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Financial Flows in the Recycling of Packaging Waste: The Case of France

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Financial Flows in the Recycling of Packaging Waste: The Case of France

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Abstract:

The recycling of packaging waste is an objective of the Community with very ambitious recycling rate targets laid down in the European law. Research on the operations and on the financial and economic costs that resulted from this environmental policy is an ongoing effort. Currently, there is still no agreement on the ‘optimal’ recycling rates, and on whether the targets should be raised, lowered or preserved. While each member state has currently its own packaging waste management system, there is still a lack of data regarding the actual costs of recycling and on how these costs have been distributed among stakeholders. It is not clear that the packaging and packaging waste Directive is being implemented correctly (i.e. it is not clear that the industry is supporting 100% of the costs of recycling packaging waste). This paper illustrates the French framework and discusses the financial transfers undertaken by Eco-Emballages the entity that manages the Green Dot scheme in this country. For this purpose, we use data from a sample of 45 entities in charge of selective collection and sorting of household packaging waste for the year 2010, covering about 20% of the French population. We match the financial transfers of the Eco-Emballages Group with the costs incurred by the local authorities (which are in charge of selective collection and sorting) and provide a discussion on the rationality and fairness of the system.

Keywords: France; green dot; packaging waste; recycling.

1. Introduction

The ‘waste hierarchy’ concept¹ has been embedded in the European Union (EU) legislation on waste since seventies². Since then, recycling has taken a leading position in the waste management systems of all EU member states. The Directive 94/62/EC on Packaging and Packaging Waste (PPW) emphasized this waste management strategy by setting challenging recycling targets for the member states.

Some countries have decided to embrace the recycling strategy and clearly exceed the provisions of the PPW Directive (e.g. Germany)³. Other countries are still striving to attain the mandatory targets (e.g. Poland)⁴. Currently, the recycling rates in France are in line with the targets of the Directive. However, the new piece of legislation on environmental issues (known as the Grenelle Act) will push the French system further towards recycling, setting the overall target on 75%.

In theory, and from an economic point of view, there should be an optimal value for the recycling rates,⁵ where the costs are balanced by the benefits of this management strategy. Evidently, this rate would be contingent to each type of material, consumption patterns, population density, current technology, among many other aspects. Determining an optimal recycling rate for France is not the purpose of this paper. The present study aims to determine the cost and benefit structures of the local authorities concerning their services for selective collection and sorting of packaging waste. The paper also illustrates the French recycling scheme so one can learn about its strengths and weaknesses.

¹ It has considered firstly reduce, reuse and recover (through the recycling and/or energy recovery) before the final disposal.

²Bulkeley H., Watson M., Hudson R. (2007) Modes of governing municipal waste. *Environment and Planning A* 39(11), 2733-2753.

³Hempen S. (2005) Status and trends of the residual waste treatment options in Germany. *Proc. The future of residual waste management in Europe*. Luxembourg.

⁴EUROSTAT. Environmental Data Centre on Waste. Accessed on March 2012. <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/introduction/>

⁵Massarutto A., Carli A., Graffi M. (2011) Material and energy recovery in integrated waste management systems: A life-cycle costing approach. *Waste Management* 31, 2102-2011.

In this context, this paper is organized as follows: after this introduction, section 2 provides an overview of the life-cycle of packaging waste, emphasizing the main financial and environmental impacts. Section 3 characterizes the current French management system. Section 4 describes the financial transfers involved in the Eco-Emballages scheme. The methodology used in this work is presented in section 5 while the results obtained are discussed in section 6. The main concluding remarks are highlighted in section 7.

2. The life cycle of packaging waste

In France, similar to other EU member states, the life-cycle of packaging waste begins with its selective collection by kerbside and/or brings systems. According to the collection system implemented by local authorities, who have legal responsibility for management of household waste collection and treatment services, the packaging waste materials can be collected through 3 main different methods: (1) bi flow (composed of glass and multimaterial flows); (2) tri flow (represented by glass, multimaterial packaging and newspapers/magazines flows); and (3) corps creux/corps plat (constituting a tri flow composed of a glass flow, paper/cardboard and newspapers/magazines flow and a third flow of metal and plastic packaging).

