We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800
Open access books available

122,000
International authors and editors

135M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

5

Strength and Weakness of Municipal and Packaging Waste System in Poland

Joanna Kulczycka[1], Agnieszka Generowicz[2] and Zygmunt Kowalski[3]
[1]*Mineral and Energy Economy Research Institute, Polish Academy of Sciences*
[2]*Institute of Water Supply and Environmental Protection – Cracow University of Technology Poland*
[3]*Institute of Chemistry and Inorganic Technology Poland*

1. Introduction

The European Union's approach to waste management is based on three principles: prevention, recycling, and reuse. The introduction to Directive 2006/12/EC of the European Parliament and the Council on Waste states that "the recovery of waste and the use of recovered materials as raw materials should be encouraged in order to conserve natural resources". According to the newest Directive 2008/98/EC on waste recovery is one of the five objectives of environment-friendly waste management. The targets for re-use and recycling of waste, which should be attained by 2020, is:

- for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50% by weight;
- and for non hazardous construction and demolition waste: defined in category 17 05 04 in the list of waste shall be increased to a minimum of 70% by weight (EC, 2008).

Moreover, the Directive 2004/12/EC (amending Directive 94/62/EC) on packaging and packaging waste was adopted. This Directive aims to harmonize national measures in order to prevent or reduce the impact of packaging and packaging waste on the environment. Therefore the recovery (60% in 2014) and recycling (55% in 2014) targets were established and must be met by each member state. In Poland, although the recycling level for municipal waste has been increasing, it still remains at a very low level (approximately 8%). One of the reasons for this is that there are two parallel systems, which are responsible for separate collection, i.e.:

- **system for local communes,** which are responsible for management of all type of municipal waste,
- **system for entrepreneur-manufactures,** which are obliged for recovery and recycling of packaging waste.

On both systems the market conditions, i.e. relatively high cost of separate collection, which depends on the amount of collected material, the unit size of the waste material, the quality

of the waste materials, changing price of waste materials, lack of education have significant influence and not allow implementing new technological solutions. As both the waste material obtained from separate collection from municipal waste and the waste packaging material should be deliver to recycling companies, the cost of their collection is a decisive factor in respect of the profitability of this process. As the cost of collection of individual waste is usually higher then bulk packaging and transport packaging waste, system for entrepreneur-manufactures is usually focus on the latter collected. The demand from Polish producers for waste materials (glass, paper, plastic) is relatively high, even the proper quality of waste with low price is required; therefore the system for entrepreneur-manufactures has higher potential to develop.
The aim of this chapter is to analyze the strength and weakness of existing systems of waste management in Poland, the assessment if the EU requirements with current systems could be achieved till 2020 and the proposal how to develop – based on best EU practice – these systems to promote both the recovery and recycling of separate collection of household waste and packaging waste.

2. The strength and weakness of local communes system

In the EU old members the planning of waste management had been developed since 1970s. In that time in most of EU new members there was central planned economy, with quite well developed system for glass reuse and metal collection. During the transformation period the waste management was not the most important subject and the waste landfilling was the most popular option. After joint the EU it was necessary to implement the EU requirements. With the EU financial support (structural funds) first it was necessary to close the ineffective landfills and then to build the system for recovery and reuse. Unfortunately this is a very slow process. Numerous economic and legal changes concerning waste management have been introduced in Poland over the last 10 years. As a result, the amount of waste deposited in landfills sites has been diminishing, dropping from over 95% a few years ago to approximately 85% last year. According to the Central Statistical Office (GUS), over 12 million Mg of waste, i.e. 319 kg per person, was generated in Poland in 2009, while about 10 million Mg (264 kg/per person) was collected, of which 8.469 million Mg was deposited in landfill sites, 0.101 million Mg was incinerated, 0.508 million Mg was subjected to biological and mechanical treatment methods, and 0.796 million Mg was segregated from mixed waste. From collected household waste 0.543 million Mg was collected separately for recycling, predominated by glass, paper and cardboard (Fig. 1 and 2).
Segregated collection has been increasing, though very slowly, mainly for economic reasons such as the fact that the price of the material separated from the waste remains low, and therefore there is not interest of implementing new technological solutions. As one of the aims set out in, for example, the National Waste Management Plan 2010 and the ecological policy, is to increase the recovery or recycling of waste material from household waste (glass, paper, metal) from the current level of 8%, to 50% of the overall quantity by 2020, new solutions should therefore be developed for the promotion of both separate collection and the segregation of material from mixed waste.
In some communes, the selective collection of waste is financed from budget sources, as the communes are responsible for keeping their region clean. A company, chosen by means of open bidding, empties the special selective waste collection containers, known as 'bells'. In 2004, the average total cost, including investment, for segregated collection in communes

