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**PLASTIC PACKAGING WASTE SITUATION
IN SLOVENIA DUE TO JOINING
THE EUROPEAN UNION**

Master's Thesis

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ABSTRACT

The subject of this Master's Thesis was to evaluate the success of implementation of the European directive 94/62/EC on Packaging and Packaging Waste and the successfulness on handling packaging and packaging waste in Slovenia. While the packaging waste is an important and growing waste stream in today's world of consumption, the packaging can not be avoided. Because the usage of plastics as a packaging material in Slovenia is increasing the handling of plastic packaging waste was stressed. Slovenia adopted The Rules on Handling Packaging and Packaging Waste at the end of 2000. The Rules reflect the demands of the above mentioned packaging directive. In 2002, Slovenia introduced a producer-responsibility packaging waste management system and in 2004, the country became a full member of the EU.

The indicators of a successful implementation of the packaging directive were the achieved recovery/recycling shares of packaging waste and plastic packaging waste according to the target shares from the packaging directive and from The Rules. The evaluation was done by analyzing the EARS waste database on produced and treated packaging and packaging waste in the 2001-2004 period. With a questionnaire-research the handling on plastic packaging waste in 2002 was analyzed. Gathered results were analyzed with descriptive statistic and the method of correlation for a comparison to the published data and information from the literature.

The results show that none of the recovery target shares of total packaging waste was met in any of the year 2001-2004, but the target recycling shares for plastic packaging waste were generally exceeded. With the annual average of produced packaging waste around 85 kg per capita Slovenia is at the bottom of the European average of around 170 kg per capita. Nevertheless, the quantities of produced and recovered packaging waste are increasing every year. The achieved recovery share of packaging waste in 2001 was 7,8% and 24% in 2004. Both shares are far from the 2001 target share of 50% (and 60% for 2008) from the packaging directive. The achieved recycling share of plastic packaging waste in 2001 was 10,1% and 33,3% in 2004, thus it has already exceeded even the 22,5% target from the packaging directive for the 2008.

The results from the questionnaire on handling of plastic packaging waste in Slovenia showed that handlers mostly collect and sort packaging waste to prepare it for further treating which is usually done by specialized treaters. Pellets of recycled plastic are then bought by Slovenian or foreign companies.

To make the whole process of packaging waste management more efficient, we believe the public should be much better educated about the importance of separate collection of packaging waste and about the environmental impact of the packaging itself.

POVZETEK

Obravnavali smo uspešnost izvajanja evropske direktive 94/62/ES o embalaži in odpadni embalaži v Sloveniji. Odpadna embalaža predstavlja pomemben del odpadkov, saj se embalaži v današnjem svetu potrošništva ne moremo izogniti. Ker uporaba plastike za proizvodnjo embalaže tudi v Sloveniji narašča, smo bili posebno pozorni na ravnanje z odpadno plastično embalažo. Konec leta 2000 je Slovenija sprejela Pravilnik o ravnanju z embalažo in odpadno embalažo, ki vključuje glavne zahteve omenjene embalažne direktive. Leta 2002 je uvedla sistem za ravnanje z odpadno embalažo, ki temelji na odgovornosti povzročitelja. Članica Evropske unije je Slovenija postala leta 2004.

Kazalci uspešnega izvajanja embalažne direktive so doseženi deleži predelave/recikliranja odpadne embalaže in odpadne plastične embalaže glede na ciljne deleže iz embalažne direktive in Pravilnika. Ocena temelji na analizi podatkov o nastali in predelani odpadni embalaži iz zbirke podatkov ARSO o odpadkih za obdobje 2001 do 2004. Način ravnanja z odpadno plastično embalažo v letu 2002 je bil ocenjen z analizo rezultatov, pridobljenih z anketo med zbiralci/predelovalci plastične odpadne embalaže. Primerljivost pridobljenih rezultatov z objavljenimi v literaturi in drugih virih smo dosegli z opisno statistiko in z metodo medsebojne soodvisnosti.

Rezultati kažejo, da v letih 2001 – 2004 deleži celokupne predelave odpadne embalaže niso bili doseženi. Ciljni deleži recikliranja odpadne plastične embalaže pa so bili v povprečju preseženi. S povprečno letno količino 85 kg nastale odpadne embalaže na prebivalca je Slovenija na dnu evropskega povprečja, ki znaša približno 170 kg na prebivalca. Količine nastale in predelane odpadne embalaže iz leta v leto naraščajo. Leta 2001 je bilo predelanih 7,8% odpadne embalaže, leta 2004 pa 24%. Kljub temu 50% ciljni delež predelave za leto 2001 (oz. 60% za 2008) iz embalažne direktive ni bil dosežen. V letu 2001 se je recikliralo 10,1% odpadne plastične embalaže, leta 2004 pa kar 33,3%, kar je več kot ciljni delež za leto 2008 (22,5%) iz embalažne direktive.

Rezultati ankete o ravnanju z odpadno plastično embalažo v Sloveniji so pokazali, da večina zbiralcev/predelovalcev odpadno embalažo zbere in sortira ter jo pripravi za nadaljnjo predelavo. Granulat reciklirane plastike je nato prodan slovenskim ali tujim podjetjem.

Da bi izboljšali ravnanje z odpadno embalažo, je potrebno javnost seznaniti z vplivi embalaže na okolje ter jo spodbujati k ločenemu zbiranju odpadne embalaže.

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ABBREVIATIONS AND ACRONYMS

EARS	Environmental Agency of the Republic of Slovenia
EEA	European Environment Agency
EEC	European Economic Commission
EIONET	European environment information and observation network
EPA	Environment Protection Agency (USA)
ERRA	European Recovery and Recycling Association
EU 15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU 25	all MS of EU since May 2004
EU	European Union
EWC	European Waste Classification
GDP	Gross Domestic Product
MESP	Ministry of Environment and Spatial Planning
MS	Member State
NEAP	National Environmental Action Plan
New MS	Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia
NIMBY	Not in my backyard
OG RS	Official Gazette of the Republic of Slovenia
OJ EC	Official Journal of the European Communities
P&PW	packaging and packaging waste
PPW	plastic packaging waste
PW	packaging waste
6EAP	Sixth Environment Action Programme (EU)
SORS	Statistical Office of the Republic of Slovenia
UNEP	United Nations Environment Programme
The Rules	The Rules on Handling Packaging and Packaging Waste, OG RS 104/00
The Operational Programme	The Operational Programme for the Management of Packaging and Packaging Waste for 2002 – 2007 Period

GLOSSARY

Disposal	waste management in accordance with disposal operations D1-D15 from Annex II.A of the EU waste directive 75/442/EEC* and from Annex 5 of The Rules on Waste Management (OG RS 84/98)
Energy recovery	an R1 process with the aim of generating energy
Handler	a legal person who collects waste and sometimes also treats it (recovers or disposes)
Incineration	a D10 process with the aim of destroying waste
Obligor	a legal person who has an obligation under the law (e.g. reporting of waste quantities, proper handling of packaging waste, ...)
Organic recycling	a form of R3 process, such as composting and/or bio-methanization (land treating and landfilling are excluded)
Recovery	waste management in accordance with recovery operations R1-R13 from Annex II.B of the EU waste directive 75/442/EEC* and from Annex 4 of The Rules on Waste Management (OG RS 84/98) <i>(energy recovery + recycling + R10-R13)</i>
Recycling	recovering waste into products, materials or substances for the original or other purposes (energy recovery is excluded)
Total or Altogether disposal	quantity of all disposed waste, regardless to the process used
Total or Altogether recovery	quantity of all recovered waste, regardless to the process used
Treater	a legal person who recovers or disposes waste

* Source: CONSLEG: 1975L0442 – 20/11/2003

1 INTRODUCTION

Waste represents the loss of both material and energy resources (Jacobsen and Kristoffersen, 2002). The amount of waste generated represents a global problem, especially in the so called developed world. With the growing living standards, the amount of generated waste is growing also. An important part of waste is a packaging waste since it arises from legal and natural persons. The quantities of it are connected also with the living standard of countries' citizens while the share of all packaging waste that originates from human daily activities is not much smaller than the quantities from industry and business.

