A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science

CAN POLAND BECOME SECOND IRELAND? PACKAGING WASTE MANAGEMENT ON EXAMPLE OF KRAKOW AND DUBLIN.

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July, 2010

Budapest

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ABSTRACT OF THESIS submitted by:
Monika Ewa GRUSZCZYNSKA
for the degree of Master of Science and entitled: *"Can Poland Become Second Ireland? Packaging Waste Management On Example Of Krakow And Dublin."*

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Poland and Ireland are both the European Union member states and share many similarities. At the same time, there are many differences between those two countries. This is clearly visible in packaging waste management system. Although most of the waste related issues is harmonized by the EU Directives on Packaging Waste Management (94/62/EC or 2004/12/EC), which need to implemented into the national policy framework, the differences still persist.

The main goal of this thesis was to analyze and compare the existing situation in these two countries in the field of sustainable packaging waste management by identifying the main factors that affect (positively and negatively) the development of sustainable packaging waste management and define barriers to this development in Poland (Krakow) and Ireland (Dublin). At the same time, this dissertation attempted to identify those initiatives, which work well in the Ireland and analyze if they could fit to the existing situation in Poland. I found some Irish experiences, which, if implemented in Poland, could have a significant influence on improvement of packaging waste management situation as Green School Initiative, regulations on reporting and monitoring system (EPA and local authorities), well established financing system which support recycling and recovery development (e.g. Repak). The Irish case also shows the need for continued investments in the development of new technologies (waste segregation – Greenstar, Greyhound, local authorities, recyclable inks and labels - TLC), as well as education and informative initiatives. However, not all actions which are workable in Ireland can be implemented with the success in Poland. The initiatives, which works well in Ireland but unfortunately can failed in Polish circumstances are for example door – to – door collection system, because of large number of multifamily houses (in many cases over 120 apartments).

The thesis also showed that both systems (i.e. Krakow and Dublin) are still not perfect and need some more improvements, especially with respect to simplification of reporting by creation of one comprehensive on-line database, strengthening the control over subsidies provides to the countries to avoid frauds, energy recovery as a solution for the waste utilization and controlling small and medium companies in order to limit the amount of waste.

Keywords: Packaging, Waste, Management, Poland, Ireland, European Union, Waste Directive.

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List of Abbreviations

DOEHLG - Department of the Environment, Heritage and Local Government

EC – European Commission

EPA – Environmental Protection Agency

EPL – Environmental Protection Law

EU – European Union

IR – Infra Red Radiation

GBO - Green business activities

HDPE - High Density Polyethylene

LDPE - Low Density Polyethylene

MPO – Miejskie Przedsiebiorstwo Oczyszczania [Municipal Cleaning Company]

MRF – Material Recovery Facility

PET – Poly-Ethylene Terephthalate

PHA – Polyhydroxyalkanoates

PLA – Polylactic Acid Polysters

PP – Polypropylene

PS - Polystyrene

SPI - resin Identification Coding System

UMWM – Urząd Marszalkowki Wojewodztwa Malopolskiego [Marshal Office of Malopolska Region]

V/PCV - Vinyl/Polyvinyl Chloride

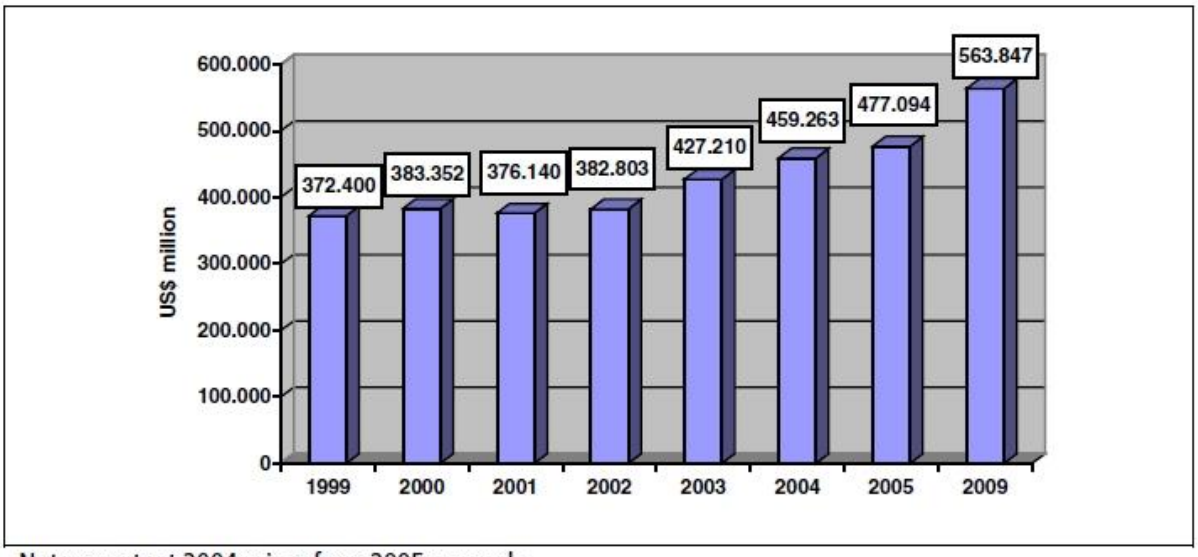
ZIKiT - Zarząd Infrastruktury Komunalnej i Transportu w Krakowie [Management of Municipal Infrastructure and Transport in Cracow]

1. Introduction.

1.1. Background

Food, beverage, cosmetics, household chemicals, pharmaceuticals and other consumer goods are strongly dependent on packaging which constitutes an integral part of many products. Furthermore, the wide range of industry sectors is also reliant on the packaging market. As a wrapping is present in our everyday life, so its common usage is seen in large growth in global economy and importance of the subject. Increase in demand for packaging is caused inter alia by population growth, convenience, smaller households (smaller packs), hygiene, "to go" lifestyle or brand differentiation what creates more competitive market not only for production but also later, for waste management. There is no doubt that packaging market is an increasing trend worldwide. Only in 2004, sales of containers were worth around $460 billion (Figure 1.1). (WPO 2008)

Figure 1.1: Trends in Global Packaging Market for years 1999-2009



Note: constant 2004 prices from 2005 onwards
Source: Pira International Ltd

In developed world, environmental security is one of the central issues on the political agenda, so that is why sustainable and reliable packaging waste management and recycling plays very important role. Some of the mature markets, regardless of the increased demand for packaging products try to kept growth of its usage on close to zero level, through the use

of less packaging for products or by for example, reducing the amount of raw material used for packaging production. (Munnelly 2010) Unfortunately, those markets in spite of its efforts, can still shows increasing trends for production packaging products because nowadays, the customers from developed countries are more likely to buy products which are nicely packed than those unpacked. Simply for the economic reasons, producers in order to meet costumers' need for wrapped, "more luxury" and "better looking" products will show tendency to increase amount of packaging introduce to market. (Munnelly 2010) This situation can work as a driving force, to find new more environmental friendly packaging solutions and develop more effective waste management. The European Union (EU), starting from 1980s, search for solution to utilize packaging waste, by creating set of laws combined in Directives, which in the attempt to harmonize national policies, regulate the packaging waste management market (targets for recovery and recycling), and also encourage producers, for example, to invest in new technologies that will help light weighting packaging or produce more sustainable products (biodegradable or those which are easier to recycle). This sector is developing so dynamically in so many different sectors, that it makes it very interesting case of study. (WPO 2008)

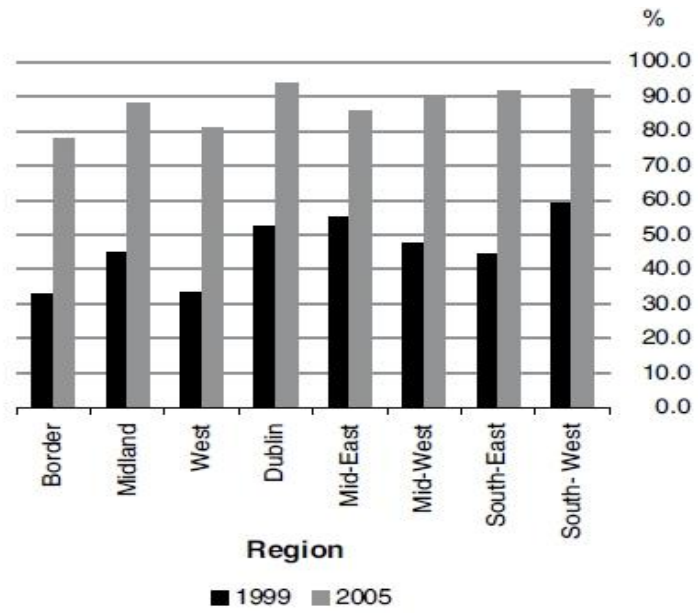
The choice of the subject and title of my thesis were inspired by public speech of the current Polish Prime Minister Donald Tusk, during last the parliamentary election campaign in 2007. He said, in context of economic development, that Poland will become the second Ireland, which was at that time a symbol of unprecedented economic success. Those words have inspired me to check whether this is possible to happen for packaging waste management. Poland is actually in very similar situation as was Ireland in 1980s, so my choice to compare those two countries in my thesis appears to be justifiable. It is more likely looking at paste and present and seeing the potential future.

When Ireland joined the EC in 1973 was the poorest country from all EC Members. Moreover, a lot of young people were emigrating from Ireland to the USA to find the better

future. In 1982 the prestige magazine The Economist published an article entitled “the poorest among the richest”, just to write 16 years later in 1998 another article about Ireland entitled “European Star”. Radical changes, were possible thank to courageous steps, which were taken by Garreta FitzGeralda who lead Fine Gael and the Work Party to enormous and fundamental changes is their economy. Nowadays, Ireland with its PKB per person is placed on 4th position in the world. (Toboła-Pertkiewicz 2007). This recent crisis has changed that situation but Ireland remains a very rich country.

As a one of the European economic leaders, Ireland is also a great example of a country, which succeeds in a field of Packaging Waste Management. Recovery Rate in Ireland in year 2008 was on level of 64.7%, which is almost 5 % more than its target from Directive 94/62//EC for year 2011. (EPA 2008) Recovery and recycling rate in Dublin city is one of the highest in EU countries and its amounts to almost 94% (2005) from households (Figure 1.2). (CSO 2008) After this success, we can still observe enormous potential and willingness for improvement.

Figure 1.2. Ireland, household recycling by region. (1999,2005)



In contrast to Ireland there is Poland, which actually is in a similar position as Ireland almost 30 years ago. When Poland joined the European Union in 2004, the economy was at a good way but still at very beginning of its development. Lots of Polish citizens emigrate to richer Western European countries like Germany, Great Brittan and of course Ireland to live a better life. But can Poland repeat a success of Ireland? With the size of the country, heirloom after communism, which is deeply rooted in Polish minds, instability of the political scene and the inability to

use the English language? I could doubt similarly to the opinion of Mr. Gadomski, who states that the similarities between those two countries after economic situation and emigration tendency are finished. (Gadomski 2006). On the other hand, some people, as the Prime Minister Donald Tusk believes, that it is possible. Who is right, who is wrong? I will try to answer this question in my thesis.

The Polish Packaging Waste Management System, still need to be improved. The rate of recycle and recovery in Poland stands at around 10% in the country and about 17% in Krakow. To meet targets from the EU Directive by already extended deadline of 2014 will be very difficult or maybe even impossible if radical changes will not take a place. (Bronicki 2010) Lack of the simple and clear legislation system, underdeveloped system of monitoring and reporting, the enormous market fragmentation and small awareness among society, create the vision of the long and difficult way to walk. (Dulemba 2010)

1.2. Aims and Objectives

This thesis describes the well developed Packaging Waste Management in Ireland and newly emerging Polish system. It includes comprehensive information about collection, existing regulations and systems which already works in these countries. Next to this information taken from existing literature and reports, this thesis is strongly supported and enriched by practical knowledge taken from specialists via interviews, who deal with different sectors of Packaging Waste Management in everyday work.

The main aim of this thesis is to compare two countries - Poland and Ireland - and check whether it is possible to use Irish experience in the context of Poland. Thus my research question is whether practices worked out in Ireland could be implemented successfully in Poland. By identifying the main factors, that affect the development of sustainable municipal solid waste management, defining barriers and opportunities for this development in Poland (Krakow) and Ireland (Dublin) and by finding similarities and differences that can determine

the main trends in analyzing the subject, I am trying to answer this question. Moreover, through determining the reasons of successes or failures in both countries in the waste management initiatives, I will search for idea how to stimulate people to collect solid waste separately, increase the investments in the recycling sector, seek alternative solutions in order to accelerate the development of recycling and increase society awareness.

I claim that, Poland could learn a lot from more qualified and successful partner like Ireland and other Western Europe countries. Based on the Irish experiences, Poland could much easier work out its own way to develop more sustainable and efficient than landfilling, way to utilize packaging waste, which will also be more economically justified.

1.3. Thesis Structure

My work is divided in to seven main parts. *Chapter 2* includes the literature review used in thesis, with the comments about findings and information included is printed materials like books, handbooks, reports and statistics. Due to the popularity of discussed subject, there is a lot of information available in literature not only from governmental publication and scientific publishing houses, but also from privet companies.

Chapter 3 includes description of methodology used for research purpose. In my research I usually base on available literature on municipal waste management, but I also conduct number of interviews with packaging producers, recycling and recovery companies, consulting agencies and also local authorities. This part will include three elements like description of data gathering, it analyze and limitations and problems which I faced during the gathering process.

Chapter 4 provides general information about the Municipal Solid Waste Management and detailed packaging sector description. There will be information about different kinds of packaging and new trends like biodegradable packaging, new fully recyclable plastic PET or even new product as labels which can be recycled with container. It will also describe and

explain symbols which consumers can find on containers, and which are usually confusing for typical buyers.

Chapter 5 describes Legal Background. It is divided for three main parts. First part includes elaboration about EU Regulations, which harmonize and standardize National Legislation in Packaging Waste Management Sector. Second and third part respectively describes and analyzes legal systems which exist in Poland and Ireland in reference to EU Directives.

Chapter 6 and 7 have very similar structure to each other. In this part which is also the most important and substantial part of work, I am describing practices which work in those two countries not only in theoretical way, but also more practical, thanks to material collected in interviews. Those chapters will explain what connection exists between different sectors of packaging, and how they cooperate and creates successfully or not working machine. This part will also include description of share between different responsibilities of the packaging market between public and private sector, functioning of these institutions and subsidies available for development. What's more, corruption and pro-environmental action will be illustrated in here. *Chapter 8* consists comparison of Ireland and Poland. In this chapter I suggested possible solutions and modifications, which would facilitate the transition of Poland to the Irish stage. These solutions would further support implementation of greening initiatives. Moreover, in spite of its efforts this part describes the main similarities and differences between those countries, and furthermore will analyze if those practices which works well in Ireland can be implemented with success or not in Poland. I also concluded all information analyzed during research and some recommendations for future Polish development.

2. Methodology and literature review.

2.1 Methodology

This methodology section intends to explain the way, in which data included in this thesis were gathered (research method) and analyzed. In my thesis I relied on qualitative methods, particularly when conducting interviews. This was combined with the analysis of the information acquired from scientific literature, statistical data and reports (described in section literature review).

2.1.1 Identifying a Case Study and formulating a Research Question

As it was mentioned before, choice of my thesis title was inspired by public remarks of the Polish Prime Minister Donald Tusk from 2007. However, before I come up with idea for the title of the thesis, I was searching through on-line reports, discussions and articles to find two similar European countries, which are now on different level of economic and packaging waste management development. Finally, I decided that Ireland and Poland will be the best possible choice.

Poland and Ireland in many aspects are very similar. Both are very traditional and catholic countries. During a long history, those countries experienced many ups and downs, including lost of independence. All those experiences contributed to the formation of a specific nature of both countries. These similarities were well captured by Sean Fitzpatrick from the Fianna Fail (Soldiers of Destiny) party in his interview for Wprost24 magazine in 2003. He particularly mentioned centuries of oppression, occupation of the island, armed uprisings, a disaster of hunger (1846-52). When joining the EU, Irish people were scared of losing, what is the best in the country, national culture, individuality and sovereignty in the great and powerful Europe. Moreover, Ireland was scared of European capital, which could dominate Irish market and make it more dependent on richer countries of Western Europe. It is also important to say, that Ireland as very religious country, was afraid of relaxing its moral principles, which were a part of their religion and culture. (Budrewicz 2003) Those fears

appeared to be premature, but very similar to those which faced Polish society before entering the EU in 2004. A number of Poles were afraid of losing its independence, of being dominated by the richer countries and compromising important moral principles. (Wysocka 2010) Ireland and Poland then have a similar history, tradition and system of values. We share not only our way of life but also our fears. Although, looking at the achievements of Ireland, one may rationally expect that Poland, which was marked by communism, Nazi occupation and repression from the more powerful neighbors, has its chance to thrive in uniting Europe and succeed not only in economic development, but also in sustainable waste management.