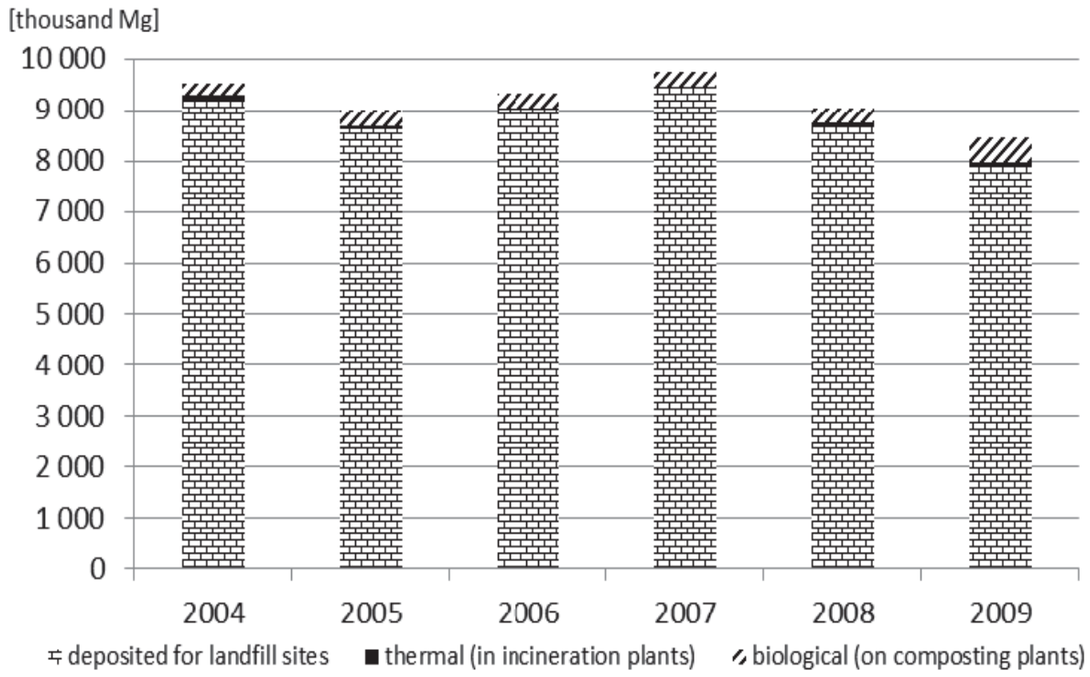

Fig. 1. Municipal solid waste managed in 2004-2009

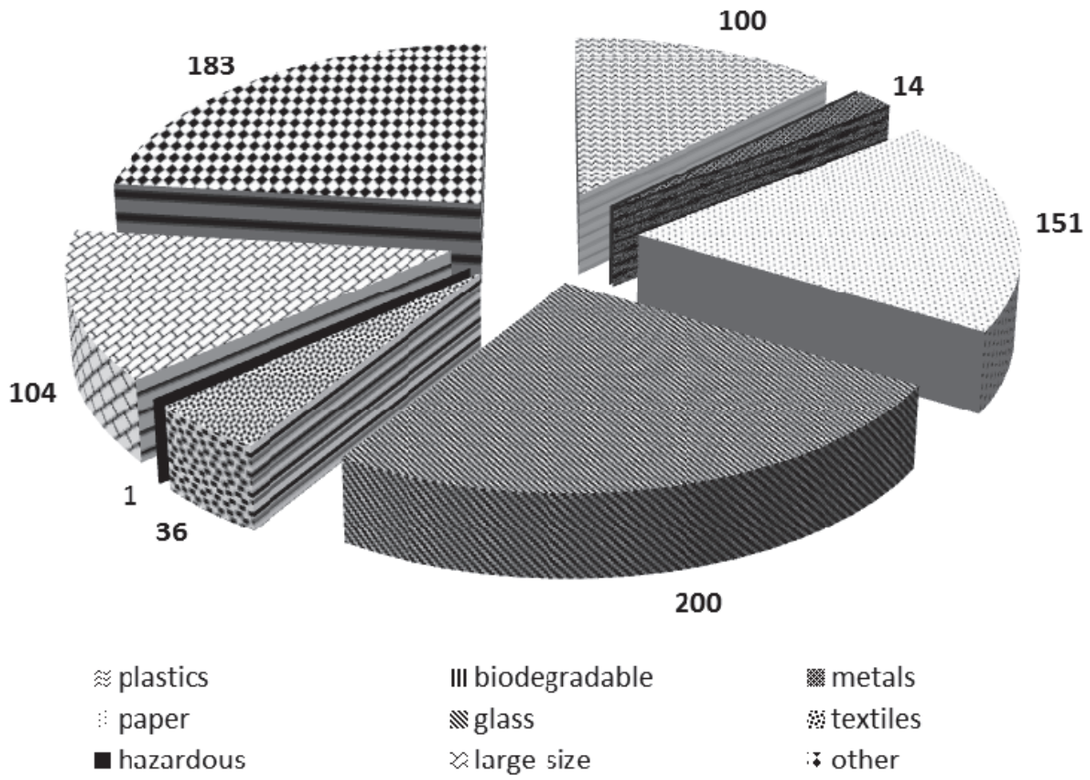

Fig. 2. Segregated municipal waste collection in 2009 [thousand Mg per year]

varied from PLN 235/Mg (glass) to over PLN 1.160/Mg (aluminium) (Poskrobko, 2005). Similar cost levels for waste collection were obtained in various towns in 2006, e.g. in Tarnów, the average cost was over PLN 600/Mg (Report, 2007). Most communes concluded that separate collection is not in the least profitable, with every PLN 1 received for the material obtained having incurred a collection cost of PLN 4. In order to reduce collection costs, the collection companies have now introduced a bag system. The cost of collecting paper in 120 litre bags was PLN 60/Mg, with plastic costing PLN 200/Mg and glass, in 80 litre bags, costing PLN 27/Mg (OGIR, 2008). An even more effective system proved to be the provision of one bag for mixed paper, plastic and glass waste. This solution made it possible to increase the amount of waste for recycling, and to cover the costs of collection for some types of waste material; for example, the price of waste paper might then be approximately PLN 100/Mg. However, even if some income could be earned from the sale of paper, plastic materials, glass and aluminium tins for recycling, it would not reach a level permitting investment in, and the development of, such an operation.

However, this system is fully dependent on market conditions, which are changeable. Therefore, other incentives for promoting recovery should thus be implemented, for instance, a system of awards for individual 'collectors', educational measures, or the seeking of financial support from Structural Funds for new technological solutions, and so forth.

The strength and weakness of local communes system is presented in table 1.