The aim of this Master's Thesis is the evaluation of the degree of success in handling packaging and packaging waste in Slovenia due to the fact that with the uniting with the EU Slovenia has to implement the EU Packaging and Packaging Waste Directive into its national legislation. The evaluation was made by analyzing the situation on packaging and packaging waste by measuring the quantities of produced and treated packaging waste to determine if Slovenia is achieving the goals set by the EU packaging directive. The additional challenge in investigating the previously mentioned situation was an observation that legal and natural persons have difficulties in understanding the concept of packaging and packaging waste, together with the interpretation of the packaging legislation (Slovenian and European). Special attention was turned to the plastic packaging and packaging waste because the usage of plastic as a packaging material is increasing. Since the Slovenian legislation on handling packaging and packaging waste came into force in 2000, there was limited information on treating just the plastic packaging waste. However, processes of treating packaging waste and problems arising along are similar for all packaging materials, therefore a wider concept of treating packaging waste in Slovenia is presented. Probably plastic is the packaging material of the future as it has many interesting and practical characteristics. A variety of processing and shaping methods for thermoplastics are available to form the desired product, including the possibility of adding colors and reinforcing fillers such as carbon or glass fibers (Internet 1) which is not negligible in today's world of consumption. The negative side of the story is that plastic is an artificial material and as such is an intruder in the environment. Usually the degradation time of plastic is long (a few decades or even centuries), it may include some hazardous substances which pass into the environment by degradation process. The direct consequence for some animals is a misconception with their natural food but this one they cannot digest or swallow so, finally, they don't survive. Consequently, how plastic packaging waste is treated in Slovenia was investigated.

The continuing chapters of the introduction show: the conception of the waste, classification of waste with the main stress on packaging waste and plastic, a short presentation of waste-problematic through the history, how packaging waste is managed the EU and especially in Slovenia, and in the last chapter is presented how can using of plastics contribute to the state of the environment.

1.1 What is Waste?

Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Many items can be considered as waste: household rubbish, waste from manufacturing activities, packaging, old vehicles, old televisions, garden waste, etc. Thus daily anthropogenic activities give rise to a variety of wastes from different sources. Over 1,8 billion tons of waste are generated each year in Europe. With such huge quantities of waste being produced, it is of vital importance that it is managed in such way that it does not cause significant harm to either human health or to the environment (Internet 2).

Packaging and packaging waste can have a number of impacts on the environment. Some of these impacts can be associated with the extraction of raw materials to manufacture the packaging itself, the actual manufacturing processes, the collection of packaging waste and its subsequent treatment or disposal. Additionally, packaging may contain some critical substances (e.g., PVC, heavy metals, methyl-bromide) which may pose a risk to the environment (Ibid).

Because excessive waste generation is a symptom of inefficient production processes, low durability of goods and unsustainable consumption patterns, waste quantities can be considered as an indicator of how efficiently society uses raw materials (Jacobsen and Kristoffersen, 2002). There are a number of different options available for the treatment and management of waste including prevention, minimization, re-use, recycling, energy recovery and disposal. Under EU policy, landfills are seen as the last resort and should only be used when all the other options have been exhausted (Internet 2).

1.2 Classification of Waste and Plastic

1.2.1 Classification of Waste

The most common classification of waste is the one which divides waste into two groups, regarding to its origin. If waste is produced by natural person, it belongs to the group of a **municipal waste**. When waste is generated by legal persons, then it would be classified as a **non-municipal waste**. So, the waste can be found in both groups, dependent on its origin.

The EWC (European Waste Classification) list of waste divides waste into 20 main groups. Each main group is further divided into smaller and more specific groups. Hazardous wastes are marked with a star (*). Therefore, each type of waste has a six-digit code (a classification number) where the first two numbers represent the main group of waste according to EWC.

Table 1 shows the main groups of the EWC list of wastes. The most important sub-group for this master thesis 15 01 – packaging waste, is broken down to all six-digit codes included. The EWC code for plastic packaging waste is 15 01 02.

Packaging and packaging waste can be classified on different criteria. In the 3rd Article of The Rules on Handling Packaging and Packaging Waste (OG RS 104/00) *packaging* is defined or classified according to the use:

- Primary or sales packaging – is the basic unit of an article/product for a final consumer in the market. The article/product cannot exist without it.
- Secondary or grouped packaging – combines a number of basic units of the same or different product on the selling site. It can be sold to a final consumer or it can serve as a skeleton for selling individual basic units. If packaging fulfills both functions – grouping and selling, it is considered to be a primary packaging.
- Tertiary or transport packaging – makes transport and handling of goods easier and protects them between transports. If packaging fulfills both functions – transporting and selling, it is considered to be a primary (sales) packaging.

According to the 3rd Article of The Rules on Handling Packaging and Packaging Waste, *packaging waste* is packaging or packaging material which became a waste as it is defined in The Rules on Waste Management (OG RS 84/98). Packaging waste can originate from municipal or non-municipal activities.

7th Article of The Rules on Handling Packaging and Packaging Waste defines *packaging materials* as follows: paper and cardboard, plastic, wood, metal and glass.

Table 1: The EWC list of waste (Source: CONSLEG: 2000D0532 – 01/01/2002)

Classif. No. of Waste	Type of Waste
01	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
04	Wastes from the leather, fur and textile industries
05	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06	Wastes from inorganic chemical processes
07	Wastes from organic chemical processes
08	Wastes from the manufacture, formulation, supply and use of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks
09	Wastes from the photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14	Waste organic solvents, refrigerants and propellants (except 07 and 08)
15	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
15 01	Packaging (including separately collected municipal packaging waste)
15 01 01	Paper and cardboard packaging
15 01 02	Plastic packaging
15 01 03	Wooden packaging
15 01 04	Metallic packaging
15 01 05	Composite packaging
15 01 06	Mixed packaging
15 01 07	Glass packaging
15 01 09	Textile packaging
15 01 10*	Packaging containing residues of or contaminated by dangerous substances
15 01 11*	Metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers
16	Wastes not otherwise specified in the list
17	Construction and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from human and animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

* hazardous waste









1.2.2 Classification of Plastic

Almost 80% of all plastics produced are thermoplastics, the recyclable plastics, and they account for nearly all of the plastics used in packaging. Within the thermoplastics category are six **types of plastic resins** and the following account for over 85% of the total volume of thermoplastics: polyethylene, polypropylene, polystyrene, polyethylenetherephtalate and polyvinylchloride (Internet 3).

In 1988 a simple coding system was developed by the Society of the Plastics Industry Inc. (USA), to assist in separating these resins for recycling. The appropriate symbol is molded into the rigid plastic or printed on more soft types of plastic (Internet 1).

Table 2 shows the identification symbols of the coding system and describes the main properties of all types of thermoplastics.

Table 2: Types of plastic resins and coding system (Source: Internet 3 and Internet 4)

Code and type of plastic resin	Properties	Products from virgin resin	Products from recycled resin
 PET – polyethylene-terephthalate	Light-weight, stiff, rigid, fracture-proof, aroma-tight, transparent, gas and moisture proof	Soft-drink bottles	Fibers for carpets, stuffing for anoraks and sleeping bags, sports boots and bags, sanitary and medicinal items; foils for packaging, deep-drawing parts for horticulture and agriculture; PET bottles
 HDPE – high-density polyethylene	Harder and stiffer than LDPE, can stand high temperatures, highly resistant against chemicals	All kinds of bottles (juice, water, shampoo, detergents), cans, buckets, beverage boxes	Shampoo, cleansing agents, detergent and fertilizer bottles; plates, tubes, cans, buckets, rubbish containers
 V/PVC – vinyl / polyvinyl chloride	Clarity, puncture resistance, cling; as a film – a little bit breathable	Packaging for fresh meat, fresh vegetable	Playground equipment, film, air-bubble cushioning
 LDPE – low-density polyethylene	Hard, stiff, extremely resistant against chemicals, almost tight against water vapor, odorless, taste-neutral, clarity, flexible; as a film – strong and tough	The most used plastic material for packaging, e.g. for all kind of foils and plastic bags (grocery, garbage), bottles that require flexibility	Plastic bags, bags and foils for construction material and for agriculture, shrink films, buckets, tubes, garbage bags
 PP – polypropylene	Oil and grease resistant, very low permeable for water and oxygen, high tensile strength	For packaging margarine, edible oils, mayonnaise, ketch-up, mustard, salad dressings, savory biscuits, bread, cakes, pastries; screw-caps and lids for PET and HDPE bottles	Flower pots, coat hangers, furniture parts, buckets, troughs
 PS – polystyrene	Clear, hard, colorless	For yogurt and cream pots	Shoe heels, video cassettes, office supplies, components for electric and motorcar industry
 EPS – expanded polystyrene (styropor)	Exceptional insulation properties	For meat trays, egg cartons, coffee cups; packaging material for protection of fragile products and devices	Admixtures to heat insulating plaster and floorings; new packaging materials; light building parts and moldings
 Other (including multi-layer packaging)			Landscape timber, roadside posts, pallets, marine pilings, benches, picnic tables

1.3 History of Waste Treatment and Disposal

The historical development of waste treatment and disposal has been driven by concern for public health. The industrial revolution between 1750 and 1850 led to many people moving from rural areas to the towns and cities, and as a consequence, there was an increase in the concentration of domestic and industrial waste. The waste generated contained a range of materials such as broken glass, rusty metal, food residue and human waste. It was dangerous to human health since it attracted flies, rats and other vermin which are potential carriers of disease. This led to an increasing awareness of the link between public health and the environment. To deal with this potential threat to human health, legislation was introduced on a local and national basis in many countries (Williams, 1998).