After analyzing Environmental Protection Agency (EPA) reports from previous years, I was confident about well developed Packaging Waste Management in Ireland. At the same time, the information which I found on NGO and governmental websites about Poland was not very promising. In particular I have decided to analyze number of different materials in order to check the reason for such differences. This body of materials includes:

- EU regulations on Packaging Waste Management and their implementation in Ireland and Poland,
- national regulations on environmental protection and Packaging Waste Management,
- reports from different nongovernmental and governmental organizations about recycling development and amounts of selectively collected waste,
- financial instruments provided by the EU and national resources to support development of responsible waste management,
- opinion of professionals,

In other words, I intend to show why one country like Ireland is succeeding in sustainable waste management and on the other hand Poland is facing such difficulties. This basis was a good starting point for future research in this subject. It is also worth to note that there are no comparative studies between Poland and Ireland which could explain why there are such a

disproportion between those countries, and how to minimize them (e.g. by relying on the practices which work well in one country).

2.1.2 Methodology selection - Qualitative Research Methods.

Making a decision about research method is very difficult. There is no ready recipe that could provide information as how to gather data and which method will be the best for the purpose of the research in particular subject. (Patton 2002). Research for this thesis, was designed taking into account accessibility of information from different sources but its main part can be classified as a qualitative. It is mainly based on information taken from interviews with specialists. At the same time, I wanted to place qualitative information in wider perspective, so that is why the interviews are supported by existing reports, statistics and literature. This approach is called data triangulation, which includes within one study, many different data sources. (Denzin 1978) By connecting different elements and resources from where information is coming from, the researcher can "generate a rich source of field data with internal checks on its validity". (Hoque 2006) My choice also appears to be supported by Esterberg (2002) opinion who indicated that multiply research strategies have tend to be the strongest one and can create one comprehensive study.

2.1.3 Document review

The literature section will include more detailed information about scientific literature. In this section I would like to briefly talk about the type of data that I used. First, reports about numbers of collected selectively packaging waste management, statistics about rate of recovery and also plans for future development for Ireland were taken from the EPA website, and they consists data from year 2008 (report for year 2009 are actually under preparation). Data which stays about recycling and recovery in Dublin are taken from Dublin city council. The information about Packaging Waste Management in Poland is taken from published National Waste Management Reports, taken from Ministry of Environmental Protection

website. Those reports are prepared on the basis of information provided by each Voivodeship every year. (16 Voivodeship in Poland) Information about situation in Krakow are taken from ZIKIT website www.ecocentrom.krakow.pl, which includes reports for amounts of waste that was recycled, landfilled and incinerated. Moreover, on this websites there are also available plans for future development of the Municipal Solid Waste Management for Krakow for 2011.

The main goal for review of these documents was to define and compare developments in the Packaging Waste Management in Poland and Ireland, identify main barriers and perspectives and existing rate of recycling and recovery in both cities.

2.1.4 Interview

The interview is one of our ordinary and everyday way of gathering information simply by asking and answering questions. (Mishler 1986) It usually includes very subjective and individual opinions, which are based on personal experiences. Those elements can provide a researcher with wider perspective, and if it is compared with information included in reports it can create very detailed overview of researched subject. That is why, it is so important "to allow interviewees to express their opinions and ideas in their own words". (Esterberg 2002)

As it was mentioned in previous subchapter, I rely heavily on interviews. I decided to use this method, to complete my research with the opinions and knowledge of well informed and experienced specialists, this allowed me to present more practical point of view. To have wider perspective I choose representatives from different fields like producers of packaging, consulting agencies, Repak, collection, recycling and recovery companies as well as local authorities.

The interviews can have a different form and can be executed differentially. In particular, it can have a form which is well structured or a form when an interview is more

like a “loose” conversation (Gillham 2004). The differences are shown on table below. (Table 2.1)

Table 2.1: The verbal data dimension. (Gillham 2004)

Unstructured →						**Structured**
Listening to other people’s conversation: a kind of verbal observation	Using ‘natural’ conversation to ask research question	‘Open-ended’ interviews; just a few key open questions, e.g. ‘elite interviewing’	Semi-structured interviews, i.e. open and closed questions	Recording schedules: in effect, verbally administered questionnaires	Semi structured questionnaires; multiply choice and open questions	Structured questionnaires; simple, specific, closed questions

For the purpose of this thesis, I chose semi-structured face-to-face interviews. I prepared questionnaire, which are attached as Appendix 1 to this thesis. Those questions were designed to understand and collect information in different fields like regulation system, experience of private sector (e.g. subsidies, corruption), technology, statistics, education and promotion. During the interviews, some questions were expanded other modified, as the conversations were changing and interesting details were appearing. Even after those changes the structure of interview were kept and attached questions were asked. Information collected this way gave me an outline for existing situation in Poland and Ireland, clear up some uncertainties and drew attention to the elements which, I did not previously take into account, such as the biodegradable packaging or recyclable labeling. In table below, I include all my interview responders, with details about their position and also background of the company where they work. This summary explains my choice and provides some information about my responders. (Table 2.2)

Table 2.2. List of Interview Responders with their company Background.

No.	Country	Name & Position	Company	Company profile
1	Ireland	**Eamonn Medley** *Director of Business Development*	**Greenstar**	Private company, which is specialized in waste management and recycling. Leader on the market in environmental friendly solutions. Serve customers from industry, business and private households. Possess MRFs (4) and licensed landfills (7). Other services: education, research, composting, recycling, safe disposal.
2	Ireland	**Clare Donnellan** *Environmental Health & Safety Officer*	**Greyhound**	Private waste management, recycling and recovery company, working worldwide, do not own landfill – promotion of zero waste to landfill solution. Possess its own material recovery facilities. On contract with Dublin City Council. Support education in the field of sustainable Packaging Waste Management.
3	Ireland	**Colm Munnelly** *Packaging Technology Advisor, actually manage the Packaging Waste Prevention Programme*	**Repak**	"Repak is an industry funded organization whose aim it is to facilitate and grow packaging recycling. Based on the principle of producer responsibility, Repak was established to help businesses meet their legal obligations to fund the recovery and recycling of the packaging on the goods or services they supply, as set out in the Waste Management (Packaging) Regulations 2007."[1]
4	Ireland	**Dr. Patrick Ward** *R & D Manager*	**Holfeld Plastics**	One of the leading Rigid Plastics Packaging Manufacturers not only for the Irish market but also European one. Produce plastics - rPET, PP and HIPS -for different sectors (food, cosmetics ect.). Use recyclers as raw material. In addition, in production process there is no waste produce, which cannot be recycled in situ.
5	Ireland	**David Clarkin** *Managing Director*	**TLC**	Company which support clients with new and more environmental friendly packaging (f.e. biodegradable labels). Investing in new technologies, new products development and research for innovative solutions leads to reduction production costs.
6	Ireland	**Declan Duff** *Senior Project Scientist*	**Fehily Timoney & Company**	Independent Irish Consulting Company, which is combining science and technology to keep high environmental standards. Next to Renewable Energy Resources, Environment and Civil Infrastructure prepare and run also Waste Management Projects.

7	Poland	**Kinga Dulemba** *Waste Management Inspector for Malopolskie Voivodeship*	**UMWM**	Local Authority for Malopolskie Voivodeship. Control and support development of Sustainable Waste Management in the Region.
8	Poland	**Marek Bronicki** *The representative of the Department Cleaning and Waste Management*	**ZIKIT**	Management of Municipal Infrastructure and Transport in Cracow. Responsible for Reporting and supervising Municipal Solid Waste Management for city – Krakow and also for licensing recycling and recovery organizations and companies.
9	Poland	**Krystyna Flak** *Head of Waste Management Department*	**MPO**	Private company, dealing with Municipal Waste management. Own the landfill and recovery facilities. Occupy over 60% of the market. Leader in Poland with recycling and selective collection of waste. Serve privet costumers, industry, business, schools, hospitals.

Thanks to such a variety of interviews, it was possible to create comprehensive study, which includes both, theoretical and practical elements.

2.1.5 Data Analysis

The data were collected through interviews, reports and articles. The reports included in my research are up to date and consists information on the amounts of packaging waste which were collected selectively and recycled. By comparing those data with previous years it was possible to check if the tendency is grooving or not. Fortunately, for my research in both cases (Polish and Irish), I could observe steady increase in numbers of selectively collected and recycled packaging waste. Those data gave me a clearer view about similarities and differences in system development in both countries, because differences in statistics were enormous (Ireland recycling rate 64,7% (McCoole et al. 2009), Poland about 10% (Bronicki 2010)).

The interviews, were analyzed by comparison of the collected information with existing documentation (International and National Legislation, EPA, Dublin City Council, ZIKIT and UMWM reports), practices and initiatives existing worldwide (green dot, bins islands, selective collection from the source) and by comparing different interviews. Those

comparisons let me to verify the accuracy and validity of collected data. Those data were the starting point for my analyses which are included in chapters 5 and 6 and recommendations included in chapter 7.

2.1.6 Scope

The thesis investigation covers legal and financial and educational instruments needed to develop more sustainable waste management services in Poland. On the basis of experiences taken from well established packaging waste management and market in Ireland, I will try to implement those practices or recommend some solutions, which can lead to improvement of existing situation in Poland.

Geographically, my research covers two cities located in two countries, which are both members of European Union. The scope of this study includes an analysis of elements like national regulatory system, phenomenon of development and privatization the Municipal Solid Waste Management sector, support from nonprofit origination like Repak, controlling and licensing system development, subsidies accessibility and market availability.

2.1.7 Limitations

The main goal for this thesis is to generate the overview of the existing situation in Packaging Waste Management in Poland and Ireland and find recommendations for future development, especially in case of Poland. During my research I faced many limitations that were disturbing the process of gathering information. First of all, the main problem was the time, not only mine, but also my responders. I spend in Ireland only a week, and it was very difficult to meet with everyone. Because time deficit, I did not manage to meet with representatives from local authority and the EPA in Ireland, and with MPO representative I spoke only by phone, so interview was shorter and less comprehensive.

Second problem, which I faced during my research, was the data accessibility, especially from private companies and data validity. National reports are usually available

upon requests in both countries as well as a public knowledge about environment conditions. In case of private investors, there are always a risk that data provided by a company could reach the competitors, so those companies are less likely to share their information. Most of the reports used in my thesis are up-to-date, but some of the scientific literature and publication available in the CEU library or upon internet may appear out-dated. So in data analysis and results I had to be very careful.

Third problem that I encountered in several companies in Poland but also at the Dublin City Council in Ireland was complete lack of cooperation. Most of private companies in Poland which deal with municipal solid waste management, production of packaging, selective collection of waste or recycling and recovery stations, was not welcoming, and did not want to meet or talk with me. In Ireland private companies were more helpful and friendly the Dublin City Council being rather the exception than a rule.

2.1.7 Literature Review

My thesis concentrates on the problem on municipal packaging waste management, the issue, which is both very actual and important these days. Due to its popularity there is many information available in books, articles and reports. However, the specificity of this thesis, which is mainly concerned with the practical operation of the municipal waste management system, cause that the presented literature review is limited.

The thesis is based, besides to interviews which are a substantial source of very specific practical information, on the most recent reports and legal acts relating to waste management. Those materials are taken from:

- Irish Environmental Protection Agency - National Waste Report for 2008, which includes detailed information about packaging placed on the market and data on waste materials collected from different sectors (industry, household, collection banks) national wide and regionally;

- Dublin Region City Councils - The Waste Management Plan for the Dublin Region 2005-2010 with Progress Report 2009 for period of 2008. Information included in this report are describes in details in chapter 5 which presents a case study for the Packaging Waste Management in Ireland. These documents consist of data on packaging recycling and recovery rate in Dublin City Region and instructions for improvement and development of more sustainable waste management plan for region by implementation of regulations, education and pro-ecological initiatives;
- Waste Management Plan for Krakow for period 2008-2011 with Progress Report for 2008. Data from this report are widely used in chapter 6 for description of the packaging waste situation in Krakow.
- statistics from the World Packaging Organization (WPO) from 2008 entitled *Market Statistics and Future Trends in Global Packaging* and reports from the Central Statistics Office (CSO) published in 2007 (*Quarterly National Household Survey - Recycling and Energy Conservation)*, which show the recent situation and expected tendency for development of packaging and packaging waste sector worldwide, with the special attention to the European regions;
- European Union Directives on packaging and packaging waste 94/62/EC, 2004/12/EC, 2005/20/EC which creates the framework for national regulation on packaging and packaging waste national regulations;
- National and Regional Waste Management and Environmental Protection Acts, which refers to EU requirements on waste management (described in chapter 6.1 for Ireland and 7.1 for Poland)

Information included in those reports and legal acts help to understand not only the legal basis but also genesis of the recovery and recycling obligations including elements like sustainable development, environmental protection issues in case of waste management and utilization, waste prevention and minimization, recovery of recyclable materials and energy.

They also describe required levels of recovery and recycling or co-responsibility between packaging manufacturers in 'packaging chain'. Moreover, the progress reports of 2008 from Poland and Ireland are build on similar order and consist analogous information, so comparison between those two countries, become more easy.

Another positions, which I used for the purpose of my thesis is literature, which helped me to better understanding of the subject of waste management in general (Bilitewski et al in *Waste Management*, P.T. Williams *Waste Treatment and Disposal*. Bradshaw at al in *The Treatment and Handling of Wastes* or White et al in *Integrated Solid Waste Management*) and more specifically packaging and packaging waste management (Levy and *Packaging in The Environment,* Tillman's *Life-Cycle Analyses Of Selected Packaging Materials. Quantification of Environmental Loadings,* Harper and his *Handbook of plastics technologies: the complete guide to properties and Performance* or Platt with *Biodegradable Polymers: Market Report.*). Information included in those materials were used to build the background for the description of packaging municipal waste management system working in two examined countries by showing the subject in the prism of available technology or possibilities of waste utilization (recycling, energy recovery, disposal, composting and others forms like such as technology of biodegradable packaging). In addition, I found in Levy's book '*Packaging in the Environment'*, information on marking system used for packaging. These data reflects the guideline from EU Directive 94/62/EC of 20 December 1994 "Packaging and Packaging Waste Directive" which requires and standardize the marking system for packaging (for example, the Green Dot logo scheme is covered under this "Packaging and Packaging Waste Directive"). Furthermore there is also Decision 97/129/EC which implements provision of marking by establishing rules for the identification of packaging materials by voluntary marking.

The above data provided a useful source for my thesis research. In particular they helped me to: identify the main factors that affect or stimulate the development of sustainable

municipal solid waste management in Poland (Krakow) and Ireland (Dublin), locate the main similarities and differences in municipal solid waste management at regulatory and economic levels, while comparing two countries with varying degrees of economic development and governance system as well as spot the main elements that can determine the future trends.

Second, the materials were also helpful in identifying main barriers for development of sustainable solid waste management at the municipal level in Poland and Ireland. Third, on basis of the progress reports I was able to determine the reasons of successes or failures in those countries in the waste management initiatives. Last but not least, looking through steps taken by each country and described in the reports I attempted to propose how to stimulate people to collect solid waste separately, check which action succeeded and what determined this success (economic initiatives, training, fun, financing systems or investment in this sector) as well as to seek for alternative solutions in order to accelerate the development of recycling and sustainable solid waste management.

