Lube oils, Used Tires and ELV), the fee is visible and bears also the cost for management of orphan waste.

This economic compensation model was important to deal with the sudden inflation of waste treatment prices compared to the situation prior to the existence of EPR take-back schemes. This price growth resulted from: 1) the establishment of mandatory collection targets and stricter waste processing requirements, which meant that some wastes that previously had a negligible or positive market value because of under or even inappropriate collection and treatment, ended up having a negative value (e.g. tires, oils, WEEE) and 2) the loss of property of operators over wastes with positive market value, when PRO's were established.

The general rule is that the PRO's are free to negotiate and establish the compensation values with the operators. These values are set in a contractual agreement as a service fee. There are however a few exceptions: the fees for collection of packaging waste and WEEE were established by the government in the licenses (GSEA, 2010; MAET-MAOT, 2005; MAOTDR-MEI, 2006a). In both cases this has resulted from unrest between the PRO's and the operators. For packaging waste there were disputes for more than two years between the PRO and the public waste collection systems over the values set, and so the intervention of the APA and later of an independent third party (consultancy firm) were required. Ultimately the APA had to impose the values. For WEEE, the value set initially in the licenses proved to be too small, as no collection operators were interested in signing contracts. However, according to the license, PRO's were not allowed to negotiate higher values. Just a few months after the licenses had been attributed the values were increased by APA.

Even though today's competition level of waste management operators is leveling, as more waste operators join the PRO's networks, in the beginning priority was devoted to establish a robust end-of-life management network – for instance, the tire and the WEEE management systems, took 2 and 3 years, respectively, to establish more than 70% of its current networks of collection, recovery and recycling partners (Amb3E, 2011; Valorpneu, 2011). During the first years, lack of operators licensed to manage specific waste flows, forced PROs to negotiate higher fees for waste management operations. These early difficulties were due to the fact that, at the time, the operational requirements for entering a PRO recycling network (e.g. logistics, monitoring) were financially and technically demanding. Recognizing these difficulties, the government issued transitory regulation allowing operators to be licensed and be able to operate with waste flows like WEEE, ELV or waste mineral oils, regardless of their integration in the PRO's operational partner's network (MAOT, 2004; MCOTA, 2003a; MCOTA, 2003b). Eventually this measure brought an additional strain to the development of the operational networks by the PRO's limiting the implementation of EPR.

Over time, new operators have been created and the importance of specific waste flows from EPR schemes to their businesses has grown. PRO's developed a stronger position to negotiate and eventually reduce the fees. This was evident for tires, where the treatment cost increased 9.3% in the first two years of the PRO's activity (Valorpneu, 2011). Over the following five years, with more operators joining the PRO, this cost increased only 2.7% per year on

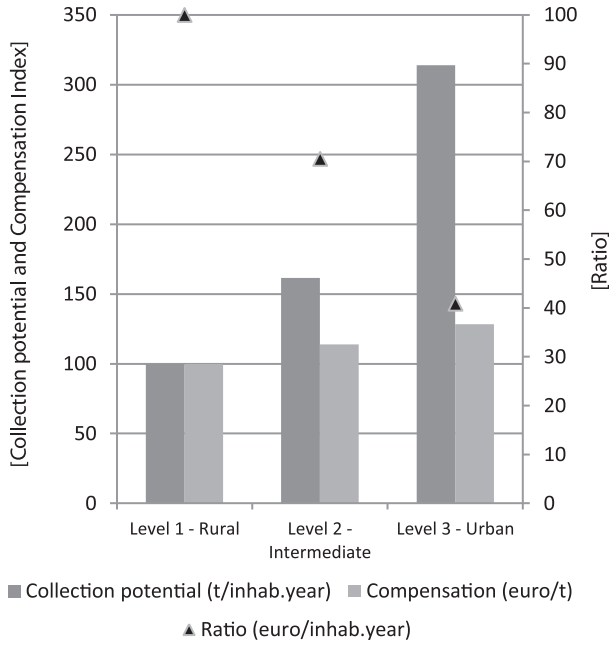

Fig. 3. Compensation levels 2009. Source: Sociedade Ponto Verde (2010).

average (Valorpneu, 2011), little above the average inflation rate of 1.8% for the same period.[7] Further reduction was achieved in transportation and recovery costs, 4.2% and 2.1%, respectively, over the last two years (Valorpneu, 2011). A similar situation occurred for WEEE (Fig. 2), where the number of treatment partners working with the PRO has grown nearly 10 times over a 6 year period, approximately 71% annual increase, with a similar increase in the amounts of WEEE treated, while the cost has dropped by 57%, about 12% per year (Amb3E 2007–2012b).

