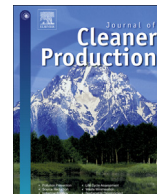




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Extended producer responsibility: a differential fee model for promoting sustainable packaging

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ABSTRACT

Extended producer responsibility in the European Union has been shown to be incapable of promoting environmentally friendly packaging, mainly because of the economic instrument used: the producer fee. To make the producer fee capable of both reflecting and influencing how packaging is produced, we propose a mathematical model for calculating a differential fee (the sustainable producer fee or SPF). The development of the model involves the following steps: the selection of sustainability criteria, the aggregation of criteria using multi-criteria decision making, the formulation of the SPF calculation, and the generation of a web-based interface for packers and product importers to calculate the differential fee applying to their own packaging. The aspects of sustainability considered are environmental aspects resulting mostly from life cycle assessment (e.g., global warming and human toxicity), and social aspects related to environmental information present in/on the packaging (e.g., the recycling bin symbol and carbon footprint information). The mathematical model developed uses the sustainability results provided by the multi-criteria decision making. The fee is higher than the current fixed fee (200.8 €/t) if the level of sustainability is low, that is, if environmental and social impacts are negative, and is lower if the level of sustainability is high. The lowest value of the fee in the sensitivity analysis, 191.89 €/t, was calculated for polyethylene packaging containing 10% of incorporated recycled material, with this recycling information being present in the packaging along with carbon footprint information and the recycling symbol. The highest value, 218.69 €/t, was calculated for polyvinyl chloride packaging without any recycled material and without any environmental information. The model is implemented in a web-based interface, where packers and product importers are able to simulate different types of packaging to reduce the fee. The success of the approach is discussed, as is the potential for changing the packaging behavior of packers and importers and for increasing the level of sustainability of packaging in the near future.

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1. Introduction

In the European Union (EU), packaging waste has been managed following the polluter pays principle, whereby the polluter is responsible for the environmental impacts caused by the waste (pollution). However, other agents involved in the packaging waste life cycle, namely, the packaging producer, should bear co-responsibility and also contribute to reducing the pollution

caused by packaging waste. Such an extension of the responsibility is referred to as 'extended producer responsibility' (EPR).

According to OECD (2001), EPR is defined as 'an environmental policy approach in which a producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product's life cycle' (p. 18). There are two related features of EPR policy: (1) the shifting of responsibility upstream towards the producer and away from municipalities; and (2) the providing of incentives to producers to include environmental considerations in their product design, such as reducing material consumption, using more secondary material, and promoting product eco-design (Forslind, 2009; OECD, 2001). To implement successful EPR, an economic instrument is necessary, a fee, paid by the producers to

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finance the entire packaging waste management system. In this way, municipalities would be relieved of the financial burden of collecting and managing such waste, because the fee would be transferred to waste managers, ensuring that sufficient financial support was provided for their waste management activities.

EPR has been applied to the management of packaging waste in various countries, and the Green Dot System for packaging waste is a widely disseminated EPR program in Europe (OECD, 2001; PRO Europe, 2015). Although EPR has been moving management responsibility to producers, obligating them to financially support a proportion of the costs of packaging waste management (Watkins et al., 2012), there is no evidence that EPR has actually been able to promote better management of packaging waste, nor even that packaging design has been improved in environmental terms. According to Watkins et al. (2012), there is no conclusive proof of a relationship between EPR and packaging recovery/recycling performance. Dempsey et al. (2010) concluded that EPR has not been designed or implemented to promote eco-design. Only recently have studies been conducted to examine the impact of EPR on innovative strategies, namely, in promoting eco-designed products (Brouillat and Oltra, 2012).

Several authors have emphasized the need to develop methodologies for calculating an EPR fee in order to allow the EPR to influence both packaging design and management (Mota et al., 2012; van Rossem et al., 2006; Watkins et al., 2012). There are several strategies for calculating a differential EPR fee. One strategy is based on the packaging type (primary, secondary, and tertiary), material type (paper/cardboard, plastic, metal, glass, and wood), packaging volume, and material origin (urban and non-urban). This strategy is related to the costs involved in the management of packaging waste. A lower fee applies when packaging material has a higher density and/or when there is a high market value for the recycled material. This strategy can be easily implemented for generic materials but is more complicated to implement for specific materials such as different polymer types or different paper types. These more complex materials demand much more information concerning their specific packaging properties and about the additional costs that would apply. Also, the strategy described is not sufficient to promote sustainable packaging, because it is focused only on the economic aspects of managing packaging waste.