3. Solid Waste Management

3.1 History

The problem of waste has existed from the very begging of human activity. 9000-8000 B. C. waste consisted mostly of bones, mussels, broken household items, food scraps and human excrement. Already then, the people collected their waste outside their settlements to avoid odour, nuisance of vermin and not to attract wild animals. (Bilitewski et al. 1996) However, the real problem with waste had begun, when people started to congregate and create well-organized and big communities. (Williams 2005) Because of lack of any waste management system, public just threw away their rubbish on the streets or into the rivers, what was attracting rats, cockroaches, parasites, lice and of course frequently resulted in a spread of diseases such as cholera. (Bilitewski et al. 1996) Greeks as one of the first nation, established around 500 B.C. in Athens the first national law, which required moving the waste to 'landfill' situated 1 mile away from city. (Williams 2005) Nevertheless the real developments occurred with the industrial revolution, which brought huge number of people from villages and rural areas to cities. This migration caused very fast raise in waste amount produced in the city and brought a problem of its utilization. The mixed waste produced in the cities and remaining on the streets was very dangerous for human health. The increasing awareness and knowledge of society about connection between health, environmental conditions and waste, help to create the first local and national acts dealing with potential health threats. For example, in Great Britain between 1875 and 1936, a number of the public health acts was adopted, covering management and disposal of waste (removal and disposal of waste, control of waste disposal into water and industrial waste) as an element which strongly influenced the conditions of people's health. Further, Washington already in 1856, as one of the first cities had a fully established waste collection system, which was financed from taxes, and by 1930, all US cities were provided with this service. (Williams 2005) The

awareness of environmental issues was however still low. This is visible when one looks at the situation in Europe in post World-War II period, when a quick industrial development was observed and environmental issues did not play an major role, what lead to significant air, water and soil pollution. (Backman and Lindhqvist 1992) In a late 1960s and '70s, together with the intensive industrial developments, several accidents occurred due to industrial waste released to the environment (1968 – "Yusho" incident, 1971 – cyanide and arsenic dump into a lake in Germany, 1972 – cyanide dumped in neighbourhood of play yard in Nuneaton, UK, 1977 – New York leaking of leachate and toxic vapour into households). Those disasters resulted in strong pressure on authorities to regulate somehow waste management issues. As welfare among people increased the understanding of importance of environmental protection started to play a significant role. Starting from the 1970s in Europe, the national regulations on waste management become an important item on the public agenda. This was supplemented with number of actions on the Community level, which aimed to create a common framework within the area of waste management for all Member countries (for example 75/442/EEC). (Williams 2005) Nowadays, all EU countries have already established waste management systems, which incorporate EU directives. The mature members such as Germany, Luxembourg, Denmark, Switzerland and Ireland have well operating regulations on waste management and are characterized by high awareness of society in responsible waste management issue. (Fischer et al 2002) The new members, who joined the EU in 2004, like for example Poland still face some difficulties in implementing and managing more sustainable waste management systems. (Dulemba 2010) The Polish and Irish waste management systems with legislation on packaging waste will be described with more details in the further chapters.

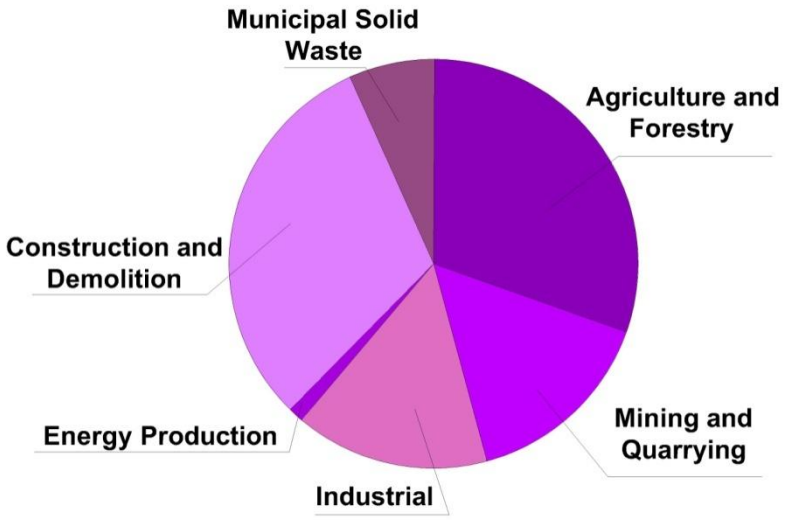
3.2 Municipal Solid Waste

So what is actually meant by waste? Directive 2006/12/EC defines waste as "any substance or object the holder discards, intends to discard or is required to discard".

(2006/12/EC) In other words, we could say that waste is a by-product of human activity, which does not have value, even if it is made from the same raw material as valuable product (cannot be recycled or reused). (White et al 1995)

The solid waste can be divided into several categories as it is shown on the Figure 3.1 (Williams 1995)

Figure 3.1. Total Waste Generated by Sector in the EU. (15 members 2001). Source: European Commission 2003. (Williams 1995)



For the purpose of my thesis I will focus only on Municipal Solid Waste, which can be defined as a "waste arising from domestic, commercial, industrial and institutional (including hospital) activities in an urban area. (…) all waste that is neither waste water discharges nor atmospheric emission." (Sasikumar and Krishna 2009)

The Municipal Solid Waste is divided into 2 categories: hazardous and non-hazardous. Hazardous waste is coming from human activity (manufacturing, industry, household) and requires responsible storage and disposal but also has negative effects on human health and on the environment. The hazardous waste very often contaminate non-hazardous waste from household, because people do not play much attention and treat it as a typical household waste This means that products like paints, batteries, electronics, oil, pesticides, and medications frequently end up in the ordinary bins. To classify waste as a particularly harmful

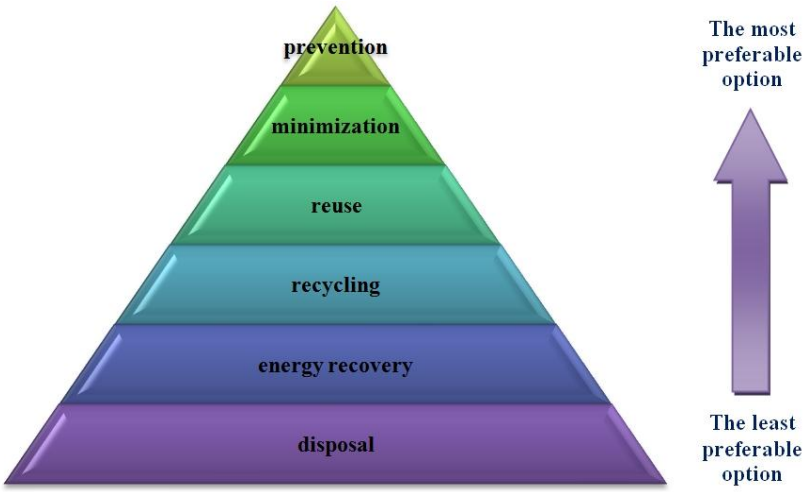
it must meet one of four criteria: ignitability, toxicity, reactivity or corrosivity. (Sasikumar and Krishna 2009)

Non-hazardous waste can be defined as all bio- and none biodegradable waste, which is not toxic or harmful for the human heath, does not react with others substances and does not corrode. Typical non-hazardous waste includes: packaging waste (glass, paper, plastic, and aluminium), cardboard, yard trimmings, food waste and many others. (Sasikumar and Krishna 2009) In my thesis, I will concentrate on non-hazardous packaging waste.

3.3 Municipal Solid Waste Management

Municipal solid waste management, as it was mentioned before, was developing through millennia. The waste by itself is strongly connected with the human activities since the very beginning of human kind. Waste management can be defined as an "(…) collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites" as it states in the Council Directive 91/156/EEC on Waste. The same directive shows the hierarchy of waste management alternatives like waste prevention - as the most favourable option, then recovery and at the end of the continuum safe disposal (the least favourable). The concept of the hierarchy of waste management as such was created in mid '70s, and was developed through 1975 Waste Framework Directive. Later, the hierarchy that encouraged more sustainable waste management (reduction, reuse and recycling) was officially adopted in the 1989 European Community Strategy for Waste management (Figure 3.2). (Williams 2005). This hierarchy is also reflected in the national waste regulations of all EU Members.

Figure 3.2. The Waste Management Hierarchy.



As the example of human health shows, it is always better to prevent than cure. The same is true for waste management. We can *prevent* or *minimize* the amount of rubbish by for example: buying the products, which can be used several times, avoid products which have more packaging that it is necessary to keep it safe, buying loose fruits and vegetables, implementing regulation and imposing financial responsibility on producers by putting fees on packaging, which enters the market. Also *re-usage* of existing materials is very important element in preventing the waste generation. It is beneficial not only for environment but also for economy (reduction of costs by reusing packaging and containers, pallets, crates, jars and bags). Of course it is impossible to avoid 100% of waste, so to minimize it influence on environment, the waste can be *recycled* and become the raw material for another products, usually other packaging. Recycling also reduces amount of pollution, which enter environment during manufacturing process as well as the use of virgin raw materials. The next step in the hierarchy pyramid is occupied by energy recovery, which is a thermal waste treatment usually by incineration, which utilizes the waste to produce energy and in the same time reduce the amount of waste to be landfilled. The least preferable way of waste utilization is of course landfill disposal, which requires very responsible and careful operation. (Directive 94/62/EC)

The human nature is geared primarily for profit, so very often happened, that environmental protection issues occurs only as a by-product of actions aimed at income, especially in a case of waste management. Still a lot of companies that collects and utilize waste instead of recycling or recovery want to get rid of the waste as quick and as cheap as possible. Usually those action can have a harmful influence on the environment by introducing waste to the air (burning waste on backyards) or water (sewage, solid waste, oil) or is simply landfilled (very often into illegal dumpings). Nowadays, lot of regulations and laws were established in order to control waste management and to improve more sustainable and healthy waste management service. (Bringer 1992) In fact, if we look on waste management sector through the prism of economy, we can see that it has become an important and very valuable element of the market. The competition in the waste sector is increasing every year, as well as subsidies for recycling and recovery facilities. We can see a paradox here, when the worthless rubbish as it identified in directive 91/156/ECC become valuable asset of the world.

3.4 Packaging

The packaging waste constitute one of the elements of municipal solid waste and accompany people for millennia, starting with leaves, shells, bamboo, animal skin and other natural elements, used commonly by ancient hunter-gatherer, to more sophisticated containers made from wood, metal, glass and formed into bottles, boxes, barrels, baskets or bags. Through the century, the development of the packaging aimed at improvement of quality, hygiene and adulteration of offered goods. Packaging at first was mostly used for transport, food and beverages protection. However, with the time, it found a lot more applications as wrapping of luxury products, cloths, cosmetics, presents or simply used for marketing purpose to attract potential clients by nice looking, colourful and exclusive packaging. (Bickerstaffe and Barrett 1993)

3.4.1 Packaging Classification

The packaging can be divided by type, function or material. Packaging division by type is as follows:

- primary;
- secondary;
- tertiary.

The *primary* packaging can be described as packaging, which has direct contact with the product. The main function of this packaging is to protect goods from hazardous influence of the surroundings. The primary packaging is also called sales packaging as it has direct contact with the customer. It can be made from different materials (paper, glass, plastic, metal and synthetics). *Secondary* packaging can be both an integral part of primary packaging (protect the primary packaging but can be removed from the product without breach of goods features) or not. In the second case, it is usually used to keep number of primary packages for transportation purpose (for example boxes). *Tertiary* packaging is used for transportation purpose, to protect product on its way from factory to distribution points like supermarkets, warehouses, or even sometimes directly to the customer (pallets, elastic folly). (Bickerstaffe and Barrett 1993) The taxonomy by packaging type includes returnable (refillable, reusable), non-returnable (used only once), recoverable (recyclable), or convenience and luxury wrappings. (Bickerstaffe and Barrett 1993)

Another division of packaging may be carried out on the basis of its function. We can distinguish five main categories:

- containment and protection (protection against damage, bacteria, viruses and climatic factors);
- logistic (safe and efficient transport, storage distribution);
- informative (enable contact between producer and customer, give an overview about product);

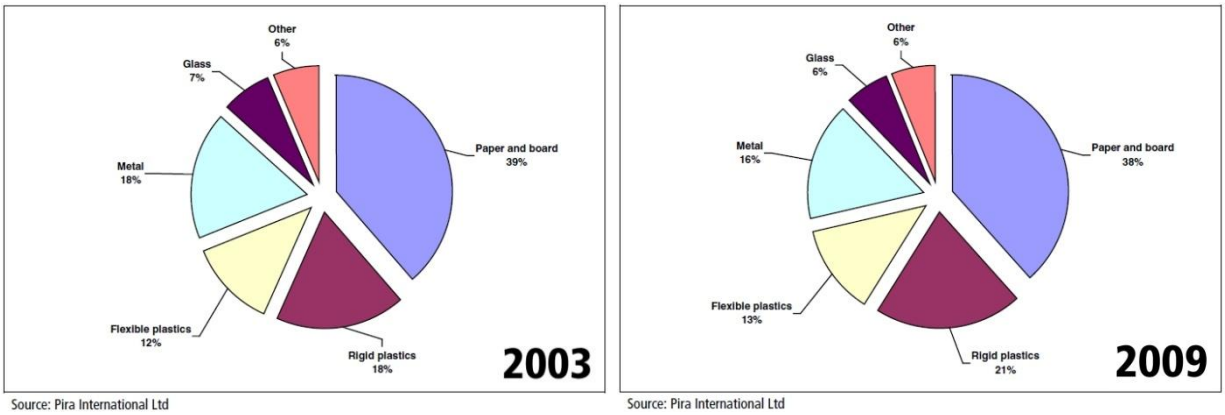
- marketing (to attract clients, to be more competitive on market);
- ecological (protect environment from hazardous influence of product).

(Kuczynska 2004)

In my opinion, for the purpose of a waste management, the most important packaging classification is the one that is based on material. Again this group is not homogeneous and may be divided in different subgroups (Figure 3.3):

- paper and cardboard, the most popular, includes 39% of World market share in 2003 ($165 billion) and have tendency to increase about 4% per year by 2009;
- rigid and flexible plastic with 18% and 12% market share in 2003, this is also the fastest growing part of the market (6,5% per year), which has ousted food and beverage packaging materials such as metal, glass or paper; in 2009 the expected market value is $116 billion;
- metal with the 18% of market share in 2003, will have a tendency to decrease its market share because of popularity of plastic containers;
- glass with 7% of market share in 2003 and it is expected to increase steadily, but with the losses in market share, caused by increasing popularity of plastic packaging;
- other packaging materials like wood or textiles and others have about 6% in the market share in total. (WTO 2008)

Figure 3.3: Market Share between different Packaging Materials in 2003 and expected share in 2009. (WTO 2008)



3.4.2 Packaging Materials

In this subchapter I will briefly describe differed kinds of the most popular and common packaging materials and provide a short overview on their advantages and disadvantages, not only through the prism of economy and physical ability but also its influence on environment.

Paper and cardboard

Paper is a commonly used material in the primary and secondary packaging. It is easy to recycle because is made from natural ingredients as cellulose, so it is also fully biodegradable. The other advantages of paper and cardboard packaging are its weight, relatively low price and easiness to print on it. At the same time, it can provide good protection for transferred products. (Kuczynska 2004) It also provides energy recovery through incineration. (Beynon 1993) The main disadvantage of paper is its susceptibility to water and permeability of fat and gasses. (Kuczynska 2004) To reduce those inconvenience, during manufacturing processes several techniques are uses such as laminating or additional usage of aluminum or polyethylene layer which prevent leakage. (Tillman et al 1992) Another way to improve quality of paper there is refining treatments consisting in adding chalk, talc or gypsum. (Kuczynska 2004) One of the biggest disadvantage of paper is high energy consumption through manufacturing process and relatively low value of recovered material. (Beynon 1993)

Plastics

Packaging plastic became more and more popular every year due to a number of its attributes (high strength, impermeability, low weight, easiness to form and merge with other materials, characterized by low reactivity) (Kuczynska 2004). Plastics used for food packaging are mostly polymers. In the packaging sector, it is possible to recognize different types of packaging polymers, with different properties to meet in the best possible way demand from both, consumers and manufacturers. (Knight and Creightom 2004) Another strengths of

plastic packaging is great variety of available materials, its efficiency and economic attractiveness. In addition it is very hygienic and also protects well goods from mechanical disturbances. Similarly to paper, plastic is representing high energy recovery. Plastic also has number of disadvantages such as: non-biodegradability and difficulty in recovery. (Beynon 1993) I will present the main kinds of plastics with its SPI symbols in the table below. (Table 3.1) SPI identification code was first established in US in 1988 by the Society of the Plastic Industry (Harper 2006) but nowadays it is commonly used worldwide. The SPI symbols were introduced to simplify the recognition of kinds of plastic materials and thus improve its recycling. So the main purpose of SPI code system was some kind of informative communication. (Beynon 1993) Those sign are not trademarks; they are only simplifying the identification of the packaging material. In the European Union, the plastic materials used in packaging are listed in European Norm: BS EN ISO 1043-1:2002 and in directive 94/62/EC.