The packaging waste selectively collected is sent for sorting stations and then for recycling centres. The packaging waste flows have different sorting efficiency, providing a variable percentage of waste rejected which is, usually, incinerated with energy recovery. Unfortunately, a significant fraction of packaging waste is still treated as undifferentiated flow, having other disposals which not necessarily lead to higher economic and environmental impacts. However, the greatest environmental nuisance is related to the plastic packaging⁶ due to its high resistance to the natural action of the environment when landfilled. In fact, landfill must be last disposal option due to its negative environmental impacts; in addition not add any value (in financial terms) to the disposed waste. On contrary, incineration of plastic packaging waste, at least, contributes for energy production (due to its high calorific value) and metal packaging can always be recycled through the slags. In mechanical and biological treatment (MBT) facilities, the undifferentiated fraction is usually

⁶KOLEK Z. Recycled polymers from food packaging in relation to environmental protection. Pol. J. Environ. Stud. 10 (1), 74, 2001.

sorted and the packaging included in this flow can be taken to the recycling system. A simplified scheme of the life-cycle of packaging waste in France is shown in Figure 1.

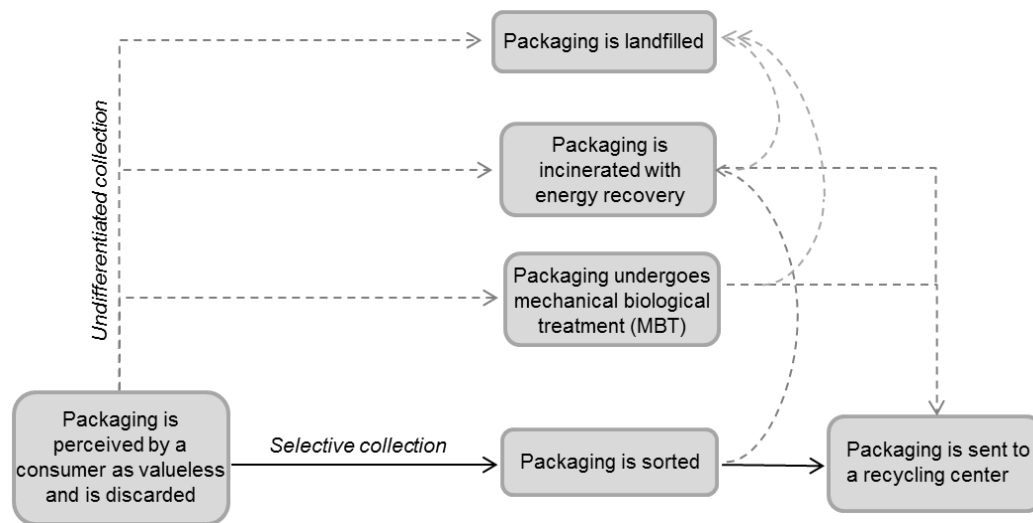


Figure 1 – The (simplified) French life-cycle of packaging waste.

In general, the greatest environmental and financial impacts are related to the transportation and collection⁷ due to the fuel consumption of the vehicles and the frequency of collection. Furthermore, a recent study of Eco-Emballages⁸ concluded that the collection costs may vary substantially depending on the packaging waste flow and the method. The average costs of collection of each packaging waste flow are presented in Table 1.

In our approach, we widen the scope of ‘traditional’ financial life-cycle costing⁷, also evaluating the impacts in an economic perspective. For the moment, the positive and negative environmental effects of packaging waste recycling will not be considered.

⁷ Reich C. (2005). Economic assessment of municipal waste management systems – case studies using a combination of life cycle assessment (LCA) and a life cycling costing (LCC). *Journal of Cleaner Production* 13, 253-263.

⁸ ECO-EMBALLAGES (2005). La base de données e-coûts. Principaux résultats. Paris: Eco-Emballages.

Table 1 – Average Costs of collection per packaging waste flow⁹

Waste flow	Bring system	Kerbside
Plastic/metal/cardboard/newspapers/magazines	---	419 €/t
Plastic/metal/cardboard	---	749 €/t
Plastic/metal/cardboard	750 €/t	---
Plastic/metal	788 €/t	---
Cardboard/newspapers/magazines	167 €/t	---
Newspapers/magazines	---	228 €/t
Newspapers/magazines	131 €/t	---
Glass	---	180 €/t
Glass	72 €/t	---

3. The French institutional framework

The PPW Directive, which came into force in 1994 and amended in 2004, had the objective of providing a high level of environmental protection, reducing the consumption of raw materials and harmful emissions, especially due to landfilling. Moreover, it also intended to ensure the functioning of the internal market, setting minimum and maximum targets for recovery and recycling and securing the free movement of packaged goods within the EU. Most member states (like France) had to recover a minimum of 60% as well as recycle a minimum of 55% (with a maximum of 80%) by weight of packaging waste from 2008 onwards. Regarding each specific material flow, the minimum recycling rates were set in 60% by weight for glass and paper/cardboard, 50% by weight for metals, 22.5% by weight for plastics and 15% by weight for wood.