One of the main constituents of domestic waste in the late 19th century was ash from coal fires. The waste also contained recyclable materials such as paper, textile, glass, crockery, iron and other metals, and was often sorted by hand by private contractors to remove the useful items (Ibid). In comparison with paper and steel products which have been part of civilization for hundreds of years, plastics have arrived on the scene after Second World War, when the chemical engineering-based technology used in manufacturing plastics become fully established (Rhyner et al., 1995).

Combustible content of the previously mentioned waste was recognized as a potential source of cheap energy for the community as a whole, and the move away from private waste contractors to municipal organized waste collection led to an increase in incineration. However, the main route to disposal was dumping, either legally or illegally. The simplicity of waste disposal to land and centralized waste management through city authorities meant that this option increasingly became the preferred one, particularly as incineration plants were difficult and expensive to maintain. The waste dumps themselves were poorly managed, open types seething with vermin and often on fire. The environmental consequence of only dumping the waste in such open sites was recognized, and increasingly waste began to be buried. Burying the waste had the advantages of reducing odors, discouraging rats and other vermin, and consequently dumps became less dangerous to health. Through the first half of the 20th century some improvements in landfill sites were seen, with improved planning and management. However, this did not apply to all areas, and many municipal dumps still had the minimum of engineering design and the open type was still very common. Following the Second World War, waste treatment and disposal was not seen as a priority environmental issue and little was done to regulate the disposal of waste. However, a series of incidents in the late 1960s and 1970s highlighted waste as a potential major source of environmental pollution. A series of toxic chemical waste dumping incidents led to increasing awareness of the importance of waste management and the need for a more stringent legislative control of waste (Williams, 1998).

The recognition of the need for environmentally acceptable methods of waste disposal led to a revival of incineration. The revival of municipal waste incineration was short-lived as the high operational costs of incineration plant had to compete with the much lower costs of waste disposal via landfill. In addition, legislation to limit the emissions from incinerators also resulted in the closure of many incineration plants (Ibid).

The majority of waste today is still disposed of in landfill sites, but modern sites are better designed, constructed and managed, and many have energy recovery utilization of the derived landfill gas (Ibid). Much more attention goes to the correct construction of the landfill site in a way of its impermeability to prevent the impact of leaking waste water. The incineration of waste with energy recovery via either electricity generation or district heating, has been developed in the 1990s and became an economically viable alternative to landfills. In many cases, the type of waste dictates that incineration is not only the most economic option, but also the best practicable environmental option (Ibid).

In summary, waste management is a highest priority item in the list of environmental concerns. Placed alongside this concern is a general public acceptance that waste requires effective treatment and disposal in a responsible and environmentally acceptable manner (Ibid). However, in Slovenia a strong negative public opinion is seen when talking about location and construction of waste treatment and disposal facilities. The presence of the well known NIMBY (*not in my backyard*) syndrome is obvious but it would be at least minimized if not totally avoided if the public would be properly and constantly educated about environmental friendly waste management, without the influence of a politics.

1.4 Packaging Waste Management in Slovenia Prior Joining the EU

In 1997 Slovenia ratified the European agreement to join the EU, and the next year the Environmental Strategy for joining the EU was accepted as a part of The National Environmental Action Programme (NEAP) to adopt the EU regulations until the end of 2002. The NEAP completely defines legislative, institutional and administrative changes necessary for joining the EU and it also considers the strategic documents and legislation about protecting the environment (Internet 5).

The transposition of the EU legislation into national legislation required dynamic changes in the way waste was managed. It has become clear that the resources, commitment and expertise needed to develop the infrastructure to support the different strategies, requires involvement from local and national decision-makers, regulators, waste producers and professionals within the waste management section. This more open approach to policy development may be criticized for its time consuming nature. However, experience from EU members has shown that it is the most effective way of progressing and ensuring realistic and feasible approaches to waste management (Wastes Management, 2001).

In December 1998 The Rules on Waste Management (OG RS 84/98) were published in which the classification list of waste and hazardous waste is defined together with rules for handling, collecting, transporting, recycling and discarding of waste. With the corrigendum made in March 2001 (OG RS 20/01), the Slovenian Classification list of Waste is in accordance with the EWC List of Waste of the EU (CONSLEG: 2000D0532 – 01/01/2002).

With The Rules on Handling Packaging and Packaging Waste (OG RS 104/00), which came into force in December 2000, Slovenia started to regulate the field of managing packaging and packaging waste. The Rules is in accord with the aims and primary target demands of the EU packaging directive 94/62/EC and defines the rules on handling packaging in manufacturing, business and consumption. It is also defining procedures for collecting, re-using, recovering and disposing of packaging waste. For municipal packaging waste, additional demands are established in The Order on the Management of Separately Collected Fractions in the Public Service of Urban Waste Management (OG RS 21/01), which came into force in April 2001. With The Operational Programme for the Management of Packaging and Packaging Waste for 2002-2007 Period (OG RS 29/02), a skeleton dynamic for achieving the targets of The Rules for recycling and recovery of packaging waste was defined.

To describe a fledgling situation in Slovenia before the implementation of the European packaging directive, abstract of some data from The Operational Programme for the Management of Packaging and Packaging Waste for 2002-2007 Period (OG RS 29/02) is shown in further text.

Data from 1998 shows approximately 170.000 tons of packaging waste is produced in Slovenia each year. Approximately 100.000 tons (60%) of that is municipal packaging waste and approximately 70.000 tons (40%) is non-municipal packaging waste. Of all packaging waste, paper represents 44%, plastic 15%, glass 14%, wood 14%, metals 7% and the remaining 6% are other materials (Table 3).

Table 3: Quantity of packaging waste in Slovenia, 1998 (Source: The Operational Programme..., OG RS 29/02)

Material	Municipal packaging waste		Non-municipal packaging waste		Packaging waste – TOTAL	
	tons	%	tons	%	tons	%
Glass	19.025	19	4.784	7	23.809	14
Plastic	18.622	18	6.661	10	25.283	15
Paper	41.933	42	31.683	47	73.616	44
Cardboard – beverage	5.908	6	0	0	5.908	4
Composite materials	1.723	2	1.983	3	3.706	2
Metal	9.009	9	3.421	5	12.430	7
Wood	4.414	4	19.423	29	23.837	14
Other	121	0	97	0	218	0
TOTAL	100.755	100	68.052	100	168.807	100

Municipal packaging waste was, to a limited extent, collected separately in so-called “eco-islands”. In spite of that, packaging waste was still a big part of wastes disposed of in municipal landfills of non-hazardous wastes.

Some materials (wood, metal and paper) of non-municipal packaging waste were already collected separately by manufacturing enterprises. Plastic materials, which are a common material in packaging waste, were collected only by approximately half of the enterprises.

Table 4 presents the situation on quantities and shares of recovered packaging waste in 1998. Evaluated total recycle/recovery rate of packaging waste in Slovenia in 1998 was 29%.

Table 4: Quantity and share of recycled/recovered packaging waste, 1998 (Source: The Operational Programme..., OG RS 29/02)

Material	Total quantity of packaging waste (tons/year)	Quantity of recycled/recovered packaging waste (tons/year)	Share of recycling/recovering (%)
Paper	73.616	31.690	43
Glass	23.809	8.550	36
Plastic	25.283	1.320	5
Metal	12.430	2.020	16
Wood	23.837	2.385	10
TOTAL	158.975	45.965	29

With The Operational Programme (OG RS 29/02) following findings were found to be problematic for reaching recycle/recovery targets laid down in The Rules on Handling Packaging and Packaging Waste (OG RS 104/00):

- Collection of separate fraction of municipal waste (packaging waste included) and recovery of packaging waste is on a relative low level.
- Existing local public waste services are technically and organizationally weak and usually don't have enough financial resources for new investments.
- Devices for sorting, recycling and recovering are rare; incineration plants for municipal waste do not exist.
- Citizens are not well enough acquainted with separate collection of municipal waste (packaging waste represents a big share of it); there is no special motivation except personal ecological awareness.
- Sources of municipal packaging waste are very dispersed.
- There is no suitable informational system.

The shift in emphasis from the environmental impact of waste towards more social issues, specifically health effects, has increased interest from the general public. Implications of this are significant in terms of public perceptions and attitudes towards waste management, particularly with regard to the additional pressure this places on the planning system in terms of developing sufficient waste management facilities to achieve the targets and requirements of national and EU waste management strategies. This has placed greater emphasis on the need for improved communication between the public and private sector, regulators, and waste generators (Wastes Management, 2001).