Table 3.1: SPI Plastic Material Cod. Source: Beynon 1993, *Knight and Creightom 2004*

SPI symbol	Name	Properties	Packaging
	**Poly-Ethylene Terephthalate (PET,PETE)**	resistant to heat, impermeable for gas and wetness clear, strong	bottles for drinks, jars, ready food (microwave), boil in the bag food, films
	**High Density Polyethylene (HDPE)**	resistant to chemicals and water, gas permeability, strong, easy to shape, thick	containers for: liquids (juice, milk, water, yogurts, margarine, cosmetics, chemicals), solids (cereal, rubbish bags, washing powder, bags)
	**Vinyl/Polyvinyl Chloride (V, PVC)**	chemical resistance, oil resistance, grease resistance, strong, clear, easy to mix	construction products (pipes, carpets, windows, cables, fittings, floor tiles, sheets), medications, film, fatty food, food oil
	**Low Density Polyethylene (LDPE)**	moisture resistant, strong, thick, ease to process	dry cleaning, bread, squeezable bottles, frozen food
	**Polypropylene (PP)**	resistance to chemicals, water, oils, heat and grease, strong and thick	containers for medicines, yoghurt, margarine
	**Polystyrene (PS)**	easy to shape, good isolation, clarity	CD boxes, plates, cups, cutlery, meet trays, egg boxes
	**All Other Resins**	dependent on material	reusable bottles

Glass

Glass, similarly to paper is one of the most environmental friendly packaging. It is made from sand, lime and soda, and it is characterized by abundance of raw material. It is also very hygienic, very easy to recycle and containers made from it can be reused many times. (Tillman et al 1992) Another advantage is its impermeability, transparency and ease of coloring and shaping (Kuczynska 2004) as well as the high society awareness about its recyclability. The significant weaknesses of glass are following: high energy consumption through manufacturing, relatively high weight, it is also easy to break. (Beynon 1993)

Metal

Metal has several unquestionable advantages for the production of packaging like: strength, resistance to temperature differences, easiness to shape, impervious, well heat-conducting and inflammability. (Kuczynska 2004) The main disadvantage is that sometimes it can corrode. Materials that are usually used are aluminium (do not corrode) or steel. (Tillman et al 1992) The main strengths of aluminium are: high society esteem about recyclability of this material, relatively low mass, and availability of raw material. On the other hand, the main weaknesses are very high energy consumption and possibility of pollution during production process. Another metal material commonly used in packaging is steel and tinplate. The main advantages of those materials are their efficiency, strength, availability and ability to be recycled and reused. Weaknesses include low public awareness about recyclability, high energy consumption and risk of pollution during production processes. Those materials can also corrode. (Levy 1993)

Biodegradable polymers

The main idea behind biodegradable packaging is to make it decompose in natural conditions, both aerobic (composting) and anaerobic (landfill), by organic activity of microorganisms like bacteria, fungi or algae, or not - organic activity as photo degradation or hydrolysis. (Platt

2006) Composting ability of the biodegradable packaging can decrease the amount of landfilled or incinerated waste, what generally has positive impact on environmental conditions and purity. The only factors, which can affect the biodegradability of bio–polymers is surrounding environment. By this, I mean accessibility to oxygen, water born enzymes and of course presence of microorganisms. The biodegradable packaging materials made from polymers are: *biopolymers*, *Polyhydroxyalkanoates (PHA)* and also *Polylactic Acid Polyesters (PLA)*. (Platt 2006).

Biopolymers, are fully renewable and 100% biodegradable materials. They are made from naturally existing in the environment materials such as: cellulose, starch, peptides, chitin or proteins. The main application of bio-polymers can be found in: (Platt 2006)

- food service products (e.g. cups, plates, containers, bags, film wrapping, laminated paper);
- agricultural film products;
- industrial packaging products;
- hygienic products;
- pharmaceutical applications.

The next biodegradable polymer is the *PHA*, which belongs to the family of aliphatic polyesters, which are also produced in natural conditions by microorganisms. This makes them similar to biopolymer that is totally biodegradable and renewable. The biggest advantage of the PHA is possibility to produce it by using natural and renewable carbon resources (plant oils or sugars). The PHA can be used for (Platt 2006):

- food packaging;
- medical devices (surgical structures, bone plates);
- electrical and electronics devices;
- house ware;
- costumers durables;

- paints;
- agricultural and industrial use.

The *PLA* is a very universal material and is made from natural components, so it is also renewable and fully compostable. It is made from e.g. corn, wheat and sugar beets. Widely used by textile, medical and packaging industry for production of (Platt 2006):

- one use vessels;
- food packaging (containers for solid and liquid food and drinks, frozen food packaging, oxygen sensitive food and many others);
- bags;
- film application.

Summing up, the main advantage of biodegradable packaging is its diverse usage in packaging, textile and medical industry use combined with biodegradability. Biodegradable polymers are made from natural components and consequently they are easy to produce and utilize without staying long in the environment.

3.4.3 Packaging Symbols

In the chapter *3.1.1,* I have listed different functions of the packaging. One of the roles of packaging is to provide customers with full information about product, usually by using different symbols. Several of them are registered trademarks, some of them are advertisements, other are included for aesthetic purposes, some can inform about the material of a product while the others tell whether particular material is suitable for recycling or not. However, in practice most labelling reflects existing legal requirements on safety and hygiene, environmental protection or trade. Every country prepares and implements its own regulations on marking the packaging material. In the EU, directive 94/62/EC provides the basis for the introduction of a single European system for the identification of packaging materials. Properly labelled packaging must contain a symbol or abbreviation and the

identification number assigned to it. Thus, for example, plastic is numbered from 1 to 19 (e.g. Figure 6), paper and paperboard from 20 to 39, metal from 40 to 49, wood 50-59, 60-69 and textile glass from 70 to 79 (directive 94/62/EC). Based on the guideline from Directive and European Commission Decision 97/129/EEC, it was established ID-System, which describes all material symbols called *IDentification*. An identification system defines symbols for all packages of material for these materials, and code number. The typical symbols, which inform customers about way of utilization, are shown in the table below. (Figure 3.2)

Table 3.2: Popular Symbols on Packaging (Knight and Creightom 2004)

Symbol	Description
	Product is made from aluminium, and can be recycles
	it asks to dispose your waste carefully and considerably
	product is made from biodegradable material, and can be composted
	product is made from glass, and can be recycles
	sign often mistaken with recycling symbol; it means that produces of the material have contributed to the construction and operation of waste recycling and recovery facilities; producers pay for this sign.
	product can be recycled
	German sign, which informs, that paper or cardboard product is not contaminated by non-recyclable materials.
	it means, that product is made from steel, and can be recycled
	product can be reused
There are also identification labels used for plastic products which are shown in Figure 7.	

3.4.4 Packaging Waste Utilization

Packaging waste, similarly to the ordinary solid waste can be utilized in several ways. I will describe only 4 the most common ways of managing packaging waste. Following the waste management hierarchy, the first, and at the same time the most favourable solution is recycling. The second is thermal utilization like incineration (as we can recover energy), and the last one, at the same time, the least favourable way of utilization is landfilling. (Marsden 1993)

Recycling, is one of the most favourable way of dealing with packaging waste utilization. The definition in Directive 94/62/EC provides that recycling "means the reprocessing in a production process of the waste materials for the original purpose or for other purposes including organic recycling but excluding energy recovery". This directive also identifies targets guidelines for recovery and recycling for all EU members in rate between 50 to 65%. Further directive 2004/12/EC, makes those targets even more sticker for some countries, like for example Ireland which was supposed to reached recovery targets for 2010 already in 2007. But why the recycling is so important? First of all, it helps to reduce the amount of waste, which could be incinerated or landfilled, second, it saves energy, third, it reduces usage of virgin raw material. (Pullen 1992) In addition, materials, which are recovered and recycled, will come back to the market and will be sold for processing, as a secondary material. (White et al 1995) In some cases, the division between raw material and secondary material can be difficult to establish. When glass, steel and aluminium are processed, the recycling line is integrated with existing manufacture lane, so the whole production will be treated as made from recycled material. Recycling, as a waste utilization scheme, will be competitive as long as good quality secondary materials stay cheaper than virgin one. (White et al 1995) Nowadays, recycling can be both: profitable, (when a demand

for the cheaper secondary material increase (China, India), material represents good quality and are not contaminated and when there are subsidies for selective collection are available) and non profitable (price fluctuation, decrease in demand, and low quality of secondary material). (Duff 2010) It is also important to remember, that recycling process is expensive by itself. It requires a lot of energy during processing. If they will not be a market and substantial demand for the secondary raw materials, then it can become economically not justified.

Composting of biodegradable packaging waste is also called an "organic recycling" and according to Directive 94/62/EC it "shall mean the aerobic (composting) or anaerobic (biomethanization) treatment, under controlled conditions and using micro-organisms, of the biodegradable parts of packaging waste, which produces stabilized organic residues or methane. Landfill shall not be considered a form of organic recycling". Put it simply, the main advantage of biodegradable packaging is reduction of waste landfilled and consequently potential harm to environment caused by processing synthetic materials combined with the availability of natural fertilizers for future use. As a biodegradable packaging is becoming increasing trend worldwide, the composting plays an important role in packaging waste sector. (Munnelly 2010) As it was mentioned in the previous subchapter, biodegradable plastics are made from biopolymers and are compostable in natural conditions. The main disadvantages of biodegradable packaging is the fact that they look like plastic what cause that people usually treat them as plastics and collect them separately to recycle instead of treating as a bio-waste. This result in contamination of separately collected waste and decline its market value. (Munnelly 2010) On the other hand, the problem of contamination of plastic material is still not significant, because of small amount of biodegradable packaging on the market, but in the future it can become more serious. The separation technology, which is employed in Greyhound's MRFs and which uses the infrared radiation to separate different kinds of plastic, has shown that this technology is not able to deal with biodegradable

packaging. Consequently, improvements in people awareness seem to be indispensable. (Donnellan 2010)

Incineration and energy recovery is another way of waste management. Incineration, is "the technique for burning refuse" but "without energy recovery it is not an environmentally acceptable solution since the material resources are simply destroyed without any effective recovery". (Marsden 1993) In directive 94/62/EC there is also definition for energy recovery, which is actually an integral part of incineration process. Accordingly, "energy recovery shall mean the use of combustible packaging waste as a means to generate energy through direct incineration with or without other waste but with recovery of the heat." Nowadays, with yearly increasing amount of waste, the incineration with heat production that deals with mixed waste can be one of the most efficient way of packaging waste utilization. At the same time, one needs to mention three main disadvantages of this kind of waste disposal (Marsden 1993):

- amount of incinerated waste need to be higher than 0,25 million ton/year, otherwise an incineration facility will not be profitable (this requires population concentration and small distances from source to incineration);
- strict regulation for gas emission to the atmosphere in the EU required used of modern technology to reduce this emission, this obviously increase costs of an investment;
- incineration technology with energy recovery is the most expensive though all considered in this chapter.

The main advantages of waste incineration are (Porter 2002):

- energy recovery;
- mixed waste input;
- significant reduction of the amount of waste;
- utilize the waste which cannot be recycled;
- requires less land than landfill.

Finally, the least favourable waste management way is *landfill disposal*. Landfilling can be defined as "(…) long-term storage for inert materials along with relatively uncontrolled decomposition of biodegradable waste." (White et al 1995) We could say that the landfill is the last resort waste utilization. The main advantage of landfill is that it accepts all materials of municipal solid waste stream, even leftovers from incineration and biological processes are sanded to the land disposal sites. Landfill does not necessarily need to be situated on land, there are well known practices when rubbish are filling up the mines corridors and caves (UK),'sea-fillings', human made islands like Tokyo Bay or Osaka Bay in Japan. (White et al 1995)

To sum up, the main advantages of landfilling:

- acceptance for all kinds of waste;
- relatively cheap and simple to operate;
- gas production from organic waste (landfill gas can be used for energy production).

On the other hand, disadvantages include:

- needed land for disposal;
- negative influence for comfort of life in a close neighbourhood (flying plastic bags, odour, birds, rats);
- risk of soil and ground water pollution (leakages);
- risk of gas explosion;
- illegal dumpings;

Modern landfills operate within very strict national and EU regulations, which reduce the potential risks to environment. Also, the number of operating landfills is decreasing in many European countries, as they try to reach zero waste level to landfill, choosing more sustainable ways of waste disposal like incineration, composting, recycling and reuse. (Pullen 1992)

4. Legal Background

4.1 History – A short overview.

An idea for creating union between European countries has a long history and may be traced back to the Roman Empire. The underlying rationale was to eliminate the conflicts based on land competition and improve security of European countries from outside enemies. (Gluszkiewicz 1998) The more intensive development of European integration took place after the Second World War, when European countries, in order to avoid future conflicts and to rebuild destroyed Europe were more willing to create alliance. For the very first time in 1949, the Western European countries create the Council of Europe. In 1951, the six countries (Western Germany, Italy, Luxembourg, France, Belgium and Netherlands) signed the Treaty of Paris creating the European Coal and Steal Community (ECSC). (El-Agra 2007) Seven years later, the same countries signed the Treaty of Rome and established the European Economic Community (EEC) and European Atomic Energy Communities (EURATOM).(El-Agra 2007). In 1967, those three institutions as a result of Merger Treaty were combined to create one combined body, the European Communities. (El-Agra 2007) The EC officially was replaced by European Union (EU) in 1993 when the Maastricht Treaty entered into force. This pact established and regulates clear principles for the future single currency, as well as foreign policy, security, justice system and economy. (Dinan 2005)

Both countries that I analyze in my thesis are members of the European Union. Ireland joined the EC in 1973 (together with UK and Denmark) as one of the poorest European countries , while Poland in 2004 with nine other countries from the Central and Eastern Europe.

4.2 European Union law

The EU may be divided into primary (treaties) and secondary (regulations, directives and decisions) sources. Treaties, are nothing else than international agreements between EU

Members, which sets constitutional laws of the Union and establish EU institutions. Those agreements are signed by all members of the Union and any change to the treaty needs to be confirmed by all associated countries. (Chalmers et al 2010)

Regulations belong to the secondary law sources and are legislative acts, which impose direct obligations on all EU Members. As directly applicable they do no need to be implemented in national law, they are simply binding as of the day of their publication.. The second type of legislative acts of the EU is *directive*. The main difference between regulations and directives is that, the latter have be implemented into national legal systems. Directives in principle expects only certain result to be reached by all Members, however they do not order how this should be achieved. This means that each Member may choose a method that is most suitable for it. Another legal instrument of the EU is a *decision*, which is addressed to particular country, company or private person and only binding for such an entity. (Cairns 2002) The EU law is also composed of number of non binding instruments such as recommendations, communications, white and green papers. Although they are not binding they have some persuasive force. (Chalmers et al 2010)

Ireland and also Poland are members of the EU, and they are obliged to observe European law. As regards the management of packaging waste, one of the earliest European regulations on packaging dates back to the beginning of 80-ties (Directive 85/339/EEC) and it was concerned with beverage packaging. However, it was vague and imprecise, and only part of the Members implemented it correctly. At the same time, the EU internal market began to be affected by cheaper than virgin, secondary raw materials, which were coming from countries with already developed recycling system. Lack of standardized and harmonized rules in this field between different Members of the Union led to the increased pressure from the countries. This coincided in time with the growing awareness of environmental aspect connected with the waste packaging. Under the influence of this demands, the EU created the framework law for all countries for packaging waste recycling, recovery, waste collection and

trade market. As a result of this action, in 1992 the Commission presented draft of directive, which governed the main issues of packaging and packaging waste (94/62/EC). Ten years later in 2004, another directive came into force (2004/12/EC), which, *inter alia*, modified the target for recycling and recovery to 2011, described requirements for design of packaging, as well as external and internal market of secondary materials to minimize potential impact on environment. The Directive 2005/20/EC governs packaging issue and recycling and recovery targets for new EU Members (2004) and the sets the deadline for achieving them by 2014. (Chalmers et al 2010) In the further subchapters I will describe the main points of each of these directives, while the subsequent section will provide a short overview.

4.3 European Directives on Packaging and Packaging Waste 94/62/EC, 2004/12EC, 2005/20/EC.

As it was mentioned above, the first comprehensive system for harmonized packaging and packaging waste management was provided by *Directive 94/62/EC* on Packaging and Packaging Waste. Currently, the directive still remains a basic and crucial legal document for the management of packaging waste and harmonization of national policies of all EU Members. However, this directive is not the only legislation regulating issues management and disposal of such waste. It is also developed and supported by several other documents such as decisions:

- *Commission Decision **97/129/EC*** of 28 January 1997 establishing the identification system for packaging materials pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste;
- *Commission Decision **97/138/EC*** of 3 February 1997 establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste;

- *Commission Decision **1999/177/EC*** of 8 February 1999 establishing the conditions for a derogation for plastic crates and plastic pallets in relation to the heavy metal concentration levels established in Directive 94/62/EC on packaging and packaging waste;
- *Commission Decision **2001/171/EC*** of 19 February 2001 establishing the conditions for a derogation for glass packaging in relation to the heavy metal concentration levels established in Directive 94/62/EC on packaging and packaging waste;
- *Commission Decision 2005/270/EC* of 22 March 2005 establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste;
- *Commission Decision 2001/524/EC* relating to the publication of references for standards EN 13428:2000, EN 13429:2000, EN 13430:2000, EN 13431:2000 and EN 13432:2000 in the Official Journal of the EC in connection with Directive 94/62/EC on packaging and packaging waste;
- *Commission Decision 2009/292/EC* of 24 March 2009 establishing the conditions for derogation for plastic crates and plastic pallets in relation to the heavy metal concentration levels established in Directive 94/62/EC of the European Parliament and of the Council on packaging and packaging waste.