The Decree No. 92-377 (for regulating household packaging) and the Decree No. 94-609 (for dealing with industrial and commercial packaging) were the first legislation on packaging waste management implemented in France in order to attain the PPW Directives targets. In 2007, French stakeholders jointly with government and other groups started to work on the *Grenelle Environnement* to take measures for environment protection and to pursue a

⁹PRO EUROPE (2011). Uniformity in diversity: producer responsibility in action. Brussels: Packaging Recovery Organization Europe.

sustainable development. Therefore, the Grenelle Act came to establish an overall recycling target of 75% to be fulfilled by 2012, where the industry will have to cover 80% of net benchmark costs for an optimal service of packaging waste collection and sorting.¹⁰

The Agency for Environment and Energy Management (ADEME in the French acronym) is the waste authority in France. It has the responsibility to define strategies for waste sector to prevent the waste production and to encourage the recycling operations. Therefore, ADEME provides financial aids to local authorities for the waste collection and disposal. Furthermore, it also manages (and reports to EU) the information on quantities of packaging placed into national market and packaging waste collected and recovered.

According to the national law, the responsibility for the management of packaging waste can be transferred by the industry to an entity duly licensed for this activity. The Eco-Emballages, the Green Dot company, is a non-profit private organization that promotes the selective collection, sorting, recovery and recycling of household packaging waste in France. However, the packaging waste from pharmaceutical sector is a specific flow which not enters into the municipal systems; thus is managed by a specific recovery programme, known as Cyclamed. The non-household packaging waste flow has been supported by packaging recyclers through *voluntary base specific structures* in order to help enterprises comply with the national regulations.¹¹

The responsibility of Eco-Emballages regarding the collection and recovery of packaging waste is materialized through contracts with local authorities (public establishments of intermunicipal cooperation with and without own tax scheme) and with guarantors and/or recyclers of packaging materials.¹²

¹⁰MEEDDM (2009). Annual report to parliament on implementing France's environment round table commitments. Paris: Ministry of Ecology, Energy, Sustainable Development and Sea.

¹¹ADEME (2008). Industrial, commercial and household packaging in France – Summary/2008 data. France: Agence de l'Environnement et de la Maîtrise de l'Energie.

¹²ECO-EMBALLAGES (2010). Annual report 2009. Paris: Eco-Emballages.

Table 2 provides an overview regarding the current infrastructure assigned to waste management operations in France.¹³

Table 2 – Infrastructure and equipment for urban waste management in 2008¹³

Landfills	256
Incinerators with energy recovery	112
Incinerators without energy recovery	17
Composting facilities	518
Sorting stations	330
Drop-off centres	4,310*

*data from 2007

The overall recycling rate of packaging waste in France has gradually increased over the last 10 years (from 42.1% in 1999 to 56.4% in 2009) reported to EU. As can be seen in Table 3,¹⁴ the global, as well as the specific, targets imposed by PPW Directive (to be achieved by France until the end of 2008) were complied. Moving towards the fulfillment of the Grenelle Act, Eco-Emballages had a relevant increase in 2009 in terms of recycling, reaching the value of 64.3%.

Table 3 – Recycling and recovery of packaging waste in France, in 2009¹⁴

Material	Packaging waste generated (ton)	Total recycling ^a (ton)	Total recovery ^b (ton)	Recycling rate (%)	Recovery rate (%)
Glass	3.133.377	1.966.000	1.966.000	62,7	62,7
Plastic	2.046.728	460.540	1.167.525	22,5	57,0
Paper/cardboard	4.283.537	3.721.400	4.124.698	86,9	96,3
Metals	717.684	432.289	437.088	60,2	60,9
Wood	2.641.660	500.000	673.000	18,9	25,5
Total	12.822.986	7.080.229	8.368.311	55,2	65,2

^a Total recycling includes material recycling and other forms of recycling like composting;

^b In France, total recovery includes total recycling and incineration with energy recovery.

¹³ADEME (2009). La collecte des déchets par le service public en France: résultats année 2007. France: Agence de l'Environnement et de la Maîtrise de l'Energie.; ADEME (2010). Les installations de traitement des ordures ménagères: résultats 2008. France: Agence de l'Environnement et de la Maîtrise de l'Energie, 2010.

¹⁴EUROSTAT (2012). Eurostat environmental data centre on waste. Accessed on December 2011. <http://appsso.eurostat.ec.europa.eu>

4. The financial transfers

In France, the household packaging waste recycling, through the Eco-Emballages system has been supported by the industry contributions (green dot fees), the sale of sorted material and the public money¹⁵, as shown in Figure 2.