As extreme cases, like waste oils and some specific WEEE the situation is such that PRO's have started to be reimbursed by the waste management operators for providing them the collected waste (Amb3E, 201; Sogilub, 2011).

This shows how the structure of the waste management market for these specific waste flows has developed and matured. Ensuring the collection and a steady inflow of waste to the system, secondary materials can be more easily obtained and higher demand drives waste management operators to compete for them.

With the waste management systems in Portugal developing to become more efficient together with an increasing demand for some of the secondary materials, there is increasing expectation that more PRO's may start to find the basis to start negotiating zero, or near zero economic compensations with waste management operators for their services.

3. Another measure that eventually contributed to harmonize waste management was the adjustment of the service fee to the context conditions of waste management operations in each region. For example, in the case of packaging, collection and recovery is mainly done by public MSW management operators. The economical compensation was set in three different levels, based on local conditions such as the amount of packaging waste produced per capita and the estimated economical effort necessary to collect each type of material. In this context, waste management operators receive compensation according to its service efficiency and the collection potential. Operators with high scale economies (usually urban-based) receive lower economical compensations than those in rural areas with scattered populations. The difference can be very significant, based on the local differences in packaging waste collection potential (Fig. 3).

4. (Future) challenges to EPR in Portugal

The results achieved in a short period of time, and presented in this paper, suggest that the evolution of the implementation of the EPR concept in Portugal had a positive effect on waste management. The main achievements were the development of organized networks of operators for collection, transport and treatment for specific waste flows, resulting in the increase of the amounts of wastes collected and recovered in Portugal; the implementation of monitoring and auditing procedures of the operators, increasing the transparency of waste management processes and the control over the waste flows; and finally increasing the visibility of the waste management activities, contributing to raise awareness of citizens on waste management.[8]

However, as stated previously in this article, there is still room for improving EPR impact in the long-run. This largely depends on policy instruments that can positively influence the context in which EPR schemes operate, namely the MSW management context – notoriously needing to improve towards decreasing landfilling. In this case, particular attention must be given to 1) economic instruments, such as landfill taxes and; 2) regulatory instruments, such as landfill bans, increasing collection, recycling/recovery targets and by-product/end of waste provisions.

In terms of economic instruments, Costa et al. (2010) have demonstrated, through means of case study comparison, that European countries with higher landfill taxes typically present higher recycling yields, due to increased competitiveness in prices. Another study by Bartelings et al. (2005) also mention the positive impacts associated to higher landfill taxes, but caution – much like other authors (e.g. Mazzanti et al., 2010) – that these instruments must be combined with other policy instruments to promote prevention and recycling.

In Portugal, the landfill tax was introduced in 2006 and is still very low in comparison with other EU countries (Fischer et al, 2012). The Portuguese government has recently updated the tax to include a specific provision (€2 per ton) for materials disposed in landfills that could otherwise be handled through PROs (MAOT, 2011) but this value is still far from the Austrian tax (€87), the Dutch tax (€16 to €108) or the British tax (€63.55), just to name a few. Therefore, landfill in Portugal is yet an advantageous option to materials managed by the PRO, since end-of-life products are cheaper to dispose in this manner. The evolution of waste policies in EU shows a further escalation of this mechanism, possibly with extension of taxation to other areas such as resource extraction (Behrens et al., 2007; Groth and Schou, 2007; Sollund, 2007), and the Portuguese tax on landfilling will undoubtedly follow this trend turning landfilling less attractive to waste operators. When combined with measures towards influencing consumer behavior – e.g. an increase in costs for mixed urban wastes – may compel households to improve their behavior towards recycling, whether by improving waste sorting at home or making more environmental conscious purchases (Reichenbach, 2008; Skumatz, 2008; Vergara and Tchobanoglous, 2012).

[7] Own calculations using monthly Consumer Price Indexes from INE, Statistics Portugal, from 1995 to 2007 (http://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE&xlang=en).

[8] http://revistarecicla.blogspot.pt/[69% of Portuguese households separates used packaging] (in Portuguese).