Even there are some improvements in waste management in Polish regions, it is important to elaborate in regional plans a conceptual model, which can promote waste recycling and recovery including regional conditions. Such model was proposed e.g. in South East England. The model was developed for the recycling chain for each priority materials. The five stages model has been analyzed and it included: collection, pre-processing (sorting/segregation), densification (volume/size reduction), reprocessing (conversion ratio into raw material) and fabrication (produce/product). This structure has been proposed to each priority material to establish the size and distribution of capacity at each point in the chain. It is recognized that some routes combine steps in the chain. For example newspaper recycling to newsprint may go direct from collection to reprocessing and fabrication (Potter, 2006). Based on such model the regional plans should set realistic targets for all form of waste. It is particularly important that communes should work together in the area where there are opportunities to achieve better value for money and to achieve sustainable waste management.

Moreover, for the evaluation of environmental impact of waste processes or systems one of the most respected, popular and widely used in the EU method is LCA (Life Cycle Assessment). The method has been seized, inter alia, to develop The Strategic Environmental Impact Assessment for the National Waste Management Plan in the Netherlands and Strategic Environmental Impact Assessment for the Waste Management Plan of the region of Liguria in Italy. Worldwide, there are many programs that use the LCA for supporting modelling of waste systems as well as evaluating their impact on the environment, i.e. IWM-2 (*Integrated Waste Management II*), WRATE (*The Waste Resources Assessment Tool for Environment*), TRACI (*Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts*), EASEWASTE (*Environmental Assessment of Solid Waste Systems and Technologies*), ORWARE (*Organic Waste Research*), WISARD (*Waste – Integrated Systems for Assessment of Recovery and Disposal*), and more general software as SimaPro and GaBi. These programs are used to evaluate both the existing as well as the modelling of new waste management systems and to determine the environmental benefits of their modernization.