Another strategy for calculating a differential EPR packaging fee is through packaging recyclability. This strategy has been used in the French Green Dot System (Eco-Emballages, 2014), where penalties and rewards related to eco-design measures are incorporated into the fee. The penalty system consists of increasing the fee in cases where packaging itself contributes to the degradation of recycled material, or where the packaging is not recoverable or has no associated recycling industry. In the case of reward, a fee reduction occurs when the packaging producer demonstrates source reduction actions or engages in activities related to environmental awareness. Such a strategy involving packaging recyclability is positive because it is focused on recycling, thereby favoring recyclers; however, the financial responsibility lies entirely with the packer, which does not encourage an equal effort from all stakeholders in promoting more sustainable packaging. Such an approach would need a consensual agreement among stakeholders concerning both technical specifications and minimal requirements to ensure that recyclable materials were used by industry.

The drawbacks of the aforementioned strategies of calculating a differential EPR fee highlight the need to disclose new strategies that could enable the EPR fee to fulfill its purpose. In the present work, we develop an innovative strategy based on a model in which a differential EPR fee can be calculated by measuring the level of sustainability demonstrated by the packaging life cycle. The sustainable producer fee (SPF) is a differential fee that includes the

following aspects of sustainability: economic, which is the only aspect considered in most current fee-charging systems and reflects the costs involved in the management of packaging waste; environmental, where environmental impacts occurring during the life cycle of packaging are considered; and social, related to the environmental information present in (i.e., displayed in or on) the packaging. To do so, a novel mathematical model for calculating the SPF is proposed, developed, and tested for plastic primary packaging managed in Portugal by the biggest packaging waste management organization 'Sociedade Ponto Verde' (SPV), which runs the Portuguese Green Dot EPR system.

2. The model design

The Portuguese Green Dot System is responsible for the management of the packaging waste system, and is known as 'SIGRE' (in Portuguese: *Sistema Integrado de Gestão de Resíduos de Embalagens*). Like other EPR systems, the fee-paying entities are those that put packaging products into the market, namely, the packers and importers of packed products. SIGRE works differently for urban packaging and non-urban (mostly industrial) packaging.

In the urban SIGRE system presented in Fig. 1, the raw materials are converted into packaging material that is then sold to manufacturers for packing their products. Consumers buy packed products and then dispose the packaging waste into recycling bins to be collected for recycling. Source-separated packaging waste is mainly polyethylene terephthalate (PET) (52% of total source-separated packaging waste by weight), with the smallest separated stream being polypropylene (PP) film (8%) (Algar, 2010; Pordata, 2012; Valorlis, 2008). Waste collectors deliver packaging waste into material recovery facilities, where it is sorted and sent to be recycled. Recycled materials are subsequently used by industry to manufacture new packaging or other products. Packaging that is not source separated is disposed with commingled municipal waste, which can be sorted and recycled (but with a lower quality of both separation and recycled material), energetically recovered, or disposed in landfills.

Concerning the flow of money in the urban SIGRE system, packers and product importers pay a fee to the producer responsibility organization, SPV. This organization promises to ensure that packaging is disposed in a way that is environmentally responsible and compliant with EPR legislation (Spicer and Johnson, 2004). The fee is passed down to the distributors, retailers, and finally to consumers, being embedded in the product price (not visible to the consumer). The fee is used to pay for the entire system of source-separated collection, transportation, and sorting for recycling. Recyclers pay for the sorted recyclable packaging waste, provided by the waste manager, in market conditions.

For non-urban packaging waste, SIGRE is much simpler, whereby the waste producer chooses who will receive packaging waste. Until now, packaging waste from industry has been sent either for recycling or for landfill, with an insignificant amount being sent for energy recovery. The non-urban system is financed with the fee paid by those who put the packaging into the market, with the amount gathered being used to finance the information subsidy. This subsidy is used to support the costs of private waste operators in managing and delivering information about the amounts of non-urban packaging waste sent for recycling and/or recovery to SPV. The non-urban packaging SIGRE is based on the free market.

Currently, the EPR fee applied in SIGRE (both urban and non-urban) corresponds to the amount needed to finance the entire system after deducting system revenues, and reflects only the economic aspect of the system. To overcome the problem that the value of the fee is not promoting sustainable packaging, the

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