In 2001 Slovenia ratified an agreement for cooperation with the European Environment Agency (EEA). Being a member of the EEA includes information exchange on the European level, a uniformed informational system for reporting, usage of tools and methodologies developed by the EEA, cooperation of Slovenian institutes in international projects and the possibility of comparison with other members – countries of the EU (Internet 5).

Slovenia became a full member of the European Union on May 1st 2004.

1.5 Generally about Plastics

The majority of plastics is produced by making chains of compounds derived from petroleum (Internet 1). Basic hydrocarbons such as ethane or methane are the building blocks. From them, simple hydrocarbon-compounds called monomers are formed, which are then linked together through polymerization to form long chains of repeating molecules with a high molecular weight, called polymers. There are many different polymers used to manufacture

plastics products. Each polymer has specific properties that enable it to meet packaging or other product requirements (Rhyner et al., 1995).

As mentioned above, different plastics have different polymer chain structures, which determine many of their physical characteristics. They are divided into two main groups (Internet 1):

- *Thermoplastics* represent the majority of the plastics market and can be recycled by being remelted and remolded many times into a new product. They are divided into commodity and engineering categories. Commodity thermoplastics are low cost and high volume plastics for a wide usage. Engineering thermoplastics are produced for specialty markets such as the electronics and transportation industries at a high cost and low volume (Rhyner et al., 1995).
- *Thermosets* have a long life expectancy and cannot be remolded into other products. If they are heated more than once, they decompose. However, opportunities for recycling thermosets are available and the recycled material can be used as carpet underlay, fiberfill, and as a blasting medium for paint removal (Ibid).

1.5.1 Using Plastics – Energy Efficiency and Waste Reduction

Plastics can help to save energy because it often takes less energy to convert plastics from a raw material into a finished product than comparable products. For instance: plastic bags require about one-third less energy to make than paper bags, foam polystyrene containers take 30% less total energy to make than paperboard containers. If plastic packaging would be replaced with alternatives such as glass, paper or metal, the energy used to produce packaging would double (Internet 3).

Plastics contribute to waste reduction indirectly by their properties – they are strong but lightweight, meaning it often requires less plastic to make a certain package compared to other possible materials. As an example: plastic grocery bags are lighter and create up to 80 percent less weight by volume than paper sacks. Also, the normal economic market forces cause manufactures to continually look for ways to reduce the cost of their packages by minimizing the amount of material used. Along with weight and size reductions, plastics can contribute to waste reduction in other ways. Their physical properties allow them to be used in multiple applications, while their durability and flexibility allow them to be used again and again (Ibid).

1.5.2 Plastics Recovering

Recovery in general is a process of obtaining materials or energy resources from solid waste. Recovered plastics can be recycled into new products or used as a fuel in industrial plants in a process of incineration, together with coal and other fuels or alternative fuels from wastes (Internet 3).

The driving force for the recovery and recycling of plastics is to save additional resources. As plastics are derived mainly from fossil fuel resources, which means that putting them in a landfill could be considered similar as dumping oil in the ground and should therefore be avoided where possible by maximizing recovery. Unlike glass or steel, which can only be recycled, plastics have the additional option of being recovered as energy as well as by material recycling (Internet 1).

1.5.2.1 RECYCLING

Successful recovery of plastics by recycling requires an infrastructure that can get plastics from the consumer and back into use as a new product (Internet 3).

Steps of the recycling circle are shown in Figure 1.

The plastics recycling infrastructure has four parts (Internet 1):

1. *Collection* – Rather than being thrown away, plastics are collected for recycling.
2. *Handling* – Plastics from collection programs are sorted to increase their value and compacted to reduce shipping costs.
3. *Recycling processes* – Sorted plastics go through a recycling process, whether through a classical or advanced technique.
4. *End-use* – Recycled plastic pellets or flakes are used to manufacture new products.

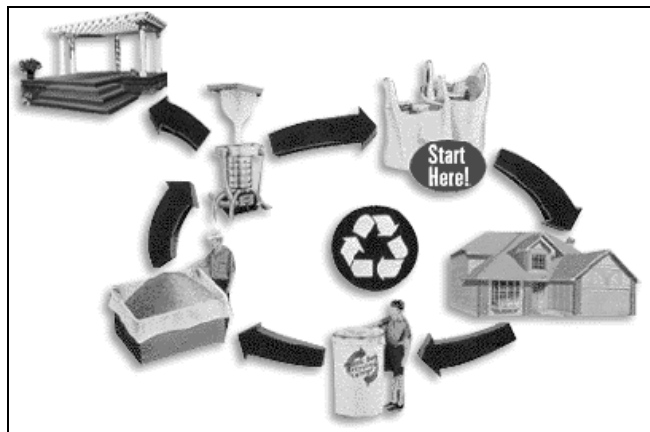


Figure 1: A type of recycling circle (Source: Internet 6)

A very important step in recycling plastics is sorting or splitting because of the different types of plastics with different and unique properties. Each of the six common packaging plastics has performance characteristics that make it best suited for specific applications. Purchasers of recycled resins want to be sure that these properties are retained, so handlers sort plastics by resin type to attain the highest market value (Ibid).

RECYCLING TECHNOLOGIES

After separation of the plastic types into individual or at least compatible fractions, they can be recycled either mechanically (classical technology; see Figure 2) or by a chemical process (also called feedstock recycling; advanced technology) (Internet 1).

Classical Recycling Technologies –

Plastic is shredded or crumbed to a flake form, and contaminants such as paper labels are removed using cyclone separators. The flake is then washed (this stage may also be used to separate different plastics on the basis of density), dried and extruded as pellets for sale to the plastic market (Ibid).

When waste streams of plastic are homogenous, relatively clean and readily available, mechanical recycling can save both material and energy and be economically attractive (e.g. plastic bottles, industrial and commercial packaging films/foils) (Ibid).

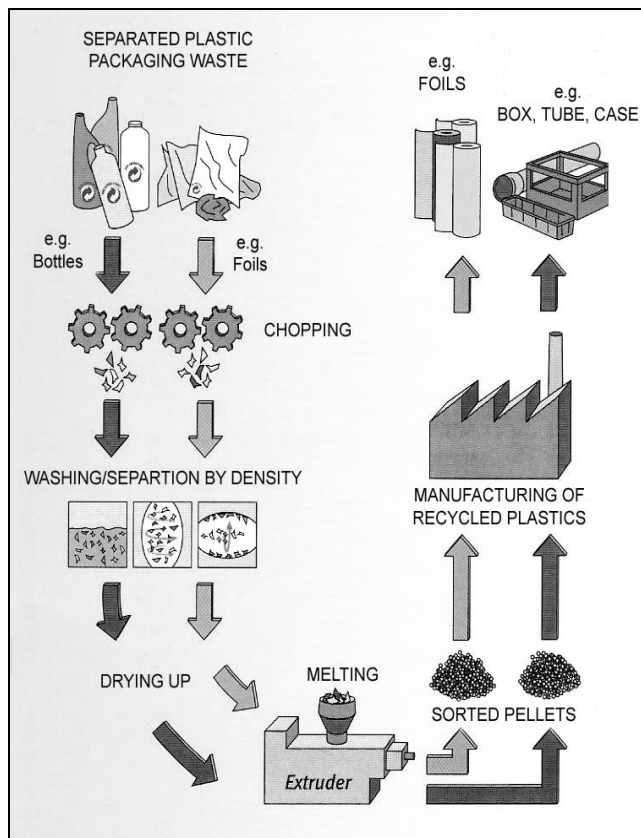


Figure 2: Classical recycling technology (Source: Verpackungsrecycling, 2000)

Advanced Recycling Technologies – This involves more complex processes whereby the plastic polymer is broken down into its chemical constituents, which can then be used as raw material to make various new products (Ibid). Those processes include pyrolysis, hydrolysis, methanolysis and glycolysis (Rhyner et al., 1995), and they yield a variety of versatile end products which are the building blocks of plastics. By unlinking or unzipping the plastic polymers to their original molecular components, recyclers can produce monomers or a petroleum product that can be made into monomers or into a number of other petroleum-based products. The products are identical to virgin feedstocks and monomers used to produce new plastics (Internet 3).

Examples of feedstock recycling are (Internet 1):

- PET, whereby the resultant product is indistinguishable from the virgin plastics material; and
- mixed packaging plastics, whereby the resultant products are fed back into the petrochemical complex to make chemical products, including new plastic raw materials.

1.5.2.2 ENERGY RECOVERY

Unlike many traditional materials, such as steel and glass, plastics are “organic” in that their chemical structure consists mainly of carbon and hydrogen. This means they have a high calorific value, so plastics may also be recovered and used as an alternative source of energy (Internet 1).