Introduction of such assessment could be beneficial also for new members, especially, as some proposals have already been done by JRC, Ispra (Koneczny et al., 2007).

strength	weakness
the planning system – based on the EU experience – has been introduced including aims, tasks and costs of its realization	lack of proper legal regulation which allow communes to manage the waste as the owner of waste. The owner of waste could be transport companies or owners of waste management facilities, i.e. sorting installation or landfills
communes started to cooperate with each other creating larger organization system for separate collection	communes are relatively small, therefore the management of waste is dispersed, and as a result there are not enough specialists responsible for waste management, planning and reporting in communes
the existence of environmental fee and fines system, which are separate from tax system	lack of common scheme for collecting and recording data for type of waste, methods of recovery and recycling, etc.
small progress in separate collection has been achieved in last years	there is not regional system of waste management, which should be connected with the regional conditions i.e. if there is a glass factory in the region the system of glass collection should be promoted
the separate collection system (i.e. bells or bags) is available for about 50% inhabitants in some regions in Poland, but not all inhabitants are used it	relatively low cost of landfilling (including environmental fee) compared to other methods
availability of financial support for new installations and education from EU –fund as well National Fund of Environmental Protection and Water Management	lack of systematic education as well lack of education provided by individual regions
	lack of economic encouragement for privet investors for development of separate collection, therefore there are only few sorting plants where waste from individual household should be cleaned
	there are not legal instruments to force to achieve the indicated in local and regional plans level for separate collection

Table 1. The strength and weakness of local communes system in Poland

3. The strength, weakness of entrepreneur – manufactures system (packaging waste)

Poland has already adopted the majority of the EU regulations, e.g. the Directive 2004/12/EC (amending Directive 94/62/EC) on packaging and packaging waste, which

imposes the obligation of adopting specified packaging waste recovery and recycling levels on Member States. The Directive was introduced into Polish law in 2001, and updated over the course of the following years. The entrepreneur-manufactures or importers of packed materials were obliged to attain the appropriate percentage level for mass of the packaging waste towards the implemented packaging mass. The legislation permits the delegation of this obligation to a recovery organization. If they fail to attain the statutory level of recycling, they are obliged to pay a product fee for the difference between the required and the achieved level of recovery and/or recycling, expressed in product weight or quantity[1]. The fees are imposed on entrepreneur-manufactures or importers of packaging materials. The system is very complicated, as the duty imposed on an individual company for different types of packaging material, and not on the total tonnage of packaging material, can be met by company itself, or by a recovery organization. The product fee is in correlation with the collection costs, but the cost of collection from an industrial source (bulky packaging waste) is several time lower than from individual one. In 2008, the product fee varied from PLN 0.26/kg for glass to PLN 2.37/kg for plastic. In general, being higher than the price, which can be obtained for material separated from municipal waste (Kulczycka & Kowalski, 2010). The system seems to be very effective, given that official statistics suggest that the required level of recycling for all types of packaging material was not only achieved, but, in a number of years, was even significantly exceeded (tab. 2). The very high level of recycling in 2004-2006 presented here was mainly due to the system of classification introduced by the Ministry of the Environment, whereby if required annual recovery and recycling levels excess 100%, were carried forward to the report for the next year. This was amended in 2007 and from then on reported recovery and recycling levels have not included the aforementioned surplus (GUS, 2009).

Year	2003		2004		2005		2006		2007		2008		2009		2014
	A	R	A	R	A	R	A	R	A	R	A	R	A	R	R
Plastics	16.8	10.0	22.4	14.0	30.3	18.0	36.9	22.0	28.0	25.0	23.9	16.0	21.5	17.0	22.5
Aluminum	27.1	20.0	33.3	25.0	86.7	30.0	110.4	35.0	82.0	40.0	60.9	41.0	64.2	43.0	50.0
Steel	14.4	8.0	17.3	11.0	23.4	14.0	34.1	18.0	21.2	20.0	26.5	25.0	33.6	29.0	50.0
Paper	52.9	38.0	57.0	39.0	65.4	42.0	85.6	45.0	69.1	48.0	67.2	49.0	50.9	50.0	60.0
Glass	20.4	16.0	31.2	22.0	38.4	29.0	48.0	35.0	39.7	40.0	43.9	39.0	41.9	430	60.0
Natural materials	9.0	7.0	19.4	9.0	47.2	11.0	73.4	13.0	47.8	15.0	26.3	15.0	23.1	15.0	15.0
Multi material	13.5	–	14.2	–	22.5	–	–	–	–	–	–	-	-	-	-

A – achieved; R – required

Table 2. Required and attained recycling and recovery levels for packaging material in 2003-2009 and required level for 2014 (in percent %)
Source: GUS

[1] The Minister of the Environment's Regulation of 14 June 2007 on annual levels of recovery and recycling of packaging and post-usage waste (O. J. No. 109 item 752) stipulated the required level of recovery and recycling.

In Poland the quantity of packaging product launched on to the market has increased from approximately 3.1 million Mg in 2005 to about 3.8 million Mg in 2009, and officially about 37% of packaging waste undergoes recycling process. At over 43% the main packaging material is paper, namely packaging made from corrugated and solid cardboard and glass (fig. 3). Bulk packaging and transport packaging waste are predominant here, as they are easy to localize because they occur in the trade and industry sectors. Glass packaging holds second place owing to the extensive production of the disposable packaging that facilitates the disposal of packaging waste.