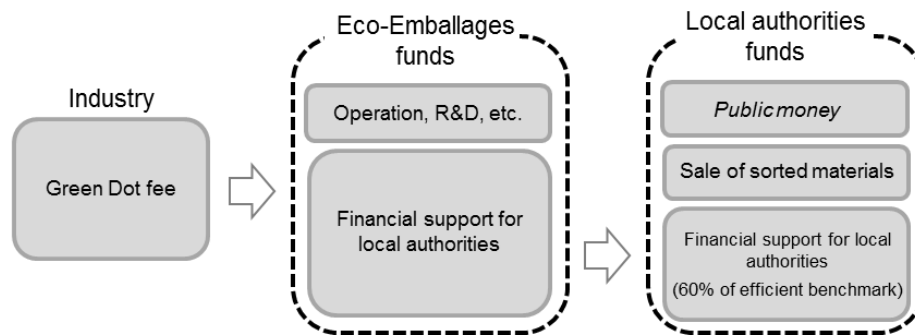


Figure 2 – Funding model for the recycling of household waste in 2010

The green dot contributions should cover 60% of the net optimized costs of collection and treatment services carried out by local authorities until 2010. Therefore, the financial support for local authorities has been calculated based on their performance and the take-back quantities for different packaging materials under agreements (called *Barèmes*). In order to achieve the new national target of 75% of recycling (imposed by the Grenelle Act) a new agreement (*Barème E*) was established for the period 2011-2016. In this sense, the Eco-Emballages raised their financial supports, in order to cover 80% of the efficient benchmark costs of packaging waste services.¹⁶

4.1. Green dot fee

The green dot fee comprises a variable component (weight fee) and a fixed component (unit fee). The weight fee is determined by multiplying the total weight of each packaging placed onto the market by the respective fee (according to the type of material).¹⁷ Table 4 presents the fees for 2010.

¹⁵ECO-EMBALLAGES (2010). Annual report 2009. Paris: Eco-Emballages.

¹⁶ ECO-EMBALLAGES (2011). Annual and sustainable development report 2010. Paris: Eco-Emballages.

¹⁷PRO EUROPE (2011). Uniformity in diversity: producer responsibility in action. Brussels: Packaging Recovery Organization Europe.

The unit fee depends on the value obtained for the weight fee. In 2010, if the weight fee was greater than or equal to € 0,0014, the unit fee was a flat rate of € 0,0014. If the contribution on weight was less than € 0,0014, the unit fee was equal to the weight contribution and the total fee was twice the weight fee. In case of packages weighting more than 1 kg, their contributions to the weight fee were limited to 1 kg.

Table 4 – Green dot fees for 2010

Fees by packaging material (€/kg)	2010
Glass	0,0045
Plastic	0,2222
Paper and cardboard	0,1526
Steel	0,0282
Aluminium	0,0566
Others	0,1526

4.2. Financial support for local authorities

In 2010, the financial support for local authorities (FSLA) was calculated based on the *Barème D*, as indicated in Table 5. As mentioned before, the calculating model was based on the recycling performance of local authorities and the efficiency of packaging waste sorting. The support and performance levels vary with the type of packaging material,¹⁸ as Table 6 shows.

Table 5 – Financial support by local authority performance

Level	Performance (P) in Kg/inh./year	Financial Support (S) in €/t
1	$P \leq N_b$	
2	$N_b < P \leq N_h$	_____
3	$N_h < P \leq N_p$	_____
4	$P > N_p$	_____
Where:		
S_p – plafond support; S_i – intermediary support; S_b – bottom support;		

¹⁸ECO-EMBALLAGES (2010). Contrat programme de durée – Barème D (version actualisée 2010). Paris: Eco-Emballages.

N_b – lower level; N_h – high level; N_p – plafond Level.

Table 6 – Variables to calculate the FSLA per material

	N_b	N_h	N_p	S_b	S_i	S_p
Steel	1	2	7	45	62,5	80
Aluminium	0,1	0,2	1	230	280	330
Paper/Cardboard ¹	4	8	18	120	200	280
Plastic	1,6	3,2	8	310	575	840
Glass	15	30	45	3	5	7
EMR ²	4	8	18	60	100	140

¹ mixture of various qualities of used paper and cardboard packaging, free from newspapers and magazines and liquid packaging cardboard.

² mixed recovered paper and board (unsorted paper and board, separated at source).

In the case of local authorities have different selective collection structures for coloured and colourless glass, the later was paid to 7€ per tonnes taken back. The FSLA for the coloured glass was determined according to the model presented in Table 4.

4.3. Other financial supports

According to *Barème D*, Eco-Emballages also supported the packaging waste incinerated with energy recovery or composted.¹⁷ These financial supports were calculated based on tonnes treated considering a unit support fee (in €/t), which is presented in Table 7.