The most common way to recover energy from waste plastics is incineration. This process is usually going on in industrial incinerators where plastic waste is used as an alternative fuel. Another option is a modern municipal incinerator, especially when the thermal efficiencies are high by using the produced energy for district heating in addition to electricity production (Ibid). In both cases plastics are recovered by R1 process from Annex II.B of the EU waste directive 75/442/EEC (CONSLEG: 1975L0442 – 20/11/2003).

Alternatively, well-specified solid, liquid or gaseous fuels can be made from combustible fraction of non-hazardous waste (e.g. plastics, wood, paper) to substitute traditional fuels in power stations or manufacturing plants. The cement industry has made the most use of this option to date, but the use of such alternative fuels is expected to increase strongly (Ibid).

1.5.2.3 OTHER RECOVERY OPTIONS

Continuing innovation in the plastics industry means that new plastics are being developed, including some which meet the criteria for biodegradability. As such, composting becomes a possible recovery technique for such plastics, provided they degrade under the same conditions as the normal compost (Internet 1).

1.5.3 Plastics Manufacturing

In their basic form, plastics are usually produced as solid granules or powders, but they can also exist as liquids or solutions. The application of heat and pressure to these raw materials in special processing equipment produces the final plastic product, ranging from solid molded articles such as car bumper to the thinnest of films (Internet 1).

There are three main types of manufacturing processes used to produce the most common types of nondurable and durable plastics: extrusion, blow molding and injection molding. Most of these processes begin with the plastic resins as pellets, granules, flakes or powder, which are then generally subjected to heat and pressure and melted before processing (Rhyner et al., 1995).



Figure 3: Pellets and granules of recycled plastics (Source: Verpackungsrecycling, 2000)

Recycled plastics (Figure 3) can replace or supplement virgin plastic resins in any of the three mentioned processes. Usually plastics must be separated by resin, by production method and in many cases it is also required that they are color-sorted with little contamination. The reason for this is that the various resins have different physical characteristics and different melting points. Color separation is often important to maintaining the color of the final product (mixing all of the colors gives a black resin with less commercial applications) (Ibid).

2 RESEARCH METHODOLOGIES

The research work has first included a literature study to develop a better understanding of the current issue with the EU Packaging and Packaging Waste Directive and its transposition into Slovenian's national regulations. Identification of the situation was carried out through desktop research, along with telephone and "on paper" (questionnaire) interviews. We also completed personal interviews with some individuals with a permit from EARS who collect and treat a separately collected fraction of waste, and with key individuals in the field of packaging and packaging waste from governmental (EARS/MSPE) and non-governmental organizations.

Talking with people was an effective way to gather information not only during the initial stages of the research but through the entire thesis preparation process. These discussions produced information that was not publicly available, or that was too new to be found in the literature. Although this kind of information was often very valuable, it was evaluated carefully because it was usually highly subjective and therefore might not be representative of the population.

Gathered results from databases and published studies along with the data collected through the questionnaire were analyzed with following statistical methods and procedures:

- Descriptive statistic (editing, counting, grouping and sorting the information, calculating frequencies and rates of individual answers).
- Correlation.

2.1 Analysis of Literature and Sources

2.1.1 Review of the Most Important Literature and Sources

The analysis of different sources was done about waste and waste treatment in general, packaging and packaging waste management, using plastic as a packaging material, ... with the aim to get the picture of the packaging waste situation in the EU and Slovenia:

- *Waste Management and Resource Recovery* by Rhyner C.R. et al (1995) describes the history of waste management, methods of determining quantity and composition of waste, how waste could be reduced and recycled. It describes also a collection of recyclable waste, recycling of plastics and markets for recyclables, environmental impacts of recycling, and costs and management of waste facilities and systems.
- *Waste Treatment and Disposal* by Williams P.T. (1998) represents definitions of waste, waste collection systems, waste reduction, re-use and recycling and describes economics of waste management.
- *Introduction to research methods and statistics in psychology* by Coolican H. (1996) describes the types of questions used in questionnaires and surveys when designing non-experimental research and how data (quantitative or/and qualitative) should be analyzed.
- *Effectiveness of packaging waste management systems in selected countries: an EEA pilot study (EEA Report No. 3/2005, 2005)* where Austria, Italy, Denmark, Ireland and the United Kingdom were selected to do an evaluation on their packaging waste management system since it was 10 years of the implementation of the EU packaging directive. For every of the country a packaging waste management scheme is described together with the quantities of produced and recovered/recycled packaging waste and is the country successfully meeting the demands from the packaging directive or not.
- *Analiza ravnanja z embalažo in odpadno embalažo v luči izvajanja zahtev iz operativnega programa s poudarkom na pripravo na obdobje od 2008 do 2012 – Poročilo* by Pušenjak T. et al. (2004) analyzes the situation on handling packaging waste in Slovenia from 2001-2003 for all packaging waste and by packaging materials; estimates the recovered quantities for 2003 and evaluates the quantities of packaging waste that should be recovered/recycled in order to fulfill target-shares from The Operational Programme.
- *Case studies on waste minimization practices in Europe* by Jacobsen H. and Kristoffersen M. (2002) represents waste minimization in EEA member countries by giving examples of successful waste minimization, recycling and cleaner technology. It describes current

situation in Europe on waste management and what was done to minimize the production of waste.

- *Internet 1: Plastics Manufacturing and Recycling (03.06.2005)* and *Internet 3: Plastics Resources (11.04.2003)* are describing the production of plastics, recycling of plastics together with other recovery processes, markets for recycled plastics; contribution of plastics to resource conservation and waste reduction, types of plastics and how can they be used as packaging.

2.1.2 Legislation of Slovenia and EU

The analysis of EU and Slovenian waste legislation was done, with emphasis on the topic of packaging and packaging waste. Following documents were the most important for this thesis:

- *The Rules on Handling Packaging and Packaging Waste (OG RS 104/00)* – the basic document on handling packaging and packaging waste in Slovenia; it includes definitions of packaging, manners of handling packaging waste, shares of recycled/recovered packaging waste that has to be achieved, the obligors for annual reporting to EARS etc.;
- *The Operational Programme For The Management Of Packaging And Packaging Waste For 2002 – 2007 Period (OG RS 29/02)* – it was adopted with the aim of setting step-by-step plan for achieving the shares of recycled/recovered packaging waste, defined with the EU Packaging and Packaging Waste Directive; the whole program is based on the situation in Slovenia in 1998 (quantities of packaging and packaging waste, existing system of handling packaging waste etc.);
- *The EU Packaging and Packaging Waste Directive (94/62/EC, OJ EC L365/10)* – the basic document on handling packaging and packaging waste in the EU was laid down in December 1994, it covers all packaging placed on the EU market and all packaging waste, regardless to its origin; it aims to decrease the quantity of packaging waste produced by setting the target shares for recovery/recycling packaging waste (total and by packaging materials), it also defines a time limit for Member States to fulfill its requirements;
- *The amendment Directives 2004/12/EC (OJ EC L47/26) and 2005/20/EC (OJ EC L70/17) on the packaging directive 94/62/EC* – the first amendment sets the new targets for recycling/recovery packaging waste and the time limit to achieve them, the second amendment sets a later deadline for the 10 new Member States.

2.2 Analysis of EARS Waste Database

Since 1998, when The Rules on Waste Management came into force, the treaters of waste with a permit from EARS are obligated to report on quantities and on handling methods for treated waste per year. Since The Rules on Handling Packaging and Packaging Waste came into force the obligors annually report to EARS on quantities and on handling methods for their packaging and packaging waste. Trade company for handling packaging waste is also obliged to annually report on quantities of handled packaging waste that was collected (and given away to treaters) from its members. The first reporting on packaging and packaging waste from legal persons was done in 2002 for quantities of the year 2001. First reporting of the trade companies for handling packaging waste was done in 2005 for quantities of collected and treated packaging waste in 2004.

Blank forms for mentioned annual reports are accessible at the EARS web-page <http://www.arso.gov.si/podroc~ja/odpadki/obrazci>.