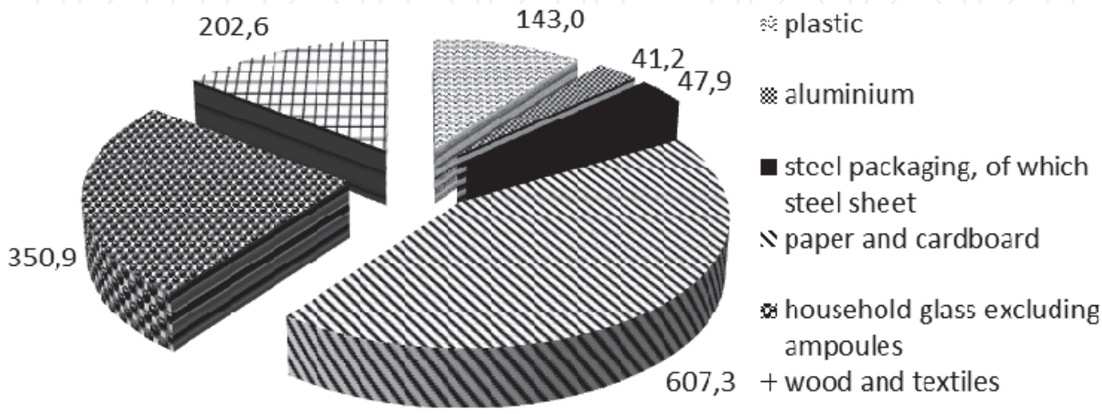

Fig. 3. Recycled packaging waste Poland in 2009 [thousand Mg]
Source: GUS

In spite of possessing the higher capacity for recycling especially for plastics and glass the owners of the recycling companies are unable to bear the high costs of selective collection. Meanwhile, the entrepreneur-manufacturers limit themselves to the statutory recovery and recycling levels to which they are bound. Product fee sanctions can be imposed on the entrepreneur-manufacturers only in cases where these levels are not met; at the same time, most of them are able to achieve this level owing to the fact that they can fulfil their obligations by means of Recovery Organization on the free market to buy so-called 'receipts' (there are about 40 of such Recovery Organizations on Polish market). An organization introducing packaging and products on to the market can buy the appropriate amount of 'virtual receipts'; corresponding to the quantity it should meet in order to fulfil its recovery and recycling obligations. The financial resources for fulfilling this obligation are known as a 'recycling payment'. When the act initially came in to force, these recycling payments were high, though they did not exceed 50% of the product payment. However, as the system was not watertight, some 'virtual receipts' were incorporated in the relevant calculations several times, and the price of the recovery payment thus dropped significantly. As a result about producers and importers of packaging waste paid 5 million PLN/year as a product fee, whereas about 60 million PLN/year to Recovery Organizations in last years, whereas the real cost of collection of 1,5 million Mg of packaging waste was estimated on 300 million PLN (Kawczyński, 2009).
The existing entrepreneur-manufactures system is presented on Fig. 4.
The revenues from product fees are distributed (according to the Act on requirements for entrepreneurs with respect to management of some wastes and product and deposit fees-consolidated text O. J. 2007, no. 90 item 607) to:

- Marshal Offices receive 100% of revenues,
- Marshall Offices keep 2%, while 98% is transferred to the National Environmental Protection and Water Management Fund (NFOSiGW),
- NFOSiGW keeps 30% of revenues, while 70% is transferred to Voivodship Environmental Protection and Water Management Funds (WFOSiGW), which transfer all the resources to the Communes Office (as income of the communes, fig. 5),
- Redistribution of funds from product payments for packages, based on the indicator of the quantity of package waste assigned for recovery and recycling, causes the funds from the voivodships which gain high revenues from product payments to be transferred to the voivodships which gain low revenues (GUS).