Table 7 – The unit support fee for metals from incineration and composting

	Incineration	Composting
Steel	12 €/t	45 €/t
Aluminium	75 €/t	230 €/t

Furthermore, local authorities could increase their funding if they served a restricted group of population (buildings and/or dispersed rural housing). Eco-Emballages still provide supports for optimization in exchange for reporting all costs of the waste management systems, besides the identification of technical, economic and social factors for improving those systems. The

supports paid for communication required local authorities reporting an annual communication plan, defining all resources needed for public awareness. Local authorities also received 10.000 € per year and per sorting ambassador if they (annually) reported all communication activities carried out by the ambassadors¹⁹.

4.4. Sale of sorted materials

In France, the sale of sorted packaging waste to recyclers is conducted through specific take-back schemes. Each local authority can choose among three take-back options: Option *Filières*, Option Federations and Option Individual; and for different materials.²⁰ The average take-back prices can vary significantly in the last two options since the negotiation of materials price is made directly with the recycling industry. However, the quality of materials should not differ greatly in the three options because, in general, the recycling operators are the same.²¹ Table 8 shows the take-back prices of several packaging materials applied in 2010 for each take-back option.²²

Table 8 – Take back prices in 2010

Material	Option <i>Filières</i>	Option Federations		Option individual	
	Price	Avg Price	Price Range	Avg Price	Price Range
Steel from selective collection (packs)	111,6	126,4	79-174	159,3	124-195
Steel from bottom ashes	41,5	49,3	6-93	69,1	47-92
Aluminium from selective collection	451	499,3	348-651	337,9	205-471
Aluminium from bottom ashes	552	635,8	573-698	<i>n.a.</i>	<i>n.a.</i>
Plastics	196,3	189,6	151-229	<i>n.a.</i>	<i>n.a.</i>
Paper/cardboard	72,3	75,6	55-96	51,4	35-68
Glass	22,42	<i>n.a.</i>	<i>n.a.</i>	<i>n.a.</i>	<i>n.a.</i>

n.a. – not available

¹⁹ECO-EMBALLAGES (2010). Contrat programme de durée – Barème D (version actualisée 2010). Paris: Eco-Emballages.

²⁰EIMPACK (2011). Framework and evolution of the packaging sector in France. Instituto Superior Técnico, Lisbon.

²¹ADELPHÉ (2010). Rapport d'activité. Exercice 2010. Paris: Adelphe S.A.

²²ADELPHÉ and ECO-EMBALLAGES (2011). Prix de reprise des matériaux: prix annuels 2006 à 2010 – toutes options séries détaillées 2006 à 2011, option filières. Paris: Adelphe and Eco-Emballages.

4.5. Public money

Besides the financial supports (by Eco-Emballages) and the sale of packaging waste materials, local authorities receive subsidies for investment (by the French government) which can be (partially) allocated to the selective collection and sorting activities. On the other hand, the tax-payer contributions also partially fund the cost of municipal waste collection and treatment (in particular, packaging waste), as seen in Figure 3.²³

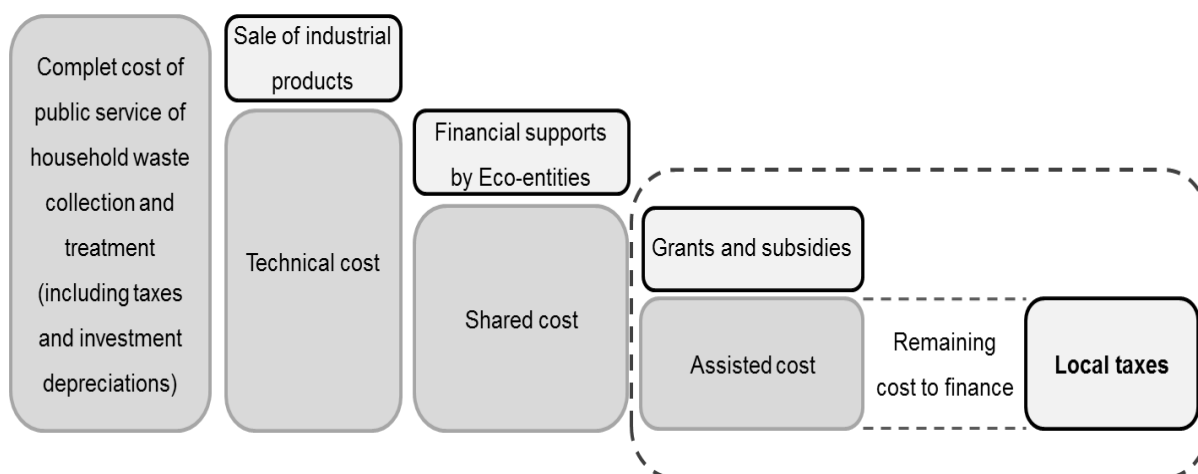


Figure 3 – General funding scheme of household waste collection and treatment

In France, local authorities can opt for financing the services through a tax or a fee on household waste disposal and/or through their general budget.²⁰