2.2.1 Gathering and Arranging Data for 2001-2003 Period on Packaging and Packaging Waste from EARS Waste Database

Data from Annual Reports on Handling Packaging and Packaging Waste and from Annual Reports on Treating Waste for the above mentioned period were collected and analyzed. Following data are available from the annual reports:

- *Annual Reports on Handling Packaging and Packaging Waste* – the obligors report on annual quantities of packaging placed on the Slovenian market in previous calendar year. Quantities of imported, exported, produced and placed on the market packaging regarding to the packaging material are reported as are the quantities of packaging waste by packaging material. They also have to declare are they members of the trade company for handling packaging waste or are they self-compliers.
- *Annual Reports on Treating Waste* – the treaters with a permit from EARS for recovery/recycle or/and dispose of waste are obliged to annually report on the quantities of waste treated in previous calendar year. The quantities and origins of gathered waste are reported by EWC numbers. The amounts stored from previous year, if any, and amounts stored again, are reported also. The report includes quantity of recovered waste, separately for quantities of waste that were energetically recovered, composted and recovered in other way; as well as the quantities of disposed waste, separately for incinerated, landfill, permanently stored quantities and other methods of disposal. Search for quantities of packaging waste was done according to the EWC numbers for packaging waste (see Table 1).

2.2.2 Analyzing the Raw-Data from EARS Waste Database on Packaging and Packaging Waste for 2004

The raw-data from the Annual Reports on Handling Packaging and Packaging Waste and from the Annual Reports on Treating Waste that were not yet processed by EARS were analyzed. The aim was to gather the same data as mentioned above in Chapter 2.2.1 which was accomplished by using statistical methods and procedures. Thus, the data on produced and treated packaging waste in 2004 were obtained.

2.3 Analysis of Handling Plastic Packaging Waste in Slovenia in 2002

The basic question of this research was to analyze how plastic packaging waste is handled (collected and treated) in Slovenia. A decision was made to design a questionnaire for handlers with the aim of gathering information on quantities and types of handled plastic packaging waste, methods of handling, about area of Slovenia they cover etc. To summarize, plastic packaging waste flow was of interest.

As stated in the “wikipedia” (Internet 7), the statistical surveys are used to collect quantitative or/and qualitative information by asking questions that should be administered to individuals. When the questions are administered by a researcher, the survey is called a structured interview or a researcher administered survey. But, when the questions are administered by the respondent, the survey is referred to as a questionnaire or a self-administered survey. Therefore, a questionnaire can be used to gather structured information from people. When used analytically, the data can also be used to test a hypotheses so it is very important to try to obtain as representative sample as possible (Coolican, 1996). At the time the research was done (2003) 70 handlers who had a valid permit of EARS for collecting/treating waste with the EWC number 15 01 02 for plastic packaging waste were found in the data base of the Chamber of Commerce and Industry of Slovenia.

The designed questionnaire consists of 14 questions. 11 of them are fixed-choice and 3 are open-ended, thus it is a highly structured questionnaire with fixed alternative responses and also open-ended with respondents able to express themselves more freely (Malim and Birch, 1997). With the fixed-choice questions possible answers were already given and a respondent (interviewed person) has to choose between them without having the option of giving his/her own opinion. The strength of that kind of question is that the numerical comparison of fixed-choice items is relatively easy (Coolican, 1994). The open-ended questions have produced more “qualitative” data so their value is in the richness given and that there is less chance of ambiguity. However, the information from each individual is harder to compare with other people’s answers, so the weakness of such questions is difficulty of coding or quantifying (Ibid). Detailed construction of the questionnaire is shown in Annex.

As mentioned above, the survey had to be administered to the chosen handlers. We decided to use a classical postal method since it does not consume a lot of time, is relatively cheap and

probably produces more honest answers since personal interaction is avoided (Internet 7). However, non-return is likely to be high so instructions had to be exceptionally clear (Coolican, 1996). According to the literature (Internet 7) we expected a response rate of 5%-30%. The questionnaire was sent to the all 70 found handlers together with an explanation letter and an envelope for sending back the answers.

Through whole process of designing and analyzing the questionnaires, it was important to remember that the research was a multi-stage process beginning with the definition of the aspects to be examined, designing the questionnaire, applying it to respondents, gathering data from them and ending with the interpretation of the results. Every step was designed very carefully because the final results are only as good as the weakest link in the survey process (Internet 8).

3 PACKAGING AND PACKAGING WASTE SITUATION IN THE EUROPEAN UNION

The European Union is developing thematic strategies on waste prevention and recycling and on the sustainable use and management of natural resources. It is an objective of the 6EAP to achieve a significant reduction in the volumes of waste generated, and prevention has been given top priority in the waste hierarchy (EEA Report 3/2005, 2005). The priorities in waste treatment are shown in Figure 4 where preference is given firstly to waste prevention or at least minimization, then to recycling, then to energy recovery and finally to disposal (Jacobsen and Kristoffersen, 2002). These priorities are applicable to all waste streams and to all kinds of waste.

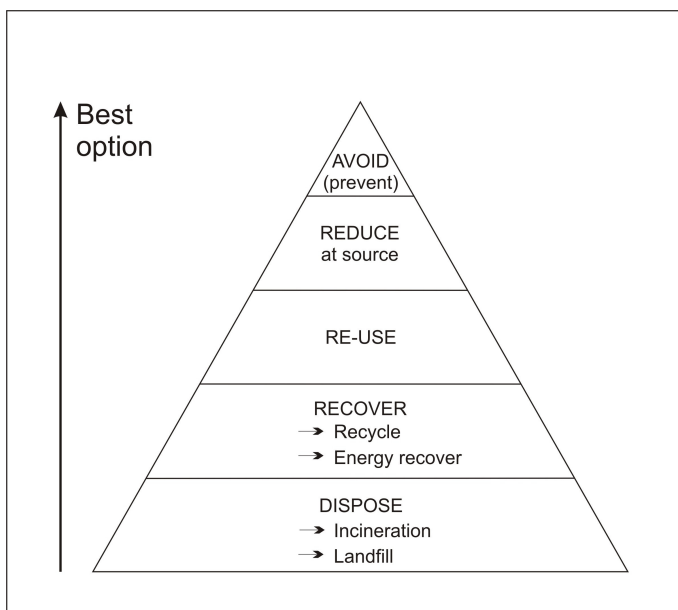


Figure 4: EU waste treatment hierarchy (Source: prepared by author)

In spite of the common awareness of the unsustainable pattern in the current waste generation, it is very difficult to initiate effective initiatives to slow down the generation of waste. On the contrary, waste quantities are steadily increasing in Europe (Ibid) where over 1,8 billion tons of waste are generated each year (Internet 2).

Waste prevention should have the highest priority in waste strategies, as it is the only way to stop the growth in the amount of waste and reduce the loss of resources. Simultaneously with the work on prevention, considerable efforts have to be placed on initiatives improving the treatment of the waste currently generated, especially initiatives focusing on encouraging recycling and the reduction of hazardous substances in waste (Jacobsen and Kristoffersen, 2002).

The Directive 94/62/EC on Packaging and Packaging Waste is one of the few environmentally-related directives to contain directly measurable, quantitative targets with an overall objective to reduce waste generation (EEA Report 3/2005, 2005). Packaging waste today accounts for about 20% of the weight and 40% of the volume of European municipal waste. According to the mentioned packaging directive one of the priority instruments which should be used in order to prevent the generation of packaging waste is the reuse of packaging (Internet 9).

3.1 The Directive 94/62/EC on Packaging and Packaging Waste (OJ EC L365/10)

Because Member States of the EU have different national measures concerning the management of packaging and packaging waste, the European Parliament and the Council of the European Union laid down the Directive 94/62/EC on Packaging and Packaging Waste in December 1994. The Directive covers all packaging placed on the market in the Community and all packaging waste, whether it is used or released at industrial, commercial, office, shop, service, household or any other level, regardless of the material used. It aims to harmonize national measures of Member States in order to prevent any impact on the environment of all Member States as well as of third world countries. In addition, it aims to reduce such impact, thus providing a high level of environmental protection. On the other hand, it aims to ensure the functioning of the internal market by avoiding obstacles to trade as well as distortion and

restriction of competition within the Community. Member States have enacted the laws, regulations and administrative provisions necessary to comply with this Directive before 30 June 1996.

In line with the Community strategy for waste management (Directive 75/442/EEC on Waste (CONSLEG: 1975L0442 – 20/11/2003)), the management of packaging and packaging waste should include the prevention of packaging waste and also promote the reuse of packaging as well as recycling and other forms of recovering packaging waste which would result in a reduction in the final disposal of such waste. Until scientific and technological progress is made with regard to recovery processes, reuse and recycling should be considered preferable in terms of environmental impact. Life-cycle assessments for all kind of packaging and packaging waste should be completed to justify a clear hierarchy between reusable, recyclable and recoverable packaging. From an environmental point of view, recycling should be regarded as an important part of recovery with a particular view to reducing the consumption of energy and primary raw materials and the final disposal of waste. If a high level of recycling is to be attained it is essential for packaging waste to be sorted at the source. In order to minimize the impact of packaging and packaging waste on the environment and to avoid barriers to trade and distortion of competition, it is necessary to define the essential requirements governing the composition and the reusable and recoverable nature of packaging. It is essential that all those involved in the production, use, import and distribution of packaging and packaged products become aware of the extent to which packaging becomes waste, and that in accordance with the “polluter-pays principle” they accept responsibility for such waste. Consumers play a key role in the management of packaging and packaging waste so they have to be adequately informed in order to adapt their behavior and attitudes.