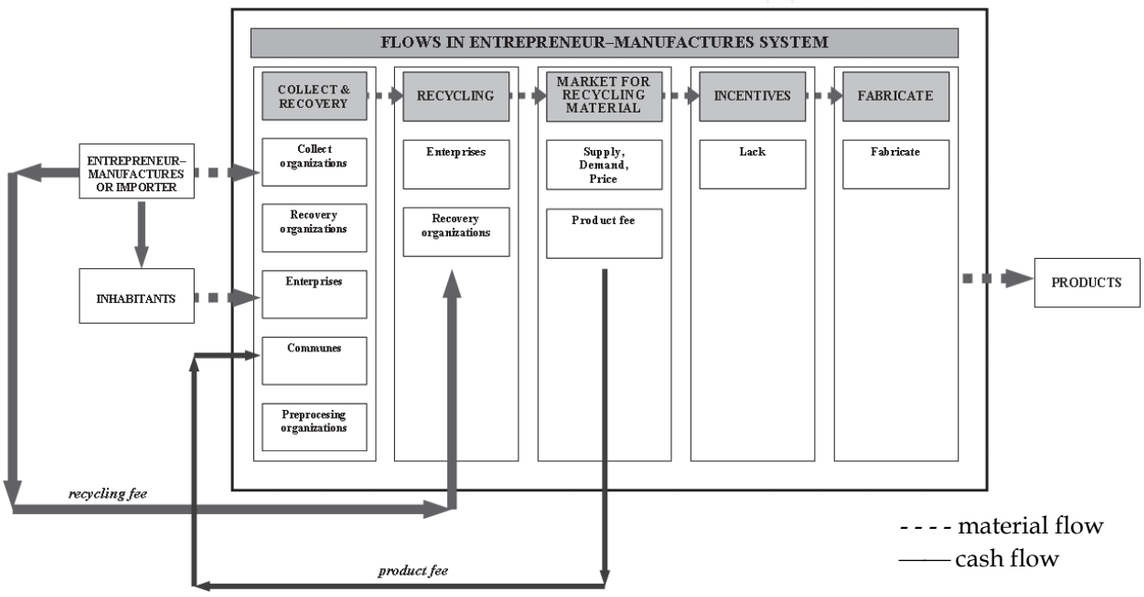

Fig. 4. The flow of packing waste in entrepreneur-manufactures system

In year 2004-2009 the total value of product fee paid by Marshals' Office varied from 1,5-4,2 million PLN, with significant drop in last 2 years (tab. 3). In 2009 the product fee paid to Marshal Offices amounted to 1,5 million PLN, whereas due product fee 4,5 million PLN (tab. 3). The value of due product fee is at least two times higher than regular product fee, as many entrepreneur-manufacturers paid with delay (then the interest for delay is added). The sum of product fee and additional fee transferred from Marshals' Office to NFOŚiGW differs from the value of receipts of NFOŚiGW as the presented in table 3 data were calculated during the calendar year, whereas the transfer of fee Marshals' Office to NFOŚiGW was till the end of April (fig. 5).

Communes also collect packaging waste, but they not always proper divided municipal waste from packaging waste. It creates a lot of problems in waste classification, quite often double counting (as entrepreneur-manufacturers or recovery organization can re-collect the packaging waste from communes) and reporting. The strength and weakness of entrepreneur-manufactures system is presented in table 3.

A proposal for new regulations for the management of packaging waste has been put forward in order to attempt to solve these problems. However, it does not propose any structural changes, such as taking into account the ratio of tones of *packaging to tones of*

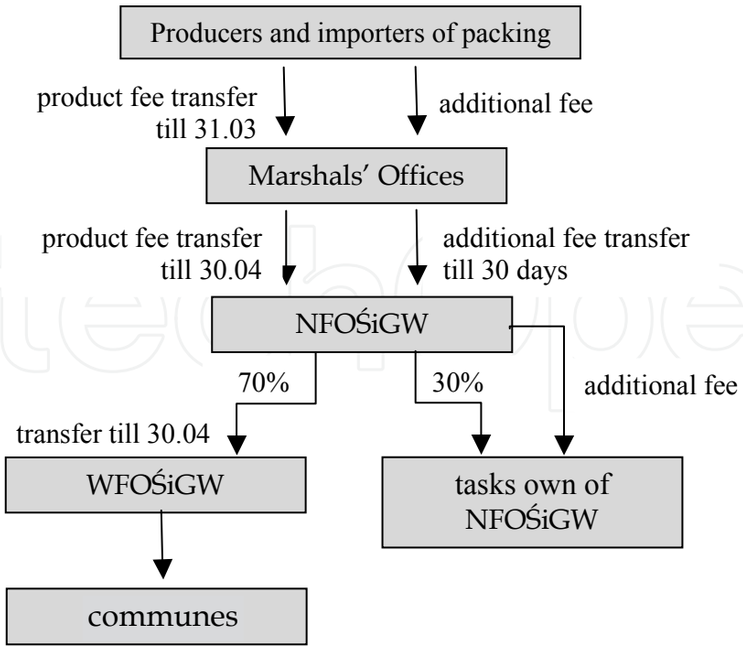

Fig. 5. Redistribution of product fee in Poland. Source: GUS

product (sold by weight), or the share of non-recyclable packaging within the total tonnage (e.g. total non-recyclable packaging as a percent of total packaging sold) or introducing correlation between packaging size and product fee. Some incentives should be implemented for companies, who introduced the packaging from recycling materials, for example for these packaging materials the product fee should be suspended.