5. Data and methodology

The methodology used was based on an economic-financial balance between costs and benefits allocated to the activities of packaging waste selective collection and sorting, carried out by local authorities. On the costs side, we took into account the operational and maintenance costs, the depreciations and the return on capital employed in the financing of fixed assets, allocated to the activities mentioned above. On the benefits side, we considered the FSLA (provided by Eco-Emballages), the sale of packaging waste materials (through the different take-back schemes), the financial support and sale of non-packaging waste materials (such as newspapers and magazines) and the government grants (where

²³SIVATRU (2010). Rapport annuelsur le prix et la qualité du service public d'élimination des déchets. Année 2010. Versailles: SyndicatIntercommunal pour la Valorisation et le Traitement des RésidusUrbains.

applicable). Furthermore, the savings from the diversion of packaging waste of refuse collection circuits and landfilling were also considered as another benefit in an economic perspective. The results obtained will be represented in a typical graphic, as shown in Figure 4.

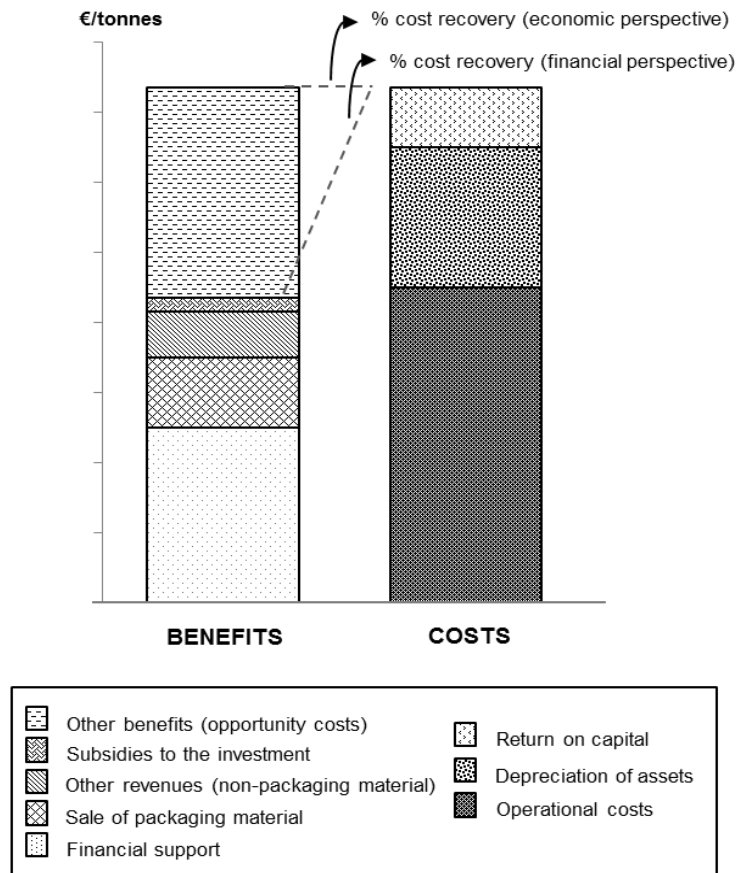


Figure 4 – The benefits and costs of recycling in France

The variables, indicated in the figure, were calculated based on the information gathered in the account and activity reports (for the year 2010) of 45 French local authorities. The opportunity costs (“other benefits”) were determined considering the refuse collection and other types of treatment and disposal costs according to the following equations:

$$\text{Costs avoided with refuse collection (€/year)} = \text{Quantity of waste selectively collected} \times \text{Unit cost of refuse collection} \quad (1)$$

$$\text{Costs avoided with waste treatment (€/year)} = \text{Quantity of waste recovered} \times \text{Unit cost of treatment and disposal} \quad (2)$$

Regarding the unit costs of refuse collection and treatment/disposal, we assumed the averages (see Table 9) stated in the Eco-Emballages' study.²⁴ In addition, we also considered the sorting efficiencies taking into account the different types of collection, as detailed in section 2, in order to estimate the quantities of waste rejected. In France, the rejected of sorting process are usually sent for incineration, which leads to an unavoidable cost. In fact, the cost of rejected treatment was included in our variable “operational costs”. Finally, the return on capital employed was calculated through equations (3) and (4).