Coming back to the directive 94/62/EC, its main goals is to reduce amount of waste, especially packaging, prevent it production and promote recycling, energy recovery and reuse solutions. This legal act also promote waste management, which has less harmful impact on the environment, create open and free internal market (reduction of barriers of material flow) and promote competition. Next to those elements, directive also states that financial responsibility for utilization and recycling of packaging should rests on packaging producers and manufacturer, which use packaging in their production lines and business. Specifically, the main features of Directive 94/62/EC are as follow:

- prevention of packaging waste production requiring actions and programs which are created in cooperation with packaging producers and manufacturers;
- setting up targets for recycling and recovery for each Member in rate between 50-65% (recovery) and 25-45% (recycling required min. 15%); because of geographical location the targets for Ireland, Greece and Portugal were lowered;
- support for secondary material use;
- requirement of creation of comprehensive selective collection scheme and promotion of easier access to those actions by private and institutional units;
- provision of guidelines for labeling, symbols and packaging identification systems;
- creation of normalizations by establishment of the EN system, which will regulate the design, manufacture process (minimizing raw materials consumption, avoidance of hazardous materials);
- requirements for reused products (rotation conditions);
- utilization requirements (recycling, energy recovery, composting, biodegradable packaging, landfilling);
- regulation of heavy metal components in packaging;
- requirements regarding the establishment of information systems in each member country, which will be included in the form of reports and information on the rate of recycling, reuse and recovery, production of packaging, material characteristics and amount of waste collected;
- requirements to include packaging waste management as an individual part in national waste management system plans;
- establishment of criteria for LCA;
- establishment of minimum content of recycled materials in packaging.

Next legal act is Directive 2004/12/EC. This directive is reviewing, amending and developing in some details the previous directive. The main changes include:

- definition of ‘packaging’ begins to be more detailed and also includes additional elements coming together with packaging as e.g. labels and caps and supplementary criteria supported with illustrated examples in appendix 1;
- recycling rate should be enlarge to reduce negative impact on environment (until end of 2008, recovery rate not less than 60%, recycling 55-80%. Ireland, Portugal and Greece should reach this target until 2011);
- incinerating waste with energy recovery is treated as way to realize the objectives as recycling and recovery targets.

Finally, the directives 2005/20/EC further amends the existing directives. With regard to the new EU Members the respective deadlines for achieving the recycling and recovery targets are extended until 2012 (Cyprus, Estonia, Hungary, Lithuania, Slovakia, Slovenia) and 2013 (Malta), 2014 (Poland) and 2015 (Latvia).

5. Packaging Waste Management in Ireland

5.1 National Waste Regulations

Ireland is now one of the mature EU members with well established waste regulatory system. However in early 1990's the Irish recycling rate was one of the lowest in Europe, while its regulation on waste was very poor, with only little attention from the government. The first step in preparation of comprehensive national regulation on waste management was taken with the Waste Management Act of 1996 (S.I. No. 10/1996). The main aims of this regulation are to (S.I. No. 10 of 1996):

- create accurate and precise framework, which would determine the functions, tasks and responsibilities in waste management for the Ministry of Environment (preparation of national waste management plans, national regulations on waste management and creation of legal background and framework for Environmental Protection Agency (EPA) and local authorities' activities), the EPA (watchdog for waste management industry, which license, control, monitor and inspect of all waste activities that takes place in the waste management sector, for example recycling and recovery facilities, collection companies, landfills, waste stream flow including export and import, establishment and maintenance of the National Waste Database and of course ensuring right collection, recovery and disposal. The EPA is also responsible for preparation of annual national waste reports), *public local authorities* (review and preparation of waste management plans, monitoring and inspection of all activities taking place in waste management sector in a particular region, issuing permits for small recovery and recycling facilities, promotion of proper waste utilization and collection, including education, internal and external movement of hazardous and non-hazardous waste, control of commercial waste collection activities, etc.);

- create legal framework for development of more effective recovery and recycling systems;
- set up very strict standards for environmental protection in regard to the waste management, especially in case of waste disposal;
- build severe licensing and permitting system (collection, transport, materials recovery facility [MRF - place where recyclable materials are processed for secondary materials market], recycling, disposal – all need authorization); under the 1996 Waste Management Act, there are two institutions, which provide industry with proper permits and licenses required to work in waste management sector; the first authorizing body is a *local authority*, which provides collection, recovery and disposal permits; the second is the EPA, which provides licenses for all activities that take place in recovery and disposal sites like establishment, management, operation, closure, aftercare of facilities;
- prevent and minimize waste production;
- provide requirements for preparation and revision of the National and Regional Waste Management Plans;
- monitor and inspect waste management facilities (MRFs, landfills, collection ect.);
- introduce substantial fines, penalties and cleaning costs for all those who do not respect the waste management regulations.

Another Acts that have influenced development of waste management regulations is the Waste Management (Amendment) Act of 2001 No. 36 of 2001 and the Protection of the Environment Act of 2003 No. 27/2003. Both acts provide several changes as compared to the previous act (S.I. No. 10/1996). One of novelties is a legal mechanism for preparation of a Regional Waste Management Plans (those plans have executive function). The Act No. 36/2001 also set up charges levied on the landfill of waste (not more than 19 EUR/t).

It is also crucial to remember that Ireland as a member of the EU is obliged to respect and implement requirements included in EU legislation on waste, especially with regard to recovery and recycling targets set up by the Directives 94/62/EC and 2004/12/EC. Apart from above described legislation, other acts that implement EU law include:

- Waste Management (Packaging) Regulations of 1997 (S.I. No. 242/1997) – that was the first act, which aimed to implement 94/62/EC Directive and was subsequently replaced by S.I. No. 61/2003.
- Waste Management (Packaging) Regulation of 2003 (S.I. No. 61/2003) – the aim of this act is to facilitate the achievements of the targets established by the 1994 directive on waste management (50-65% recovery and 25-45% recycling by 2005). In addition, the act sets up obligations for major producers of packaging under the formula of the 'supply chain' that impose shared financial responsibilities on different actors - i.e. manufacturers who produce packaging, convertors, goods producer who is filling packaging, distributors and retailers. (Munnelly 2010) According to those requirements, any manufacturer who place packaging on the Irish market worth over 1,27 million Euro and weight more than 25 tones (major producer status) is oblige to signed in to the Repak or to local authority (self-compliers) and pay annually product fee (the amount of which depends on weight). In addition, the Act requires that segregated packaging waste should be collected by authorized waste operators (operators that have all necessary licenses and permits). The materials, which have to be collected separately and later recycled include: glass, cardboard, paper, steel, aluminum, plastic and wood. (S.I. No. 61/2003)
- Waste Management (Packaging) Regulation of 2004 (S.I. No 871/2004) – this act is also contented with the Directives 94/62/EC. It introduces some changes and improvements to existing Act from 2003, e.g. with regard to facilitation and promotion of recycling and recovery targets by the end of 2005. The main change concerns

obligations of packaging producers and distributors to collect packaging that they introduce to the market by creating collection points. At the same time, this act also describes how the customers should be informed about possibility of utilizing packaging waste by bringing it to the collection points (manufacturers need to publish information about collecting points in local newspapers). In addition, the Act increases the self-compliance registration fee from €5,000 to €15,000 per premises.

- Waste Management (Packaging) (Amendment) Regulations of 2006 (S.I. No 308/2006) - this regulation in line with the Directive 2004/12/EC, introduces new and more strict targets for recycling (55%) and recovery (60%),setting up deadline for those targets for the end of 2011. It is worth to mention here that according to the Directive 2004/12/EC, Ireland has some additional time to reach the Community-wide targets (due to its geographical location - island, mountains and valleys), rural population and low density, which make the collection and waste services more difficult. However, as it is mentioned in the Introduction, those alternations were not necessary and Ireland met its targets for 2011, four years earlier.
- Waste Management (Packaging) Regulations of 2007 (S.I. No. 798/2007) - this act refers to Directive 2004/12/EC and modifies existing regulation on packaging to improve efficiency and optimize the recovery and recycling rate. The main differences is reduction from 25 to 10 tons of packaging products placed on the market that determines major producers status (obligation to sign up to Repak or local authority.)

Those regulations, as compare to Poland, seems to be more comprehensive, detailed, and regulate more strictly the issue of reporting, supervision and monitoring, what produce less gaps and uncertainties in reports and illustrate well the packaging waste stream flow. This is definitely an area from which Poland could learn. At the same time, it is also important to remember that the Irish system is not perfect and still need some improvements. As Mr. Colm Munnelly from Repak said (2010), still about 35% of the packaging market is not under

control of the Repak or local authority. Companies which are excluded from obligations are mostly small, so do not reach the level of packaging (10t, 1,27m EUR) which is required in order to report to Repak or local authorities (this also means that those companies do not pay product fee). By including all companies without any thresholds, there will be more financial resources available for further investments in development of more environmental friendly waste management system. (Munnelly 2010)

5.2 Local Waste Regulations

According to Waste Management Act of 2006, Dublin similarly to the other 9 regions in Ireland needs to prepare waste management plan for every 5 years period. The last report describes the Waste Management Plans for the Period 2005 – 2010 and it is combined with Annual Progress Reports. Plan and Reports cover all four local authorities of Dublin Region (Dublin City Council, Fingal County Council, Dun Laoghaire-Rathdown County Council and South Dublin County Council). The waste management plan and report contain and regulate the following issues (WMPDR 2010):

- prevention, minimization and reuse of packaging materials;
- statistics for waste collection, recovery and recycling;
- informative and educational actions,
- collection systems description (bring banks and bring centers, collection at source with 3 bins system, recycling centers) and plans for improvements;
- characterization of priority waste streams as Waste of Electrical and Electronic Equipment WEEE, End of Use Vehicles, Waste Tyres;
- description of the current state of waste management in Dublin;
- waste generation in Dublin Region;
- waste disposal, and plans for improvements by reducing the amount of waste which is landfilled by for example energy recovery from landfills;

- infrastructural development (collection points, recovery facility, biological treatment, waste - to - energy);
- regulations and enforcement.

The main objectives of the packaging waste management plan as well as a report will be described in more detail in subsequent subchapter.

5.3 Packaging Waste Management – Dublin

The waste management system in Ireland, similarly to Poland, is mostly privatized and a waste owner is the one who collects waste from the source (who collects the waste, then own the waste) (Medley 2010) The main differences between Poland and Ireland is that the latter has well established regulation system, which give the proper tools to local authorities and the EPA for controlling the waste flow and implementing standards and targets for recycling and recovery rates (No. 10/1996). Another advantage of Dublin lay not so much in the fact that there are many companies, which offer waste collection services and its utilization, but because none of them really dominated the market (in Krakow over 60% of the waste management market is served by one company - MPO). This obviously builds the competition and allows providing better and cheaper service for the customers. The biggest market players in Dublin are: Greenstar, Greyhound, Oxygen and Panda.

After interviewing the representatives of Greyhound and Greenstar, a clearer picture of their operations becomes visible. First, both companies offer a wide range of services to their customers on very good financial conditions (prices), what is possible, thanks to subsidies from Repak. (Munnelly 2010) *Greyhound* is a company, which works internationally for over 30 years. It advertises itself as a player of sustainable waste management, whose target is to achieve zero waste to the landfill. Consequently, Greyhound does not own its own landfill and needs to pay a large fee for waste disposal on existing landfills (this is probably an additional driving force to manage waste differently than

disposal). At the same time, the company owns in Dublin two MRFs licensed by EPA, which process mixed recyclables (Ballymount) and already segregated materials for production of solid recovered fuel **(**Clondalkin**)** with combined capacity of those facility 500 000 t/yr (including Regional Waste Transfer Facility in Limerick). Those MRFs are equipped with very modern technology that uses 3 screens segregation method (infrared screen, colour detector screen and glass detector screen) to separate waste on the basis of material density and colour (Donnellan 2010). This technology is very effective and posses bigger capacity (100 000t/yr) as compare to facilities located in Poland, where MPO's technology used in MRF for segregation of dried recyclables is simple made by hand (people are standing in front of the production lane and segregate the waste by hand). (Flak 2010) The main obstacle in Infra Red (IR) segregation, and what gives an advantage to the simpler technology, is that the machinery does not recognize the biodegradable plastics and plastic film, which are not recyclable and just treat them as plastic. This in turn contaminates the final separated material. In that case hand segregation can be superior and improve the quality of the segregated material. On the other hand, this method is characterized by lower effectiveness and capacity. (Donnellan 2010)

Greyhound, offer its services to over 3500 households and industry. The company has also a contract with local authorities to utilize municipal waste from Dublin City. Since 2004 they invested over 25 million Euros in building recycling infrastructure in Ireland. (Donnellan 2010) Greyhound offers to its customers three different bins. First is black bin, which is designed for mixed, not recyclable residual waste and for this bin it takes charges. Second is a green bin, which is designed for all recyclable materials as paper, plastic and metal (glass and bottles need to be transported to the bottle banks) and third – brown bin which is designed for biodegradable waste. For those two last bins, Greyhound does not take any charges (collection of those bins is covered from Repak funds). The share of the collected recyclable materials looks as follow (Donnellan 2010):

- paper and cardboard 60%;
- plastic 14%;
- metal 6-7%;
- rest covers not recyclable materials.

As Ms. Donnellan (2010) said the highest contamination of the recyclable materials (green bin) are taking a place during the summer, when people put the green, biodegradable waste from their gardens (grass, leaves, branches) because they treat that waste as recyclable material (brown bins are not so popular yet). At the same time, the highest collection of packaging waste takes place seasonally, twice a year: during the winter (Christmas time) and during spring time (Eastern). It is also important to add that Greyhound received certificate from *National Standards Authority of Ireland ISO 9001:2000* and *14001:1996***.**

Greenstar is a competitor to Greyhound that can be labeled as a leader of environmental friendly waste management in Ireland and which invested already 275 million Euros into to the development of waste management infrastructure and still is planning to invest another 250 million Euros. Greenstar provides its services to over 70,000 households and 25,000 industry costumers in Ireland (nine main municipalities in Ireland Cork, Dublin, Waterford, Wexford, Wicklow, Sligo, Donegal, Kilkenny and Mayo), what gives over a million tons of waste collected while about 60% is recycled or recovered. In addition, Greenstar operates 5 MRFs, 4 licensed landfills and 2 recycling facilities. (Medley 2010)

Similarly to Greyhound, Greenstar offer to its customers collection of mixed recyclables in green bin (without charges) and for other mixed residual waste black bin (payable). The Greenstar also owns ISO certificates (ISO 14001:2004 and ISO 9001:2000). (Medley 2010)

Both companies export segregated materials and recovered waste to the, EU (particularly the UK), China, India, and Indonesia markets for recycling or energy recovery. (Duff 2010) Greyhound and Greenstar, next to the municipal waste utilization, also invest in

research of the new technologies and education. They organize trainings and many activities for kids, school students and adults to improve knowledge in the subject of responsible and more environmental friendly waste management. They both also support green schools initiatives. (Duff 2010)

It is also worth to mention that Ireland does not possess any incinerator at the moment but the plans include construction of Dublin waste - to - energy facility (incinerator) in Polberg by the year 2013. This should cost approximately 350 million Euros and will employ 60 people. (WMPDR 2009)

In 2008, 3.224,281 tons of waste was collected in Ireland with the total recovery rate of 64,7%. The packaging waste generation with disposal and recovery rate looks as shown on Table 5.1.

Table 5.1: Packaging Waste Generation with Disposal and Recovery (EPA 2010)

Material	Gross Quantity Managed (t)	Quantity Landfilled (t)	National Landfill Rate (%)	Quantity Recovered (t)	National Recovery Rate (%)
Paper and Cardboard	406 468	88 473	21,8	317 995	78,2
Glass	157 848	41 197	26,1	116 652	73,9
Plastic	248 046	176 265	71,1	71 781	28,9
Ferrous	52 647	15 409	29,3	37 237	70,7
Aluminum	12 252	9 497	77,5	2 754	22,5
Mixed Metals	2 670	774	29	1 896	71
Textiles	1 801	1 787	99,2	14	0,8
Wood	111 014	1 211	1,1	109 803	98,9
Other	34 013	28 102	82,6	5 911	17,4
Total	1 026 759	362 715	35,3	664 043	64,7

The data taken from the Waste Management Plan for the Dublin Region 2005-2010 and the Progress Report for 2008 show than the recycling rate from the household in Dublin reached 35% with 82,000 t. coming from green bins collection system (door - to - door), 32,000 t. from recycling centers and 31,000 t. via bring banks (301 bring banks located in the Dublin City Region). The recovery rate in 2008 was on level of 41% (municipal waste), 46% (commercial waste) and 54% (packaging waste) – an increase of 7,7% as compare to 2007. The target for recycling rate of packaging provided in the Waste Management Plan is 55% by 2011, so the Dublin City region is still progressing to reach the target (recycling of packaging waste in 2007 – 52%). Packaging waste, which was landfilled in Dublin is as follows (WMPDR 2010):

- household – 22,3%;
- commercial – 20,5%.