Taking into account the best practice from other EU regions (Boag, 2010) the following idea may be taken into consideration:

- the objective of the system should be to discourage producers from generating waste in the first place,
- if the packaging waste are placed on the market the evidence system should be verified gathering information from different sources, i.e. associations or NGO,
- the recycling companies should be accredited or by the National Fund of Environmental Protection and Water Management or the Ministry of the Environment, i.e. in Scotland there are 31 SEPA accredited re-processors and exporters of packaging waste, and 415 re-processors and exporters for the UK in total,
- the entrepreneur-manufactures or importers of packed materials should be registered in the system special created for them, for example in Scotland producers for registration can join a compliance scheme (private business ensures recycling evidence on behalf of producers), or to register with the relevant environment agency and obtain the evidence of recycling. There are 5 compliance schemes, which have registered with SEPA (120 members in total). In the UK as a whole there are 48 Schemes with a total of 6487 members. Whereas 76 companies have directly registered with SEPA in Scotland and 535 for the UK,
- the regional or national web-based database with on-line submission, both from producers and re-processors should be created, i.e. in the UK the National Packaging Waste Data base was established in 2005 and it is supported by the UK environment

agencies, government and companies obligated by the packaging regulations including re-processors, exporters and compliance schemes. In Poland the regional data based was also created, but it includes information concerning mainly municipal solid waste, i.e.

- the amount and type of produced waste and the ways of its management,
- the registry of the issued decisions regarding waste production and management,
- the waste management plans,
- installations that are used in order to reclaim and neutralize waste with separation of the landfills and installations for thermal transformation of waste (Góralczyk et al., 2008).

Product fee /Year	2004	2005	2006	2007	2008	2009
Value of total product fee as well as additional product fee paid to Marshals' Offices	3 261,5	2 799,0	4 217,5	3 357,2	1 925,1	1 500,5
Value of due product fee as well as additional product fee paid to Marshals' Offices	n.a.	4 306,7	4 604,6	9 103,6	6 571,6	4 471,6
Receipts from Marshals' Office for the NFOSiGW	7 097,4	9 545,0	6 116,9	13 819,8	11 441,3	7 162,8

Table 3. Value of product fee and its distribution (thousand PLN)
Source: GUS

strength	weakness
clear defined responsibility on entrepreneur-manufactures or importers for collection and recycling the required level of packaging waste	system is complicated, as the duty are imposed for different types of packaging materials, and not on the total tonnage of packaging material
there are legal and financial instruments to fulfil the obligation	lack of clear rules for documents and information flow in the system what allows to create of 'virtual receipts'
significant increase in recovery and recycling of packaging waste in Poland	not coherent classification of waste (as communes not always divided municipal waste from packaging waste)
income from product fee are dedicated mainly for improvement of the waste system including educations and promotions	double counting - as entrepreneur-manufacturers or recovery organization can re-collect the packaging waste from communes
	lack of control on recycling organization and proper reporting
	lack of economic instrument or other system for encouragement for recovery or recycling
	the system does not encourage to the prevention of waste

Table 4. The strength and weakness of entrepreneur-manufactures system in Poland

4. Conclusions

1. The simultaneous introduction of an effective instrument promoting the recovery of waste from both municipal waste and packaging waste in new EU members is difficult, as these two systems deliver their final products to the same recycling companies and are thus forced to compete on the market.
2. Despite the high capacity of recycling companies in Poland, only about 50% of the packaging waste introduced into Polish market undergoes the utilization process. Although they possess the recycling capacity for plastics and glass, the owners of the recycling companies are unable to bear the high costs of the selective collection.
3. The collection costs for the individual packaging waste obtained from municipal waste is much higher than the costs of collection of transport, or cumulative packaging.
4. Owing to its lack of economic efficiency (high collection costs), the communes system is support from local authorities in the majority of cases. However, such a system cannot be applied in the long term, as the local authorities have no specific funds allocated to such operations.
5. The entrepreneur-manufactures system introduced in Poland is complicated as it was addressed to individual entrepreneurs manufacturing for each type of packaging waste, rather than addressing the total tonnage of packaging waste introduced on to the market.
6. There are no other measures (the ratio of tones of *packaging to tones of product* sold, or the share of non-recyclable packaging in total tonnage) then the tonnage of packaging waste introduced on to the market for the assessment of entrepreneur-manufactures system. As a result, the obligation is fulfilled by either packaging or cumulative (bulk and transport) packaging, and not by individual packaging.
7. Recovery and recycling obligations can be met by various entities, i.e. the company itself or a recovery organization; a failure to meet the obligation on the part these entities results in the requirement to pay a product fee. This solution gave rise to the market for so-called 'receipts'. Corresponding to the quantities designated for recovery and recycling. Entrepreneurs from recovery organizations buy them, the latter being responsible for mediation between companies and the processors of the obligations. There are therefore no effective incentives for entrepreneurs to decrease the packaging waste tonnage as, owing to competition on the market, the cost of the 'receipts' dropped. As it stands, the act also fails to encourage entrepreneurs to co-finance collection, recovery and recycling. This obligation was placed on residents, communes and recycling companies.
8. The education system and especially, the introduction of marketing instruments for the promotion of segregated collection at 'source' is insufficient.
9. The instruments for prevention of generating waste or eco-designing is not well developed.
10. It is necessary to introduce the other than based on market solutions incentives, i.e. support for developing new technological solutions.