In terms of regulatory instruments, landfill bans may provide added incentive to improve the impact of EPR schemes. In Portugal, there are bans implemented for used tires and liquid wastes, but in the majority of EU countries extended the ban to all combustible and recyclable waste (e.g. EEA, 2009; Costa et al., 2010; WRAP, 2012). If this trend extends to other countries, it represents an opportunity to expand EPR systems to other waste materials that represent a significant environmental burden while eventually generating economic benefits. Disposable diapers and cooking oils are examples of such waste flows, for which collection and treatment schemes are being implemented throughout Europe (e.g. Environment Agency, 2008) and are already being considered by Portuguese government as the next step for EPR schemes.[9]

Another important regulatory instrument which supports the case for EPR scheme development is the increasing rates for collection, recycling and recovery imposed by EU and national directives (Zoeteman et al., 2010; Fischer, 2011). As mentioned, these targets have been consistently becoming more demanding with each successive revision of EU Directives, pushing the current PROs to develop mechanisms to improve their collection and recycling systems. For instance, the European Council published a recast of the WEEE Directive (Directive 2012/19/EU) widening its scope in order to cover more categories of electronic equipment, such as photovoltaic panels, equipment containing ozone-depleting substances and fluorescent lamps containing mercury, which will have now to be collected separately. Additionally, four years after the entry into force of the present directive, member states must collect annually 45% of the average weight of electrical and electronic equipment placed on their national markets. Three years later, member states are to achieve a 65% collection rate.

Also, several projects have been deployed throughout the EU to improve material recovery from Automotive Shredder Residue[10] most of which are supported by the national ELV EPR schemes (Forton et al., 2006; Vermeulen et al., 2011).

The last regulatory instrument to be featured in this analysis is the by-product/end of waste provision implemented by the EU Waste Directive in 2008, which mandates EU Member States to develop technical and certification guidelines to exempt waste materials from being considered wastes and therefore be traded as typical market commodities. Some countries have acted preemptively in this aspect, for example by developing end-of-waste guidelines for several waste materials (e.g. Costa et al., 2010; Environment Agency, 2012). The European Union is also working on specific technical guidelines for some waste flows, to be implemented by Member States (e.g. European Commission, 2012). In Portugal, it is the stakeholders related to several PROs which are moving ahead in this respect, by creating online trading platforms, certified and monitored by the APA, for end-of-waste and waste materials and by-products to be exchanged (e.g. MOR Online[11]). The next steps will be to develop information and communication mechanisms to expand the suppliers/consumers network associated to the platform.

5. Conclusions

The EPR implementation in Portugal consisted on the development of a specialized network of decomposers (e.g. recyclers, disassemblers, etc.), financially supported by means of an eco-value paid by producers to the PRO. By delegating this responsibility through the licensing of private organizations that are built by the industry and stakeholders themselves, the government could keep more focused in the monitoring and control of waste management operations rather than on its development.

Even though comprehending a relatively short amount of the overall wastes produced in the country, current EPR systems in Portugal have become key mechanisms to prevent environmental impacts from improper waste management (Ferrão et al., 2006). The waste management sector became more organized, closely monitored and better understood by the different stakeholders involved.

The conditions established by the EPR policies contributed to an increase in the quantity and quality of waste recovered and recycled, while providing a more leveled competition field for waste management operators. Nevertheless, there are aspects that EPR policy, and the PROs, still need to address more consistently, especially in terms of articulating with emergent waste related policy drivers and challenges such as increasing landfill taxes and end of waste provisions. As demonstrated, efforts are being made especially at the end of the end-of-life management value chain; it is important that future work includes the development of policies that compel PROs to exert their influence up the same value chain, for example by influencing product lifecycle performance, like eco-design and even eco-consumption. Even though for most of the products under EPR Portugal is mainly an importer (or a manufacturer of products whose brands are owned by companies of other countries, where they are designed) Portuguese PROs may still have a role in identifying opportunities for product improvement, namely in terms of dismantling at the end of life.

Additionally, a strong commitment should continue to exist to improve and correct current approaches on EPR policies, and to complement them by making use of other types of instruments of fiscal, information and supervision natures.

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[9] The APA designates these flows as emerging flows: http://www.apambiente.pt/politicasambiente/Residuos/fluxresiduos/FE/Paginas/default.aspx (in Portuguese).

[10] E.g. project LIFE98 ENV/S/000476 (1) [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=1027&docType=pdf]; project W2Plastics [http://www.w2plastics.eu/].

[11] http://www.moronline.pt/UK/.

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