The success of Dublin and Ireland (amazingly high rates of recovery and recycling) consists in its well developed selectively waste collection infrastructure. The waste collection from the household (2 bins door – to – door system), 301 bringing banks all over the city and 11 recycling centers, makes selective collection more ease and, what is more important, available. (WMPDR 2010) The condition, which also simplifies the selective waste collection, is Dublin urban structure. The city is mostly dominated by single family or small multifamily households, what simplifies the waste collection at source (additional infrastructure does not need to be built as for example in Krakow where large multifamily buildings dominate). Furthermore, the awareness and knowledge of the society, seems to be at the higher level in Dublin than in Krakow what also have influence on recovery and recycling developments. This may be attributed to educational programs, which starts already in the kinder garden or to clearly financial reasons (as mentioned before, green bin is collected for free). In my opinion, both are good reasons.

It is also important to remember that recycling by itself can be sometimes unprofitable, what can cause stagnation in its development as it is a case in Poland (Krakow) and on the smaller scale in Ireland (Dublin). First of all, Ireland is rather small country with about 4 millions population. The solutions such as incinerator could be therefore problematic, because of too small amount of waste stream coming to potential energy recovery facility. This in turn may lead to disruption of energy production. Moreover the same problem can be met with building the recycling facilities, which also could have a problem to work continuously, because of too little materials inflow. In other words, the expenses of running the facility would be much higher than expected profits (that is why Ireland exports almost all its selectively collected waste). Another problem, which development of recovery and recycling can face in both Poland and Ireland is relatively high fluctuation on the secondary material market, what can cause large financial losses. (Duff 2010) Also, when segregated material is highly contaminated the prices for it are dramatically going down. The truth is that in many cases without financial support from Repak in Ireland (Duff 2010) and local authorities in Poland (product fee, in addition in Poland recyclable bins are charged similarly as in case of not recyclable waste), (Flak 2010) increase of recovery and recycling rate would be just economically not justified for the private investors. (Duff 2010)

5.4 Pro-Ecological Initiatives and Subsidies

One of the best working initiatives, which promote and financing development of recycling and recovery, as well as environmental education in field of sustainable waste management, is *Repak*. It is an industry funded organization, which provides a link between government and private sector. The main goals of this organization is to support companies to meet recovery and recycling targets from Directive 94/62/EC and 2004/12/EC, and improve the packaging waste recycling and recovery rate in Ireland. Repak works by subsidizing companies, which collect waste separately, recyclables banks, recovery and recycling facilities and educational and informative programs. Repak funds are coming from product

fee collected from packaging manufacturers (producers' responsibility). (S.I. No. 61/2003) In practice, Repak control over 65% of the market while local authorities around 5%. (Munnelly 2010) Another subsidy available for recovery and recycling facilities for development of the infrastructure (machinery, MRFs facilities, recycling facilities) is coming from the Enterprise Ireland and of course from EU structural funds. (Donnellan 2010)

In Dublin Region several initiatives related to the waste management take place. One of them is known as a *Green Schools* or *Eco-Schools.* It is a very successful program, the main goal of which is to promote waste awareness, prevention and reuse and many other environmental issues. (WMPDR 2010) The schools starts their action with understanding issues like how much waste they produce, how much they recycle, how much paper and energy they are use, how much of their waste is send to the landfill or what kind of waste is generated in their environment. Sometimes, schools can decide to spread out the action to the bigger area and include students' and their neighbours' households. Schools, which created their green school committee (involving students, teachers, parents, school stuff) and prepared their detailed environmental review (which includes information about who was involved in the program and what kind of results were achieved), produce an action plan (with targets and goals to be achieved), provides of monitoring and evaluation (plan realization progress), provide educational services (traditional as theme books or more innovative set up by school individually), and prepare a green code (a green code is a school's commitment to environmentally friendly actions)**,**can apply for a green flag, which nowadays can be also treated as a well known, international eco-label. (Donnellan 2010) In Dublin Region 516 schools joined the program what consist over 75% of all schools in the region, 16% more than in the previous year and green flag symbol has been already received by 252 schools. (WMPDR 2009)

In Ireland, next to the Green School initiative, there are many other educational actions organized on the national basis, which are founded not only by local authorities, but

also by private companies as Greyhound or Greenstar. Those companies organize for example courses, games and conferences to improve knowledge and awareness in the subject of sustainable waste management, recycling, recovery and reuse starting from very young kids to adults. As Ms. Donnellan (2010) mentioned kids are very interested in subject and get involved very seriously in any organized activity (more than adults who are not very interested in the subject and normally do not get involved into discussion or workshops). So most of the investments in educational programs are directed at the kids who try afterward introducing good habits at their homes. (Donnellan 2010) In addition, the funds assigned for ecological education in Ireland (environmental research and education including waste management in 2008 reached 10 million euro) (NDP 2008) are much higher than in Poland (for a period 2007-2010 it will be spend about 1,65 million Euro/4 years) (PGOWM 2010).

Another action, which takes place in the region, is the *Local Agenda 21*. This is an initiative, which promotes sustainable development at the community level. From this initiative many pro-ecological projects are funded, in particular those which improve awareness and knowledge of the society in sustainable waste management (schools, school books, informative websites). It is worth to mention here that 12 projects out of 51 were waste related. The founding (over 122,000 Euros) comes from local authorities with co-funding from the Department of the Environment, Heritage and Local Government (DOEHLG). (WMPDR 2009)

Green business activities (GBO) is an action, which supports industry with implementation of green strategies into their businesses via workshops, informative campaigns about environmental management practices and promotion of environmental initiatives for business. (WMPDR 2009)

Dublin Regional Waste Awareness Website (www.DublinWaste.ie), which was created by the Dublin local authorities, in order to improve awareness and knowledge of Dublin citizens in the field of waste management with special consideration of recycling, reuse, and

waste minimization. In 2009, the website was visited over 1,463,484 times, which gives an average number of heats 124,648 per month.

5.5 Corruption

At the request of my interlocutors in I am not including any references here. The information presented below is unofficial and does not refer to any publications or official reports. It is only subjective opinion of some of my interviewers.

Ireland as an island does not face different problems that exist in Poland, which is located in the Continental Europe and is surrounded by many other countries where for example waste flow through the borders is much simpler. As far as the corruption problem is concerned, all my interviewers confirmed that well working reporting and monitoring system does not allow for many uncertainties to happen and if they took place they are checked very carefully by the EPA, Repak and local authorities. Consequently, in their opinion there are little chances to cheat on weight, amount or collected material type. The ordinary differences on weight between packaging waste collected and introduce to the market are caused by contamination of packaging (food and organic waste), what can increase the weight of collected packaging waste, or backyard burning, which might slightly decrease the amount of collected waste. Usually, those uncertainties amount to1%.

Of course, nowadays, the above does not mean that there were no attempts in the past to cheat on the system. Few years ago, there was a problem related to shipping. The exporting companies tried to sell and send the recovered material, which were contaminated (poor quality) or they mixed different recyclables in the containers (for example a container should include paper but it was plastic, different fees for different material and different weight). This problem was solved quite quickly and now the control system in ports is very tight. The containers are opened and checked carefully, to avoid in the future such a fraud.

The second problem, which was recently discovered, also relates to export of recyclables, especially to the Northern Ireland and the United Kingdom. The companies

which transfer waste both ways, to the Northern Ireland and the UK from Ireland, can receive double subsidies for selective collection and recovery. First they receive subsidies from the Repak in the Republic of Ireland, second from the Packaging Recovery Organization Europe (PRO EUROPE – the same profile of company, different location) what can affect the amount of subsidies provided to the other companies in the market. Unfortunately, this type of illegal transactions still takes place.

5.6 Conclusions

Ireland is a EU country with well developed waste management system. Ireland will help meet the EU targets for recycling and recovery (64,7% of recovery in 2008) before the deadline of 2011 (60%). At the same time, the Irish government, local public authorities, governmental and non-governmental institutions as well as private investors knows their strengths but they are also aware of their weaknesses and elements that need to be improved. (Table 5.2)

Table 5.2 Strengths and Weaknesses of Packaging Waste Management In Ireland

Strengths	Weaknesses
Comprehensive regulations on reporting and monitoring of the packaging waste stream.	Gaps in the legal system for the control of small and medium-sized enterprises, causing that 35% of packaging going to the market is not registered.
Control of packaging waste flow - EPA (national waste report – once a year), local authority and Repak (reporting every month)	Over reporting. Each company needs to prepare 3 different reports, which finally consist of the same information. The best solution will be to create comprehensive on-line database that will help to collect all necessary information and which is easy to access for everyone interested.
Door – to – door initiative (green, brown and black bins)	This initiative does not work in case of multifamily houses.
Well establishes financing system - Repak	Scams still happen, especially where the waste is transported from country to country (many subsidies for the same waste)
Modern technology used in MRFs	IR radiation does not recognize plastic film and biodegradable plastics
Financing of education and society awareness in sustainable packaging waste management – large investments	-

6. Packaging Waste Management in Poland

6.1 National Waste Regulations

Poland, as it was pointed out earlier, is a member of the EU. Consequently, national legislation on packaging and packaging waste management strongly relies on EU regulations. In case of Poland, one may distinguish between legal provisions at the national level, which reflect requirements of relevant directives and decisions of the European Commission, and local regulations, which are more detailed and adjusted to existing situation and ability of regions.

The main legal acts that are relevant for Waste and Packaging Waste Management include:

- *Environmental Protection Law (Prawo Ochrony Środowiska) from 27.04.2001 (consolidated text: Dz. U. 2008, Nr 25 poz. 150, as subsequently amended)*

The EPL says that waste management should take into consideration the principles of environmental protection and sustainable development. Besides, it requires environmental monitoring for waste management as well as establishment of restricted areas around facilities, which could potentially negatively influence on surrounding environment. In terms of waste, the Act refers to the Law on Waste from 2001. In relation to waste management, EPL law refers to the issues of charges and penalties for environment use, waste storage and landfilling, which is again more specifically regulated by the Law on Waste. EPL Act also regulates the financing system of the National Fund for investments in recycling, energy or waste recovery.

- *The Law on Waste (Ustawa o opadach) from 27.04.2001 (consolidated text: Dz. U. 2007, Nr 39, poz. 251 as subsequently amended)*

As it was mentioned above, this act sets out more detailed rules for dealing with waste management with regard to life and health protection through the prism of the environment

safety and principle of sustainable development. The main points of this law are to prevent, reduce and minimize negative influence of waste on surrounding environment, reuse packaging products, recover waste and energy and guarantee safe disposal (those elements reflects the rules contained in Directive 94/62/EC, or in other word the main objectives of Waste Management Pyramid). As Mr. Marek Bronicki (2010) mentioned in his interview, this law was established three years before joining the EU by Poland and it is a first try for Poland as a candidate member to create comprehensive waste management regulation that is compatible with the European standards.

The Law on Waste also defines and classifies wastes due to their place of origin, which is further supported by the detailed waste lists in waste catalogue described later in this chapter. In addition, the act defines waste itself and activities related to waste management, such as selective collection, storage, warehousing, transportation, recycling, treatment, recovery, energy recovery, processing, composting or combustion. The act also sets up the bodies responsible for regulation, supervision and monitoring of waste management issues and details responsibility of waste producers, waste owners and public authorities.

An important element regulated by the Law on Waste is obligation for the waste management plans at all levels (national, regional and municipal). In order to guarantee efficient implementation of waste plans, public authorities monitor and report of their progress (waste composition, quantity, recovery, processing, segregation rate and information about import and export of packaging and packaging waste) Unfortunately, Article 36 and 37 of law appear to be insufficiently specific with regard to reporting. Although the Law on Waste requires, similarly as in case of Ireland, preparation of waste records by all manufactures (in the form of waste cards - the official documents, which include more detailed and reliable information about waste introduced to the market exchange between different actors and later its utilization), number of reports submitted by traders to the Polish local authorities are too general, too late or simply inaccurate. The reasons for this vary. First

of all, many small companies do not provide any documentation relating to the qualitative and quantitative records of its waste and have a full right to do so, because under the Polish law no such records are required. In particular, the regulation of the Minister of the Environment on the types or quantities of waste for which there is no obligation to keep records of waste, provide for simplified record of waste for small and medium-sized enterprises. (Dz.U. 2001, Nr 152, poz, 1735) This Polish system in this regard seems to be less stringent than the one which operates in Ireland. Another reason for inaccuracies in the reports may be due to the illegal disposal of waste (illegal landfill), as a result of mixing different waste or just because companies submitting waste reports are simply late (sometimes year or more). (ZIKiT 2009) Another problem is enforcement. Public controllers tend to look through the reports carefully only in the situation when the serious shortcomings and incompatibility is detected. In other cases, the control is rather shallow even if the reports are checked at municipal, regional and national level. The another reason that also influence accuracy of reporting system is relative lack of effective punishments for manufacturers in case of inaccuracy and unreal information included in reports. (Bronicki 2010) that the above observations make clear that controlling system is very important to ensure the proper functioning of the responsible waste management, as it takes place in Ireland, where even small incompatibility require painstaking clarification to Repak, local authorities and the EPA. (Munnelly 2010)

- *Act on Packaging and Packaging Waste (Ustawa o opakowaniach i odpadach opakowaniowych) from 11.05.2001 (Dz. U. 2001 Nr 63 Poz. 638, as subsequently amended)*

For the purpose of my thesis, one of the most interesting acts that directly affects the packaging and packaging waste management. It provides definitions of waste and waste utilization as well as it regulates targets, which must be met with regard to environmental, life and human health protection in accordance to the principle of sustainable development. The Act also specifies the responsibilities of a manufacturer, importer, exporter and supplier of

packaging and packaging waste (within communities), determines duties of the vendor's products as well as the responsibilities of public bodies.

- *The Law on Clean Maintenance in Communities (Ustawa o utrzymaniu czystości i porządku w gminach) from 13.09.1996 (consolidated text: Dz. U. 2005, Nr 236, poz. 2008, as subsequently amended)* – []

National law that is particularly important for local regulations. It establishes the responsibilities of the local authorities and defines the responsibilities of property owners for maintaining cleanliness and order. It also includes the conditions for licensing, concession and authorization of services in the field of waste management services. In Krakow, the public body responsible for licensing, controlling and supervision of waste management issue is ZIKiT (*Zarząd Infrastruktury Komunalnej i Transportu, the Board of Communal Infrastructure and Transport*). (Bronicki 2010)

- *Law on Obligations of Entrepreneurs in the Management of Some Waste and on Product Fee and Deposit Fee (Ustawa o obowiązkach przedsiębiorców w zakresie gospodarowania niektórymi odpadami oraz o opłacie produktowej i opłacie depozytowej) from 11.05.2001 (consolidted text: Dz. U. 2007, Nr 90, poz. 607, as subsequently amended)*

The Act regulates all responsibilities of traders, who introduce to the Polish market packaging or packaged products irrespectively whether it is national production or importation of products. Besides, this Act also commits the entrepreneur to achieve specific levels of recovery and recycling. In a situation where the designated levels are not met, the Act introduce so-called '*product fee*', which is paid by both, the company with and without established targets for recycling and recovery – defined in Article 4, paragraph 1. Later, those financial resources are divided by public administration bodies. The calculations of the product fee shall be made on the basis of annual reports, which contain information about the company, mass marketed, recovered and recycled rates, as well as information about the achieved levels of recovery, by each business.

Furthermore, one may also notice a certain similarity to the system functioning well as Repak in Ireland, with the main difference that the income derived from product fees is only partially (app. 70%) transferred for the development of recycling and recovery infrastructure, improvement of awareness in the society, and subsidies for separate collection. At the same time, similarly working system in Ireland transfers all founds which are coming from the product charges to those initiatives, what increase competitiveness of recycling materials on the market and make selective packaging waste collection more cost-effective and more economically justified. (Munnelly 2010) Poland in contrast to Ireland does not provide regular subsidies for privet companies, which collect waste selectively, what makes it less rental and more risky not only for investors but also for customers. The reason is simple. Potential costumer pay similar fee for 'black' and 'green' bin utilization, so for him or her it does not make much differences, which bin he or she will use. Moreover, the waste regulations requires from buildings administrators and property owners, to collect waste selectively, but in most cases is not respected because, there is no legal regulation, which will put financial of punitive responsibilities for people who do not respect this law. (Flak 2010)

Furthermore, this Act sets out the main responsibilities of public administrations in terms of reporting to the National Fund, the distribution of funds, the amount of packaging put on the market and levels of recycling and recovery.