As laid down in the Directive, packaging are all products made of any materials of any nature that are used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user. “Non-returnable” items used for the same purposes are also packaging. The division into primary or sales packaging, secondary or grouped packaging and tertiary or transport packaging has been made. Packaging waste is defined as any packaging or packaging material covered by the definition of waste in the Directive 75/442/EEC, excluding production residues. Packaging waste management is also defined in the Directive 75/442/EEC.

In order to comply with the objectives of the packaging directive 94/62/EC, Member States shall attain the following targets no later than five years from the date by which this directive must be implemented in national law:

- between 50% and 65% by weight of the packaging waste should be recovered,
- between 25% and 45% by weight of the totality of packaging materials (contained in packaging waste) should be recycled with a minimum of 15% by weight for each packaging material.

Packaging materials are defined in Annex I and III of the Directive and they are: paper and cardboard, glass, plastic, metal, wood and textile.

Some Member States (Greece, Ireland, Portugal) were allowed to adopt lower targets of recycling/recovering because of the specific circumstances in those countries, on condition that they achieve a minimum target for recovery within the standard deadline, and the standard targets by a later deadline.

No later than six months before the end of the first five-year phase mentioned above, the Council shall fix targets for the second five-year phase and this process shall be repeated every five years thereafter.

Member States shall ensure the systems for:

- return and/or collection of used packaging and/or packaging waste from the consumers, other final users, or from the waste stream in order to channel it to the waste management alternatives,
- reuse or recovery including recycling of the packaging and/or packaging waste collected.

Member States shall take the necessary measures to ensure that databases on packaging and packaging waste are established to enable Member States and the Commission to monitor the

implementation of the objectives set out in the packaging directive. The database should provide information on the magnitude, characteristics and evolution of the packaging and packaging waste flows of individual Member State. In order to harmonize the characteristics and presentation of the data produced and to make the data of the Member States compatible, Member States shall provide the data in formats adopted by the Commission. The data obtained shall be available with the national reports and updated in subsequent reports. Member States are obliged to report to the Commission on the application of this Directive and the first report shall cover the period 1995 to 1997.

3.2 The most important Amendments on the Directive 94/62/EC on Packaging and Packaging Waste

As mentioned before, the packaging directive calls for a revision of the recovery and recycling targets every five years (Koca and Nilsson-Djerf, 2000). The adoption of new packaging, recycling, and recovery targets for the second five-year period of its application (2001-2006) is required. The Commission intends to clarify the scope of application of the packaging directive, especially the definition of packaging since it has proven difficult to interpret. The main focus of the Commission is the revision of the targets along with some fine-tuning. Recovery/recycle targets shall be increased in order to reduce the impact of packaging on the environment. However, a more fundamental review of the Directive is envisaged for the post-2006 period (EFPA: Revision of 94/62/EC, 2000).

The first revision of the Directive was laid down in December 2001. New targets were set for recovery and recycling of packaging waste. In preparing the revision the Commission carried out a detailed analysis of the cost and benefits of potential targets. This analytical work has led to a delay compared to timetable set out in Article 6.3 (b) of the Directive. The expected completion date for the revised targets of 30 June 2006 still seems achievable but it has become urgent to adopt new targets to give Member States the time needed to establish national legislation and to allow industry enough planning to set up the necessary infrastructure (Proposal 2001/0291 (COD)).

Directive 2004/12/EC (OJ EC L47/26) amends the Directive 94/62/EC by establishing criteria clarifying the definition of the term “packaging”. Clear examples are given in Annex I, which replaces Annex I to Directive 94/62/EC. It also establishes new targets for recovery and recycling packaging waste (Internet 10). According to the Directive 2004/12/EC Member States shall attain the following targets no later than 31 December 2008:

- 60% as a minimum by weight will be recovered,
- between 55% as a minimum and 80% as a maximum by weight will be recycled,
- minimum recycling targets for materials contained in packaging waste to be attained are:
 - 60% by weight for glass,
 - 60% by weight for paper and cardboard,
 - 50% by weight for metals,
 - 22,5% by weight for plastics (counting only the material that is recycled back into plastics),
 - 15% by weight for wood.

This directive also lays down that no later than 31 December 2007, the European Parliament and the Council, acting on a proposal from the Commission, will determine the targets for 2009-2014 (Ibid).

Directive 2005/20/EC (OJ EC L70/17) also amends the Directive 94/62/EC by setting a later deadline for the 10 new Member States (Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia) to meet the targets of the revised Packaging Directive (Ibid). The extensions are generally until 31 December 2012 and until 31 December 2015 at the latest. According to the Directive 2005/20/EC Member States shall enforce the laws, regulations and administrative provisions to comply with the packaging directive by 9 September 2006.

There are **six additional acts**, Commission Decisions, connected and related to the Packaging Directive 94/62/EC, published in Official Journal of the European Union from 1997 to 2005 (Ibid): 97/129/EC (identification system for packaging materials), 97/662/EC (questionnaires for MS reports on the implementation of certain directives in the waste sector), 1999/177/EC (derogation for plastic crates and plastic pellets in relation to the heavy metal concentration levels), 2001/171/EC (derogation for glass packaging in relation to the heavy metal concentration levels), 2001/524/EC (publication of references for standards EN 13428:2000, EN 13429:2000, EN 13430:2000, EN 13431:2000 and EN 13432:2000) and 2005/270/EC (formats of the database system).

3.3 Implementation of the EU Packaging and Packaging Waste Directive in Member States

Implementation of the packaging directive by Member States is still incomplete. This is not surprising considering that the last extension of EU was in 2004. Moreover, although a number of studies have been carried out for the Commission, a serious lack of quality data on national achievements and on the economic consequences of implementation of the Directive persists (Internet 11).

As already discussed in chapters 3.1 and 3.2 the packaging directive and its amendments oblige Member States to take measures to achieve certain percentages of energy recovery and material recycling. Member States were given various options on how to monitor packaging and packaging waste in the future at national and EU levels (Koca and Nilsson-Djerf, 2000). Although some countries have achieved the recovery and recycling targets, data submitted by Member States is often questionable and incomplete because of the different ways Member States have implemented the Directive. A study for ERRA demonstrates that data to measure the achievement of the recovery and recycling rates are difficult to locate, ambiguous and not comparable, both within and between Member States (Ibid).

The packaging directive of the EU was incorporated into Slovenia's legislation by The Rules on Handling Packaging and Packaging Waste which came into force at the end of 2000 and was published in the Official Gazette of the Republic of Slovenia, Number 104/00. The Rules cover the entire contents of the Directive 94/62/EC except provisions on the identification system for packaging materials and on standards for quality of packaging.

Slovenia asked the EU for a transitional period of 5 years. The reason for the request was the time-consuming project of re-establishing systems for collecting and recycling packaging waste and also an adaptation/adjustment of technological processes for manufacturing and using of packaging. The Rules and EU packaging directive represent goals Slovenia has to reach during the process of becoming a full member of EU. This means that Slovenia has to recover at least 50% of packaging waste and the recycling rate for each packaging material should be at least 15% by the end of 2007. This also includes creating an effective infrastructure for handling packaging and packaging waste.

A revision of The Rules on Handling Packaging and Packaging Waste is taking place. The new Rules intend to cover the entire contents of the packaging directive 94/62/EC so it would be fully implemented into Slovenia's legislation.

3.4 Generally about Packaging Waste Management Situation in the EU

All 25 EU Member States face increasing demands for information and knowledge about the extent to which the policies they put in place give "value for money". They are also very interested in knowing what policies have worked under what conditions in other countries, and what did not work. This is particularly the case for the 10 new Member States from 2004 (Figure 5) who now face a significant challenge to implement the EU directives as soon as possible, without repeating the mistakes and problems that the older EU Member States have encountered (EEA Report 3/2005, 2005).

The packaging directive 94/62/EC has now been in place for ten years and because packaging waste is an important and growing waste stream, the EEA saw an opportunity to conduct a study of the effectiveness of packaging waste management systems in some EU Member States. The study primarily covers data from 1997 to 2001. Direct comparison between countries' waste generation is not possible because of differences in data-reporting methodologies (Ibid).