$$\text{Return on capital employed (€/year)} = (\text{Depreciation-subsidies}) \times \text{Useful life of the assets} \times \text{WACC}^{25} \quad (3)$$

$$\text{WACC (\%)} = \text{Cost of equity} \times \frac{\text{Equity}}{(\text{1-marginal corporate tax})} + \text{Cost of debt} \times \text{Debt} \quad (4)$$

considering the following values:

- Useful life of the assets = 9.6 years
- Cost of equity = 6%
- Equity in the capital structure = 19%
- Marginal corporate tax = 11.1%
- Cost of debt = 4.5%

Table 9 – Values used in the methodology

Unit costs of refuse collection	85 €/t
Unit cost of other treatment (incineration, landfill, MBT)	96 €/t
Sorting efficiency:	
Glass	99%
BCMPJ	80%
BCMP	80%
BMP	76%
CJ	95%
J	98%

²⁴ ECO-EMBALLAGES (2005). La base de données e-coûts. Principaux résultats. Paris: Eco-Emballages.

²⁵ Weighted average cost of capital

6. The costs and benefits of French recycling system

The results of the balance between the economic and financial costs and benefits of selective collection and sorting activities, carried out in 45 French local authorities, are shown in Figure 5. Two different analysis were developed, the first one is based on the waste collected (the one internationally used) and the second one on the waste taken back, taking into account the services' efficiency (and allows us to know the real cost of each tonne of recycled material).

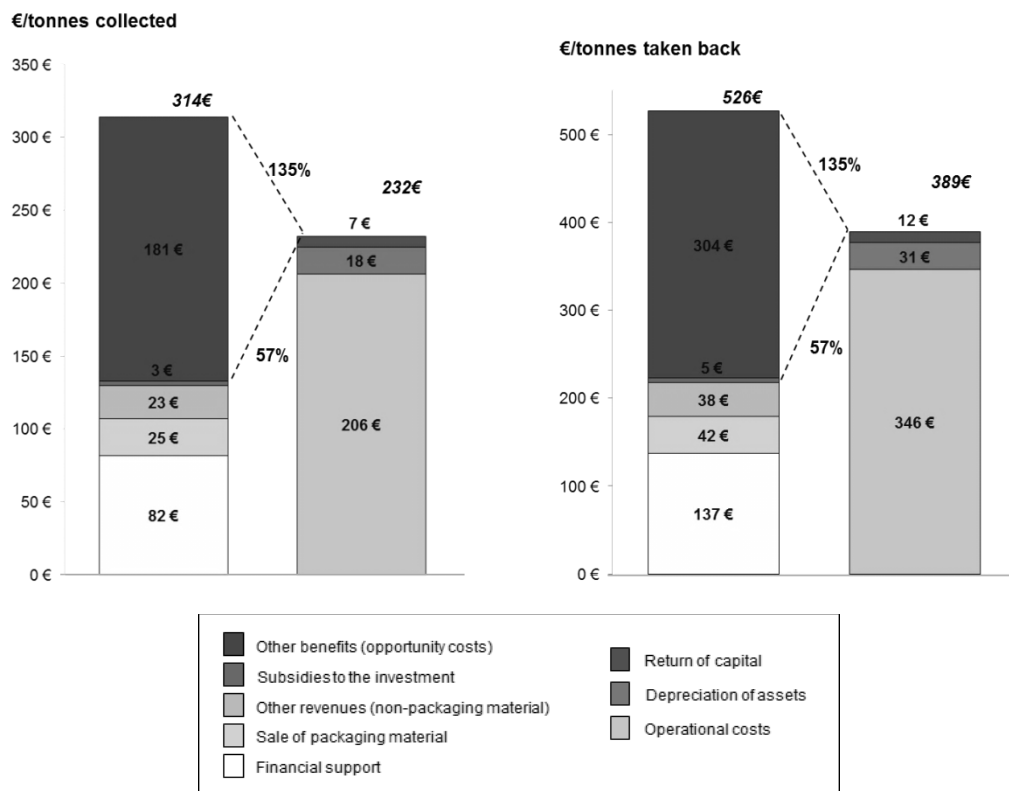


Figure 5 – Service cost recovery considering quantities collected and taken back

On average, the costs and benefits per tonnes taken back are significantly higher (about 60%) than the ones per tonnes collected. In the first case, local authorities benefited 526 € per tonne of packaging waste sorted and sent for recycling in 2010. In a strictly financial perspective (not taking into account the opportunity costs), the benefits represented only 223 € per tonne. On the other hand, each tonne of packaging waste sent to the recycling system of local authorities had a total cost of 389 € per tonne. Based on tonnes collected, the economic costs and benefits decreased to 232 € per tonne and 314 € per tonne, respectively.