As a consequence of the requirements provided in the Act and concerning targets for recovery and recycle by each company working in waste stream, many recovery and recycling companies were created. How does it work in practice? It is very simple. The company, which need to reach recovery and recycling rates, has three ways to deal with this problem. First, it can simply pay product fee, second, it can reach those targets by itself or finally, it can pass this task to recycling and recovery organization. Such firms represent their clients in matters of implementation of statutory duties (producers' responsibility – product fee, recycling and recovery targets, reporting of packaging waste stream flow), facilitate contacts with

governmental organizations as well as provide help to deal with the problems concerning the sustainable packaging waste management. Those companies could be easily compare to Repak (organization, which works in Ireland), with the difference, that there are no obligations for reporting of the waste stream flow to them. One of the best known and largest companies operating on Polish Market are: Polski System Recyklingu SA and Rekopol SA. Now in Poland there are several hundred such companies. (Flak 2010)

- *Regulation of the Minister of Economy and Labour on the Detailed Method of Dealing with Packaging Waste (Rozporządzenie Ministra Gospodarki i Pracy w sprawie szczegółowego sposobu postępowania z odpadami opakowaniowymi) from 25 October 2005 (Dz. U. 2005 Nr 219 Poz. 1858)*

Regulation standardizes sorting of packaging waste and selective collection of glass, aluminum, steel, paper, cardboards and plastics (containers bells) and specify how those materials should be recovered, processed, recycled and stored.

- *Regulation Of the Minister of Environment on the Annual Recovery and Recycling of Packaging Waste and Post-Consumer Waste* (*rozporządzenie Ministra Środowiska w sprawie rocznych poziomów odzysku i recyklingu odpadów opakowaniowych i pożytkowych) from 14.06.2007* (Dz. U. 2007, Nr 109, poz. 752)

This regulation reflects the requirements of 2004 Directive and determines the level of recycling and recovery, which must be achieved by the end of December 2014 by Poland. This regulation covers the period from 2008 to 2014, together with the required target for each year starting from 50% of recovery and 27 % of recycling level in 2008 to 60% recovery and 55% recycling rate in 2014. As Mr. Bronicki (2010) and Mrs. Dulemba (2010) states, by taking into account the current situation of packaging waste and recycling and recovery rates Poland do not have a chance to reach the targets imposed by EU by 2014, while Ireland reached its targets 60% in 2007, so 4 years before dead line of 2011.

- Regulation of the Minister of Environment on Waste Catalogue (Rozporządzenie Ministra Środowiska w sprawie katalogu odpadów) from 27.09.2001 (Dz. U. [112 poz. 1206)

The waste catalogue lists and classifies the waste at the place and method of manufacture of waste, determines and standardizes the waste codes (6 digits) and waste groups (20 groups). This regulation also covers the classification hazardous wastes.

6.2 Local Waste Regulations

National regulations on waste management are reflected in both the regulations of a Voivodeship, as well as a commune. According to the Law on Waste, both the Voivodeship and the municipality are required to prepare a Waste Management Plan, which is consistent with the principles of regulations on environmental protection. This plan is valid up to four years, and additionally in the case of municipalities, the law requires reporting on implementation of the objectives of the plan every two years (submitted to the City Council and Zarząd Województwa Małopolskiego). Additionally, all plans for Voivodeship before entering into force need to be verified by the provincial administrative and municipalities units, as well as by the Regional Inspector of Environmental Protection, Ministry of Environment, and also are consulted with communities under the Act of 3.10 2008 on sharing information on the environment and its protection, public participation in environmental protection and the environmental impact assessment. (Dz.U. 2008, Nr 199, poz. 1227)

The current "Waste Management Plan for the City of Krakow - Plan for 2008-2011 and outlook for the years 2012-2015" updates the assumptions of "Waste Management Plan for the City of Krakow - A Plan for 2005-2007, taking into account tasks completed in 2004 and outlook for 2008-2011. Progress reports on the delivery of the plans main objectives will be developed respectively in 2008 and 2010.

The waste management plan for Krakow contains and regulates the following issues:

- sources of information included in the city plan, an analysis of planning documents and general information about the geopolitical situation in Krakow;

- a description of the current state of waste management;

- description of the changes in waste management on the basis of demographic and economic changes (the amount and composition of waste);

- proposed changes in waste management (two variants);

- strategic tasks that are necessary to achieve the changes in waste management;

- development of education and public awareness in sustainable waste management;

- scheduling, monitoring the implementation of the assumptions, analysis of its impact on the environment.

The main objectives of the waste management plan as well as a report for the period 2007/2008 will be described in more detail in subsequent subchapters.

6.3 Packaging Waste Management – Krakow

As a case study for Poland, I choose Krakow as it is similar to Dublin in many respects as such size and population. It also shows great interest and motivation in developing sustainable waste and packaging waste management and seems to be a leader among the other Polish cities.

The waste management system in Poland is mostly privatized and the Commune does not have ownership over the waste. Waste ownership is regulated via civil law contract between waste collectors and waste producers. Nowadays, there is still no regulation, which gives the commune the full control over the waste and contractor, *(Act on Waste Dz. U. 2007 nr 39 poz. 251)* Actually, in Poland, there is debate between communities and private contractors whether to pass or not the full ownership over the waste to local authorities. This situation, on the one hand, could offer the best available services on waste collection with recycling and utilization by biddings, ensuring at the same time maximum utilization of existing facilities. On the other hand, this could block development of competitiveness on waste market, fail to optimize the transport routes and load of waste trucks, what may be less sustainable and economically not justified. (Bronicki 2010) To find a consensus in this

difficult situation, the Minister of the Environment has published a draft framework law amending the Law on Cleanliness and Order in Communities (18.01.2010), which gives to the local authorities additional instruments to manage waste streams, ensure optimal use of existing and planned installation of waste treatment facilities, (thermal waste treatment plants built with EU funds), establish more tighten control instruments over waste companies as penalties for breaking laws. In other words, commune will still not have ownership over waste but it will have bigger control over waste stream and management what may result in more honest, controlled and sustainable waste management as it take place in Ireland. (Munnelly 2010)

In 2008 in Krakow, there were 68 officially registered and licensed collection companies. The most important ones, which handle around 95% of the waste market in this city are as shown in Table 6.1, rest of the companies are small, usually with one collecting truck (Bronicki 2010):

Table 6.1 Market Share between Collection Companies.

No.	Company	Market Share
1	MPO	60-65%
2	SITA	10-15%
3	VAN	8-9%
4	MIKI	4-5%
5	ASA	4%
6	REMONDIS	2%
7	OTHERS	5%

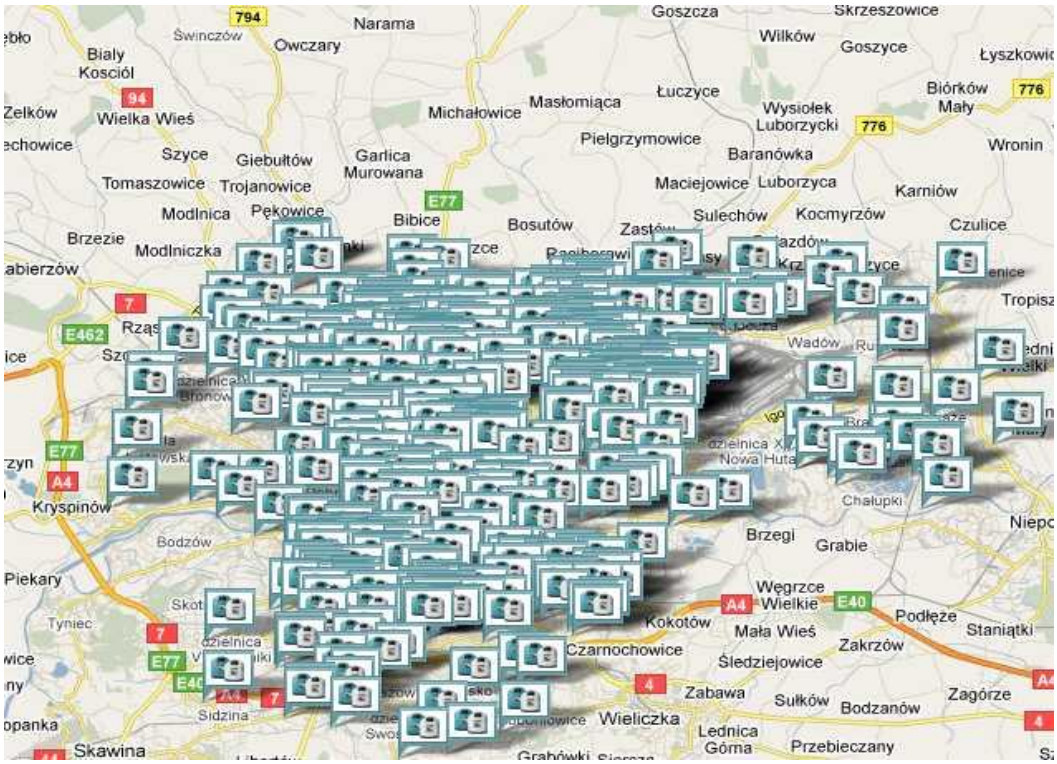
The most important player on the waste management market in Krakow is MPO (Miejskie Przedsiędiorstwo Oczyszczania Sp. z o.o.) which controls over 60% of the waste market. This communal company operates on normal market conditions and it is fully financially self-sufficient. It also owns MRF facility, modern landfill Barycz (modernized from EU funds – ISPA similarly to MRF, or composting facility), container power unit powered by biogas, composting facility, dismantling plant (under construction), warehouses for separated waste (in situation, when market prices are too low, MPO can keep secondary material in warehouses over the weeks period) and an educational project for children and

young people, called the ecological path. MPO, also give to the customers possibility to collect waste separately (yellow containers or bags) (Flak 2010)

On the basis of the report on the realization of the Waste Management Plan for Krakow for 2007-2008 (Report), it is possible to show and analyze the existing situation of packaging waste management system. According to data from the, in 2007 the total amount of municipal waste collected by those companies reached the level of 292,080.59 tones while this figure increased by a next year by 3.3% (301,831 t), whereas the amount of waste collected selectively increase in these years from 768.60 t in 2007 to 1,055.92 t in 2008 (an increase of 37%). Those data includes only numbers in case of waste collected by contracted companies (ZIKiT 2009)

In Krakow, selective collection can take place in several ways. The first option is to collect waste separately in so-called bells (containers in a bell shape for collection of glass, metal, paper and plastic). in Krakow there are 580 of this kind of containers with capacity 1,4-2,5 m^3 each. They are located all over the city (Figure 6.1), they are easy to reach and what is

Figure 6.1: Location of Bells Containers. Source: (EkoCentrum 2010)



the most important, they are available for free. The biggest disadvantage of those containers is that they are located sometimes, really far away from households, so many people instead of carry their waste for the selective collection banks, prefer to just through recyclable waste into containers for mixed waste, which are located closer to their homes. In addition, the containers are frequently objects of the acts of vandalism and remain not repaired for a quite a long time. The waste collected through those containers in 2007 was 4537.45 t to in 2008 increase for over 25% - 5681.90 t. (ZIKiT 2009)

Another way of selective waste collection in Krakow is collection at source. This is a pilot scheme of double-container, which started in 2006. At the moment, this is an initiative, which in principle works effectively only in single family houses, and it is done in two ways. First, one may use yellow container for dry recyclables collection (paper, glass, metal, plastic - recycling rate 55-60%); second it is also possible to use plastic yellow bags (recycling 70%). (ZIKiT 2009) The main disadvantage of this system relates to difficulties to introduce it multi-flat buildings which are characterize by one rubbish chute), and which is dominating in Krakow. Another disadvantage of the system is low awareness and motivation to recycle in the society and high prices for collection of separated waste (there is the same cost for utilization of mixed waste containers and recyclable containers collection). (Flak 2010) Here, again it is possible to see the differences between Dublin and Krakow. Dublin is mostly dominated by single and few family households and this makes selective collection much easier. In addition, awareness among Irish society of environmental issues and sustainable waste utilization is much higher. It is also more attractive from economic point of view because in Ireland, as it was mentioned in chapter 5, recyclables are collected without any charges what additionally attract society (charges for ‘black bin’ remain relatively high). As it is easy to see, the idea to increase charges for collection of mixed waste and reduce costs of dry recyclables could work as a driving force for development of dual – containers collection system.. Of course, the big problem remains how to make selective collection easy, cheap and

convenient for people who live in multi-family building (suburbs and the city center) which includes 80,2% of all households. (ZIKiT 2009)

Third possibility for selective waste collection is by pro-ecological actions organized by local authorities and private companies like Earth Days, Recycling Festival, or paper and cardboard collection in schools (competitions). Those actions are described with more details in further chapter. It is enough to say here that the average is 591.45 t in 2007 and 635.6 1t in 2008.

In summary, the total amount of packaging waste collected via bells (containers), private companies, ecological initiatives and others are shown in Table 6.2 with waste management system in Figure 6.2 and 6.3:

Table 6.2 Total Amount of Packaging Waste Collected in Krakow in years 2007-2008. (ZIKiT 2009).

Year	Amount Of Packaging Waste Collected In Krakow [t]					
	Paper	Glass	Metal	Plastics	Mixed	Total
2007	2503,10	2439,15	63,98	890,61	-	5896,84
2008	3467,29	2676,04	54,73	1182,82	1,85	7382,73
2008/2007	138,5%	109,7%	85,5%	132,8%	-	125,2%

Figure 6.2: Municipal Waste Management in Krakow in 2007. Source: (ZIKiT 2009)

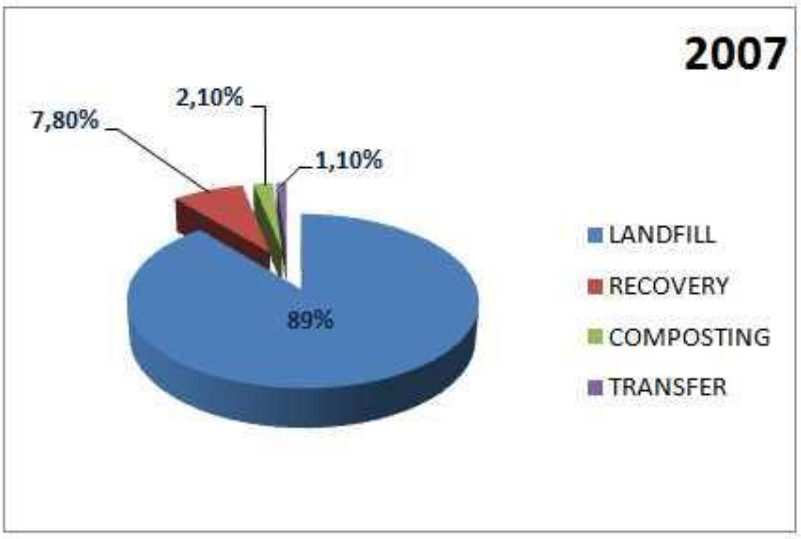
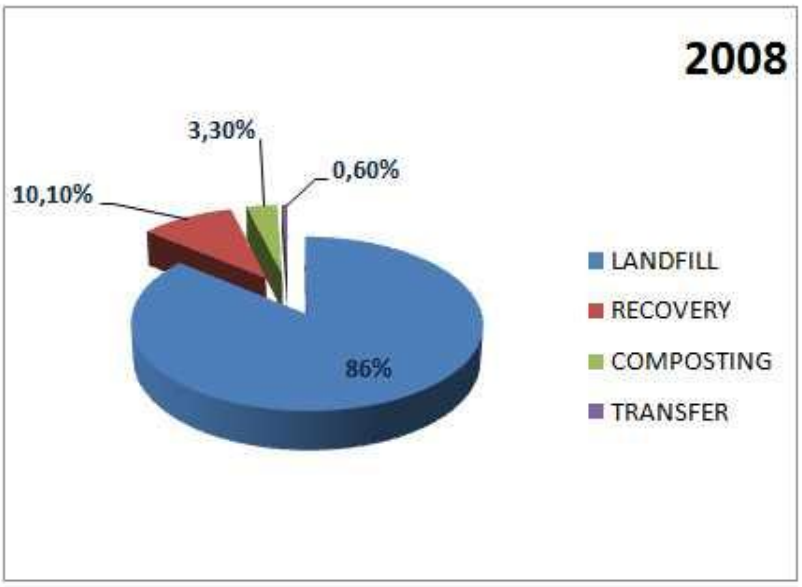


Figure 6.3: Municipal Waste Management in Krakow in 2008. Source: (ZIKiT 2009)