5. Acknowledgements

This research was supported by the project Assessment of the municipal waste management system and methods for its evaluation N R14 0016 04 from National Centre for Research and Development.

6. Abbreviations

EASEWASTE – Environmental Assessment of Solid Waste Systems and Technologies,
EU – European Union,
GUS – Central Statistical Office,
IWM-2 – Integrated Waste Management II,
LCA – Life Cycle Assessment,
ORWARE – Organic Waste Research,
PLN – Polish zloty, is the name of Polish currency,
TRACI – Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts,
WFOSiGW - Voivodship Environmental Protection and Water Management Funds
WISARD – Waste Integrated Systems for Assessment of Recovery and Disposal,
WRATE – The Waste Resources Assessment Tool for Environment.

7. References

Boag, K. (2010). Implementation of the Directive on packaging and packaging waste in terms of waste management plans. *Packaging waste conference*, Kielce, Poland, pp.1-5.

Directive 2008/98/EC of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives, EN 22.11.2008, *Official Journal of the European Union*, p. 2.

Góralczyk, M.; Kulczycka, J. & Czarnecka, W. (2008). Regional waste data systems and sustainability indicators. *Czasopismo techniczne CHEMIA*; 16(105), p. 4.

GUS (2009). *Ochrona środowiska*. Warszawa, Poland, p. 361.

Kawczyński, K. (2009). System odzysku i recyklingu odpadów opakowaniowych w Polsce – stan obecny i perspektywy rozwoju. *Polski System Recyklingu*, Warszawa, p. 12-13.

Koneczny, K.; Dragusanu, V.; Bersani, R. & Pennington, D.W. (2007). *Environmental Assessment of Municipal Waste Management Scenarios*. European Commission, Joint Research Centre, Institute for Environment And Sustainability, Italy, p. 12.

Kulczycka, J. & Kowalski, Z. (2010). *Valorisation of Packaging Waste Material – The Case of Poland,* 3 rd International Conference on Engineering for Waste and Biomass Valorisation. Beijing, China, p.165.

OGIR (2008). *Ekonomia w gospodarce odpadami*. p. 24.

Poskrobko, B. (2005). *Analiza kosztów selektywnej zbiórki, odzysku i recyklingu odpadów opakowaniowych w kontekście stawek opłat produktowych i opłat recyklingowych z uwzględnieniem zmian dyrektywy opakowaniowej*. Białystok, Poland, p. 15.

Potter, A. (2006). *Scoping Review of recycling and reprocessing infrastructure in the South East.* Beyond Waste, p. 16.

Report (2007). "*The costs of municipal waste management in municipalities*". Foundation to support environmental initiatives.

Integrated Waste Management - Volume I

Edited by Mr. Sunil Kumar

ISBN 978-953-307-469-6
Hard cover, 538 pages
Publisher InTech
Published online 23, August, 2011
Published in print edition August, 2011

This book reports research on policy and legal issues, anaerobic digestion of solid waste under processing aspects, industrial waste, application of GIS and LCA in waste management, and a couple of research papers relating to leachate and odour management.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Joanna Kulczycka, Agnieszka Generowicz and Zygmunt Kowalski (2011). Strength and Weakness of Municipal and Packaging Waste System in Poland, Integrated Waste Management - Volume I, Mr. Sunil Kumar (Ed.), ISBN: 978-953-307-469-6, InTech, Available from: http://www.intechopen.com/books/integrated-waste-management-volume-i/strength-and-weakness-of-municipal-and-packaging-waste-system-in-poland

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

IntechOpen