The cost recovery is around 135%, from an economic perspective but only 57% if the cost savings due to recycling are not taken into account. Assuming that the financial transfers should follow an economic approach, the FSLA, for 2011, could be eliminated. If the industry was 100% responsible for the processing of their waste packaging, and excluding the government grants (as shown in Figure 6), the sustainability of the service would require an increase of 125% of the FSLA and the public money could be invested in other services.

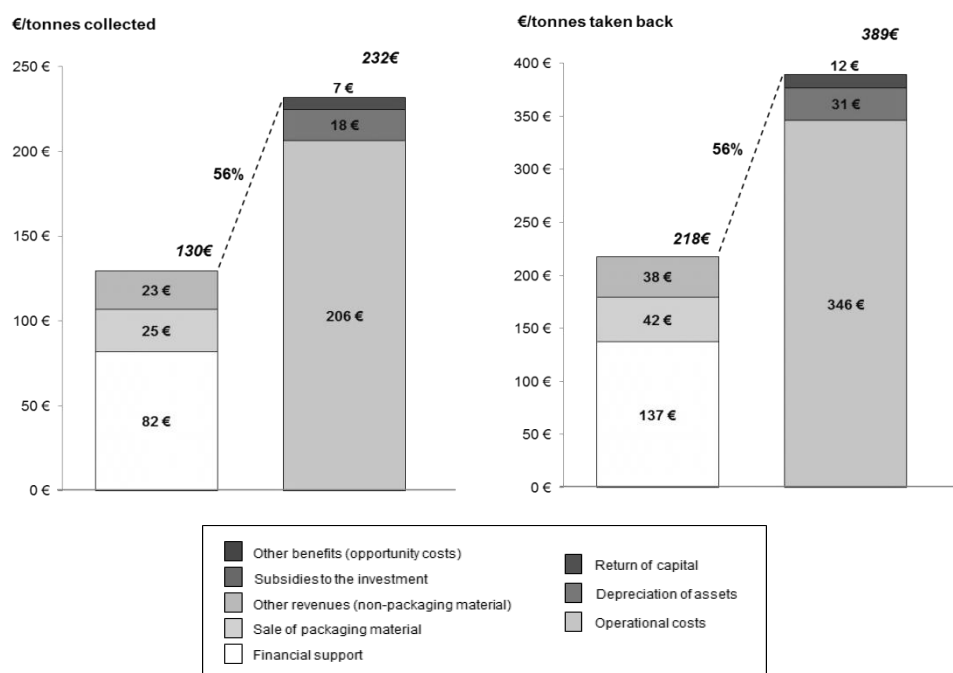


Figure 6 – Cost recovery of local authorities excluding subsidies and other benefits

Chen mathematically demonstrated that the application of government subsidies on recycling promotes a greater increase in recycling rates and in recovery technology level than their application on services of selective collection and sorting (the current situation).²⁶

According to our analysis, we can also concluded that FSLA only covered 35% of the packaging waste services costs in 2010, when the Eco-Emballages funding model set acosts recovery of the optimized service on 60%. However, note that the actual costs of the service do not correspond to the ones defined as “benchmark costs”.

²⁶ Chen C.C. (2005)An evaluation of optimal application of government subsidies on recycling of recyclable waste. Polish Journal of Environmental Studies, 14(2), 137-144.

Conclusions

This study presents the costs and benefits of packaging waste recycling in France. It describes the methodology implemented and two innovative components are considered. The return on capital employed (debt and equity) regarding the financing of the assets allocated to the packaging waste services and the opportunity cost of refuse collection and landfilling are traditionally left out in these assessments.

The evaluation of the opportunity cost in the economic-financial balance of selective collection and sorting of packaging waste seems to be quite relevant, since the cost of refuse collection and waste treatment avoided with packaging recycling were significant (181 € per tonne collected). Adopting this perspective, one might conclude that the financing model of French “recycling system” was sustainable in 2010. On the other hand, industry only covered 56% of the total service costs. So, this paper debates on two pertinent questions: (1) if the costs of the ‘recycling system’ should be entirely borne by the economic operators; and (2) if the public money should be applied on the collection and sorting of packaging waste.

Finally, we should highlight that public authorities are encouraged to protect the environment and municipalities should educate their citizens so that they can adopt better practices in terms of municipal waste management. In this sense, the *Barème E* was established between the Eco-Emballages and local authorities in order to encourage a better performance of waste public services in the next years.

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