As it is show on the chart above, the landfilling waste is still the most popular way to manage waste in Krakow. The real problem can start in 2016, when existing landfill (Barycz) capacity will be filled up. Next to waste recovery and recycling, Krakow has plans for building first *energy recovery installation* (incinerator), which will be located in XVIII district called Nowa Huta. (Figure 6.4)

Figure 6.4: Location of Incinerator in Krakow. (KHK S.A. 2010)

The project is accepted and supported by 91,5% Krakow population and 58,9% of those, who lives in the closest neighborhood to the investment. The project has already received an environmental decision and on 29 June 2010, Krakow send an application for

funding from the EU – (about 500 millions PLN from the EU Structural Fund). Works should start in 2011 and incineration facility should start working in 2013/2014. (Pilat 2010) The efficiency of the incinerator will amount to 220 000 t/year, so over 68% of actually collected waste could be incinerated. The installation will be very modern and reach strict EU standards on gas emission. An additional advantages will be production of electricity and heat for the City of Krakow, reduction of amount of waste, utilization of mixed waste and of course creation of new work places. (KHK S.A. 2010)

Another waste management facility, which operates in Krakow are two MRFs (sorting facility) – Barycz (located in surrounding of landfill) and Sortownia Zakładu Gospodarki Komunalnej Sp. z o.o. Barycz. This MRF is able to sort 20,000 tons of waste a year. Secondary materials recovered in this facility are characterized by excellent purity as well as uniformity. The materials separated in this facility are:

- paper and cardboard
- glass (white and colored)
- iron and non-ferrous metals
- plastics (PET, PEHD, folly)

Total waste separated and recovered in this facility in 2007 reach 7,611.27 t and 11,498.03 t in 2008. The second MRF is sorting only plastic materials and it is working since 2003. In 2007 in this facility sorted 50 31 tons of plastic waste and in 2008 over 85 tones. Those numbers are still very low, but hopefully the increasing trend will remain. (ZIKiT 2009)

6.4 Pro-Ecological Initiatives and Subsidies

Nowadays, in Krakow many pro-ecological initiatives are taking a place. One of the most popular and recent actions in case of packaging waste management are:

- ***Krakow Recycling Festival*** - Festival was organized for the first time in 2003 and every year attracts more and more people to join. The main aim of this social action is promotion of selective waste collection. During a festival, many concerts, games, conferences and seminars

are taking place. The action that always takes a center of people attention is exchange recyclable waste for free tree seedlings, and later construction of buildings from recycled materials (Figure A). (ZIKiT 2009)

Figure 6.5: Florianska Gate. Building constructed from 80 000 empty bottles. Krakow Recycling Festival 2007. Source: http://www.panoramio.com/photo/2324470

- ***Earth Days*** – a pro-ecological action which main aim is to find a balance between environment and human. Bike marathons, theater plays, competitions, cleaning the surroundings and selective waste collection takes place. (ZIKiT 2009)

- ***Krakow Ecological Exhibition,*** is an initiative associated to the Earth Days, where municipal companies present their ecological investments. (ZIKiT 2009)

- ***Czysta Akcja Krakow (Clean Action Krakow)*** - educational program, which started in 2006. The main goal of this action is to increase awareness of the society about different kinds of waste and what should be done with it. It also shows how one should utilize electronical waste, batteries and accumulators, medicines and other hazardous waste. (ZIKiT 2009)

- ***Pogadaj z Gadem Co Zrobic z Odpadem (Talk to the Dragon what to do with waste)*** - educational initiatives which took place for a first time in 2006. The main idea was to provide teachers with the proper training about sustainable waste management, later this action has also included teenagers and kids. It is supported by ecological path located in Barycz Landfill,

which teaches through fun shows how to separate waste, explain the recycling process and illustrate what happens with landfilled waste, and how long is it takes to utilize it. (ZIKiT 2009)

- ***EkoCentrum portal*** - information and education campaign designed to increase public awareness related to the proper management of waste, increasing knowledge about different kinds of waste and ways of its utilization (hazardous and non-hazardous) developing habits (selective collection) and minimizing packaging waste by choosing products with less packaging. This campaign realized its objectives via internet website www.ecocentrum.krakow.pl (source of information about waste legislation, ecological actions, waste development plans, reports of its implementation, info about new investments in waste sectors, educational games and films and many other information). There are also free info lines and distribution of films, leaflets, posters, adverts, gadgets, articles in newspapers and magazines. This portal is co-organizer of many ecological actions like Krakow Recycling Festival, Earth Days, Cleaner Krakow, Better Life and many others. (ZIKiT 2009)

In Poland the financial resources for investments in the waste sector comes from several different institutions and programs. First of all, subsidies are provided by the EU:

- ISPA (Instrument for Structural Policies for Pre-Accession) was a fund that could cover up to 75% of overall investment coasts. The aim of this program was to help applicant countries to adapt its technological infrastructure to requirements of the EU (including environmental requirements), Important examples in Krakow include expansion and modernization of Barycz landfill, developing a system of selective waste collection and sorting building, the construction of composting facility, extension of the energy installation of biogas plants, construction of a warehouse and the construction of a bulky waste, and electrical and electronic equipment removal.

- EU Structural Fund, which supports the poorer state members. Poland may seek grants, inter alia, for the development of transport infrastructure and environmental protection; the project of an incinerator, if accepted, will be supported from structural funds;
- Norwegian Financial Mechanism and EEA Financial Mechanism, which priority areas are environment protection and sustainable development.

In Poland there are also available national funds and preferential loans for the development of environmental friendly initiatives, relating, inter alia, to responsible waste management. Grants and loans are available at:

- NFOŚiGW and WFOŚiGW – Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej (National Environmental Protection and Water Management Fund) and Wojewódzki Fundusz Ochrony Środowiska i Gospodarki Wodnej (Voivodeship Environmental Protection and Water Management Fund) – offer loans, which can be remit after bail 60% of its value.
- Bank of Environmental Protection – preferable loans for environmental investments.

In addition, funding also comes from the state budget, which collects funds from: fee for use of the environment (the fee marshal, green taxes), product fees, and fees for emissions.

6.5 Corruption

This chapter is based on the information collected during interviews with representatives of local authorities and private investors. They frequently mentioned uncertainties in the reporting waste streams and waste black market.

The first and in the same time the most common crime, which takes place in Poland and Krakow, is falsification if documentation of the waste stream flow and trading in 'receipts'. Sometimes it happens that documentation and ‘receipts’ of recyclable waste is duplicated several times, and circulated around Poland appearing many times in different reports. Sometimes it also happens that companies without required licenses and permits sell

fake receipts, which in any way does not reflect the true waste circulation. Another problem is located in financing sector, more specifically in distribution of the financial resources from product fee. Companies, which get waste transfer documents, with false amounts, receive money from product fee, what reduce the money available for honest contractors and leads to increasing costs of recycling and recovery. It is estimated that around 25-40% of whole waste management market is under such kind of dealings.

6.6 Conclusion

Krakow by taking into consideration the experiences of Ireland, should seek the way to create comprehensive and fully integrated waste management system, which is also consistent with the principles of sustainable development. Poland similarly to Ireland is aware of its strength but also weaknesses. On the table below there are shown the main elements that can contribute to achieving or failing the development of sustainable packaging waste management. (Table 6.3)

Table 6.3 Strengths and Weaknesses of Packaging Waste Management In Poland

Strengths	Weaknesses
producers responsibility and product fee which provide local authorities with additional funds for development of recycling and recovery infrastructure and improve awareness of society	similarly to Ireland, the differentiation of packaging material during calculation is missing and small and medium companies are relief from the obligation of product fee
single family houses are provided with door-to-door service	difficulties with waste collection at source (domination of large multifamily households)
large number of selective collection points all around the city	lack of discounts for collection of 'green bin' waste
-	Relatively low payment for landfilling
lot of educational initiatives considering recycling and recovery development	lack of permanent and constant initiatives as Green Schools. (periodic and quite short actions), small financing
-	corruption
-	underdeveloped monitoring and reporting system
Incinerator under construction	reluctance of residents for designed incinerator

7. Recommendations and Conclusion

Krakow, based on the experiences of Ireland, should seek the way to create comprehensive and fully integrated waste management system that is consistent with the principle of sustainable development. The main elements that can contribute to achieving this objective are described below.

First, the most important factor that will have the biggest influence on the development of sustainable waste management is creation of the comprehensive legislation on waste and packaging waste management. Such legislation should be more strict (penalties for industry and companies, which are not following the policy and targets), impose deadlines for submitting waste reports to the ZIKIT and UMWM and give the power to the local authorities for detailed supervision over the waste streams flow (alternatively other organizations that have knowledge and financial capacity to carefully analyze reported data of the waste flow and to intercept all uncertainties in recovered and recycled numbers reported by private companies - in Ireland this function is performed by Repak and the EPA).

The substantial problem, which is face by both Poland and Ireland, relates to small and medium size companies, corruption (more significant problem in Poland) and lack of on-line database. First of all, maybe any remedial action should take place at the level of the European Commission, but the regulations over the small and medium companies need to be more strict but at the same time reasonable. It seems unacceptable not to not have any control of over 30% of the packaging produced and introduced to the national market (Ireland). To have a full and detailed overview over the existing situation of the packaging and packaging waste, all companies should share financial responsibilities, and it should be strictly regulated. Moreover, such an approach will bring additional funds from product fees, which could be subsequently used for development of infrastructure and educational actions.

Another solution, which could simplify in both countries reporting and gathering information of the recent situation of packaging and packaging waste, is creation of one

comprehensive on-line database, where the all companies provide statistics on packaging waste flow and all institution have an access to the most recent information. The similar system works already in the United Kingdom and is called WasteDataFlow. This system is widely used by local authorities and allow for faster, more regular and the simplified formula for the waste data collection. In addition, introduction of such database will allow to monitor progress in the development of municipal waste management and packaging and simplify the generation of the national statistics on waste. That network should be established by local authorities (as a joint action) or at the governmental level. This also would require proper regulation to implement it into the reporting and monitoring system of waste flow and oblige companies to join the network. After conversation with Ms. Donnellan (2010) and Mr. Medley (2010), I know that companies will be willing to join the network and provide the documentation on–line, instead of preparing three different reports to the EPA, Repak and local authorities (Ireland).

Corruption is also a significant problem especially in case of Poland, where regulations are not comprehensive enough, which leads to delays in reports (sometimes even 3-4 years), lack of permits and licenses for a waste collection (not authorized companies), and of course financial frauds and corresponding uncertainties in data on waste flow. This obviously falsifies the outlook of the current situation of packaging and packaging waste management in Poland. Those elements show clearly, how important is well prepared and comprehensive legislation.

Another proposition is to consider the issue of waste minimization, not only by the educational programs, but also by financial restrictions. The second element after policy, which enforces people to do or not to do something, is clearly economic. The promise of profit or lost can work as a driving force for reduction of packaging material used in manufacturing process and later introduced to the market, by simply putting ‘packaging on diet’ as it was explained in the chapter 5 and 6. Unfortunately, in this regard both countries

failed. On the basis of Irish and Polish experience, one may rationally argue that the conditions of charging a product fee should be changed considerably. The biggest drawback of the current system is calculation of fee solely on basis of weight without differentiating type of packaging material. That leads to the paradox where glass as a material, which is much easier to recycle and process is replace by plastics, which the only advantage is its weight. If the product fee would be counted by taking into the consideration the material type and only afterwards its weigh, this will lead to more environmentally friendly solution.

Further observation, which I had while analyzing packaging waste management situation in Poland in comparison to Ireland is a need for increasing the amount of recovered and recycling materials, by making recycling more attractive and more convenient for people. For example initiative 'door to door' collection is underdeveloped in Poland because of many reasons such as domination of multifamily architecture. One solution would be to modernize chutes in multifamily houses (e.g. the program which would be similar to national thermo-modernization in order to improve energy efficiency), or place the collection banks for recyclables within the building or in the nearest neighbourhood. From my own experience I know, that after couple times of walking couple kilometres, with the heavy bags of glass, pales of newspaper and huge amount of plastic bottles with not receiving anything back, I will rather choose the 'black bin' instead of green one. Another solution could be financial discounts for the separate waste collection as it takes place in Ireland. The example one can think about the following scheme: by calculating every moth a new price for waste collection on the basis of amount of waste collected in the green bin (decrease of the fee) and those in black bin (increase of the price). That would encourage people to collect waste separately, because they will 'feel the differences' in their wallets. However, it is also true that in multifamily houses it could be more difficult as it would require cooperation among all residents.

Another way to reduce the number of waste, which is disposed on the landfill, would be by increasing substantially the charges for waste disposal on landfill. That increase should be much more than couple percentage as it usually happened in Poland – a preferable increase should amount to 300-400% as it is actually planned in Ireland where a fee for landfilling the waste will increase from 20 Euro to 70 Euro per ton of material disposed. That will be the first such an increase on the island. Such a significant change could lead to the great decrease of the waste send to the landfills and searching for other solution as incineration and energy recovery, recycling and recovery or composting. But for the result of this action we need to wait. (Munnelly 2010)

Another significant similarity, between Ireland and Poland can be seen in the development of energy recovery, as an important element in sustainable waste management. What is the best in waste utilization by incineration is possibility to use different kinds of waste, mixed waste, not recyclable waste or contaminated waste, which do not have a market value. In Ireland, the problem of fears of the society and negative public opinions has been solved by offering people who live in the closest area of planned incinerator lifetime free access to electricity and thermal energy derived from energy recovery facility. (Donnellan 2010) This solution was not introduced to the local community adjacent with planned incinerator in Krakow, what bring up the problem of how to convince people to be more favourable to idea of building an incinerator in their vicinity. If, they will not receive anything in exchange, they will become more frustrated and reluctant to investment, even if such an investment is beneficial to the environment. This should not come as a surprise as any harm to environment has only indirect impact on those people, while incinerator located next to their doors has a direct one. It is also important to remember, that incinerator in order to be effective should not be located far away from the large metropolises and urban areas, because the ecological effect will decrease, in the

situation, when waste will need to be transported on the large distances or the incinerator will work half empty. (Duff 2010)

Poland could also learn from Ireland that, what is called rubbish for someone can also become a resource for someone else. As the landfilling is still the cheapest way to utilize the packaging waste in Poland, not many people think about alternative ways of its utilization, which may be also very profitable. (Flak 2010) Moreover, Poles are still not very committed to the idea of recycling and they are rather suspicious. The probable explanation is that they still do not know much about it. Poland as the EU member is required to maintain a certain standard in waste management, so inevitably, the current situation will need to change. It will be rather slow change, but hopefully constant in progress. As of today funds that are transferred to the development of infrastructure or for improvement of knowledge or awareness of the society are not sufficient and should rise dramatically in the future. Another thing, which could be more valuable in development of the more responsible waste management is organizing and running more permanent initiatives rather than one-day festivals, tours or competitions. Similarly, as in case of Ireland and other Western European countries, Poland should get engaged in Green School initiative, which would allow young people and children go in depth of the topics of environmental protection and balanced and responsible waste management. That could bring significant changes in the behaviour of future generations, and more understanding of existing situations. This is particularly important as any program of waste management system should start from the youngest generation, because adults are not likely to undertake changes in their existing habits.

One of the reason for slow development of comprehensive and responsible waste management system in Poland can be caused, next to the policy, economy and awareness of society, also by the lack of experience in that field. The recycling and recovery do not have a long history in Poland, so still there are not so many specialists, which could take the lead in the creation of responsible and more environmental friendly waste utilization. Recently,

subject of sustainable waste management is becoming more popular so there is a chance than in several years, the situation will improve. The fact that Poland is rather new in the market of sustainable packaging waste management, recycling and recovery, can relatively become an advantage (at least for its economy) and with the fact that the sector of waste management and utilization is privatized can attract investors from other countries as for example GreenStar from Ireland, who already started a research of the Polish market. The companies as Sita, Van Asa, Remondis has now small share in the market, but within next few years they will probably become more important players, which will set up the new standards on the market and improve competition.

Summarizing, in my opinion Poland could definitely take a lot from the experiences of Irish waste management system. The important thing is to remember, that next to the similarities, which connects those two countries like culture, history, religion or their early beginnings in the European Union, there are many differences, which will bring difficulties in implementation of some of the initiatives working in Ireland in Poland (e.g. door – to – door selective collection initiative due to domination of multifamily houses in Poland or problems with illegal waste stream flow from neighbouring countries due to geographical conditions - island versus Central European country). On the other hand, in some cases Poland seems to have more advantages than Ireland as for example in a case of efficiency of incinerators and recycling facilities (bigger country, larger waste streams, what will secure constant and full capacity of facility utilization).

Both countries in some extend are similar to each other, but not quite. It is really difficult for me to say that 'Poland can become the second Ireland'. In some situations as regulatory systems, reporting or product fee and education, as it was shown in the previous chapters it can, but in the others like door – to – door collection it would be rather difficult to make it work.

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