The packaging directive's overall objective is to reduce waste generation. However, the targets are for recovery and recycling, not reduction: full compliance with the targets does not automatically mean achievement of the policy's wider objective of reducing waste volumes. Measures at the national

level are primarily aimed at increasing recovery and recycling, with prevention measures being limited to awareness-raising campaigns, some deposit-refund systems and some taxes. Prevention is difficult to deal with and measure because of constantly changing consumer demand, distribution systems and packaging materials. Although costs are not directly comparable, some useful observations on cost-effectiveness are made. The analysis shows that in some countries, the current waste management system is reaching its upper limit for recycling (Ibid). Countries also made different institutional decisions: the fees of some compliance schemes include all costs (Austria), while others serve merely as an intervention to enhance the attractiveness of the recycling option (Italy), supplemented by local authority support (EEA: Policy effectiveness evaluation, 2005). In general, economic instruments have an overall efficiency advantage for society since they can achieve environmental objectives and targets at a relatively low cost (EEA Report 3/2005, 2005).

The packaging directive forms the basis for the establishment of the **packaging waste management systems** in some countries, whereas others already had such systems in place (EEA: Policy effectiveness evaluation, 2005). A packaging waste management system is comprised of the set of national regulations and measures established to ensure the achievement of the objectives and targets of the packaging directive and any national targets (EEA Report 3/2005, 2005).

Jacobsen and Kristoffersen (2002) ascertained that the majority of the EU countries has introduced a **producer-responsibility management system/scheme** for packaging waste. Producer responsibility is characterized by giving the producers (of the goods or waste) the organizational and economic responsibility for a specific waste stream. Normally, the national authorities specify targets for the producers to fulfill, for example, reaching a certain recycling rate. The same authors also found out that because of the difficulties with a delegation of each producer or retail store, the normal setup involves the establishment of a specific company that covers the interests of the whole branch. This company organizes the collection and treatment of the waste and manages the fulfillment of the producers' obligations on behalf of the branch. The collection and treatment activities are financed by the producers and retailers.

By establishing producer responsibility strategies, the public authorities lose some influence in waste management and have to invest resources in control systems. In return, producer responsibility schemes provide the possibility to reach recycling or prevention targets that could not be obtained in a public waste management system without extensive public investments. A big advantage connected to producer responsibility schemes is that it is not necessary for the competent authorities to be in charge of developing new collection schemes. This task is



Figure 5: The European Union and its enlargements
(Source: Internet 12)

transferred to the producers. Furthermore, producer responsibility is leading to a clear distinction of competence between the part to establish the environmental targets (the competent authorities) and the part to fulfill the targets (the producers). Apart from setting up targets, the authorities are responsible for establishing the regulatory framework for collection and treatment of waste and the relevant control activities (Ibid).

A negative consequence of producer responsibility schemes is that parallel collection schemes are established – one organized by the producers (e.g. packaging) and one organized by the municipalities (e.g. municipal waste). This emphasizes the necessity of clearly defined areas of responsibility (Ibid).

As established by Jacobsen and Kristoffersen (2002), another option for the EU countries to manage packaging waste is the introduction of **environmental taxes and fees**. They are considered to be effective, economic instruments needed to make environmentally sound activities such as separate collection, treatment and recycling of wastes economically attractive by increasing the costs relevant to uncontrolled waste disposal. These cost-based initiatives supplement the legislative framework, which is set at the national level following the transposition of EU directives into national law.

The extent and magnitude of environmental taxes and fees must be carefully considered in order to avoid undesirable effects such as illegal and uncontrolled waste disposal. This can occur if the economic burden on waste operators (collection / treatment companies) becomes unbalanced in relation to the expected benefits from recycling of waste fractions. Therefore a cost/ benefit analysis based on environmental and economical terms should always be developed and analyzed before any decision-making (Ibid).

The EEA study of effectiveness of packaging waste management system in selected EU countries, published in 2005, shows big differences in the amounts of packaging waste generated in the EU-15 (Figure 6), from less than 100 kg per capita in Greece and Finland to more than 200 kg per capita in Ireland and France. The EU-15 average is about 170 kg (EEA Report 3/2005, 2005).

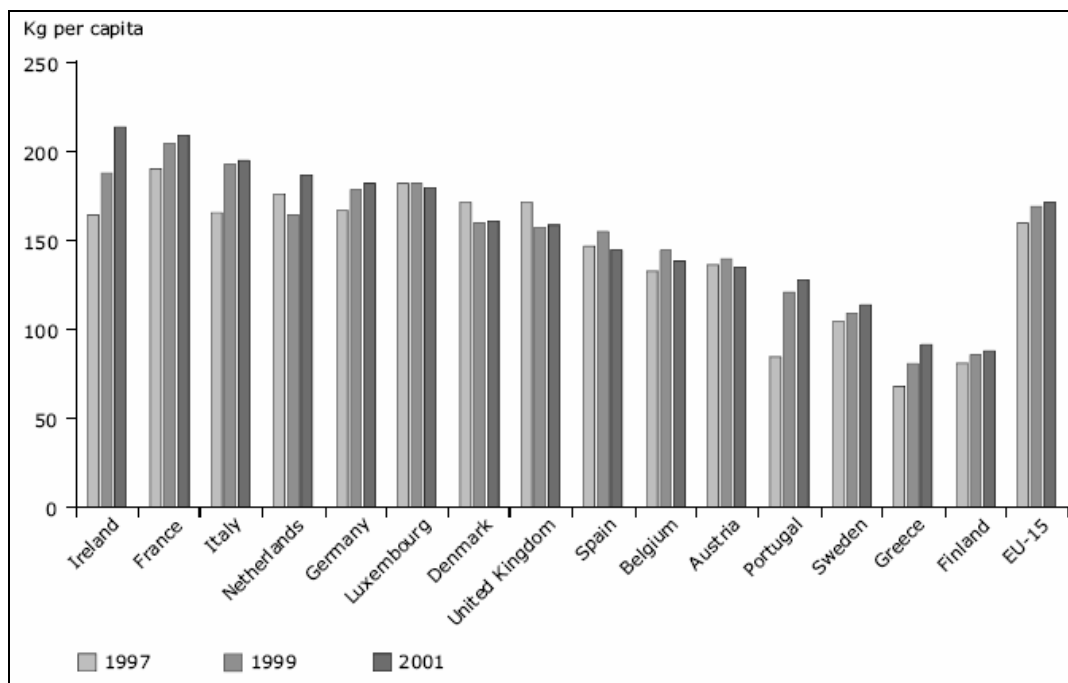


Figure 6: Packaging waste generation in EU-15 per capita (Source: EEA Report 3/2005, 2005)

Figure 7 shows that generation of packaging waste in the EU has followed the growth of gross domestic product (GDP) very closely (Ibid). Waste per GDP per capita expresses the link between waste generation and economic activity per capita: high values mean more waste generated per unit of economic output per capita (EEA Report No.10, 2003).

Between 1997 and 2001, packaging waste generation increased by 8,3% and GDP by 11%. These increasing quantities of packaging waste create problems from an environmental perspective since packaging waste leads to a number of environmental impacts and waste of resources. Despite absolute increases in packaging waste generation, the majority of EU countries are successful in achieving a relative decoupling of generation of packaging waste and economic growth (EEA Report 3/2005, 2005).

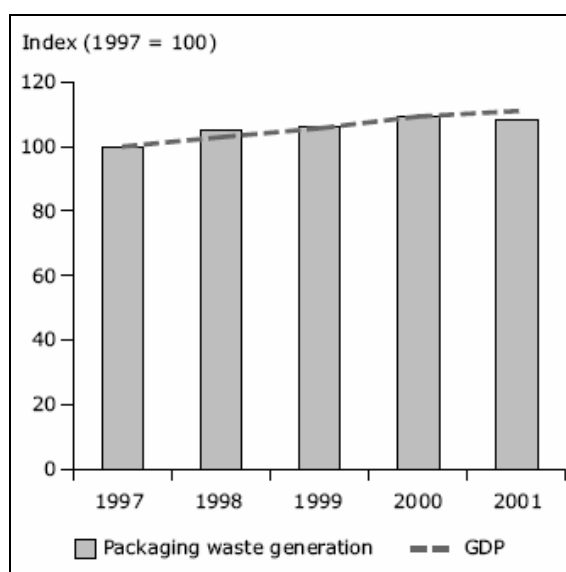


Figure 7: EU-15 packaging waste generation and GDP, 1997-2001 (Source: EEA Report 3/2005, 2005)

Looking at target achievement alone, the picture looks good: most of the EU-15 countries met the minimum 50% recovery target in 2001. The average recovery rate in EU-15 is 60% and increased steadily between 1997 and 2001 (Figure 8). Denmark, Belgium and Germany have the highest recovery rates: between 80 and 90%. The UK is the only country that did not meet the 50% recovery target. More than half the EU Member States already fulfill the 60% recovery target for 2008. Portugal, Ireland and Greece have all reached their 25% target (Ibid).

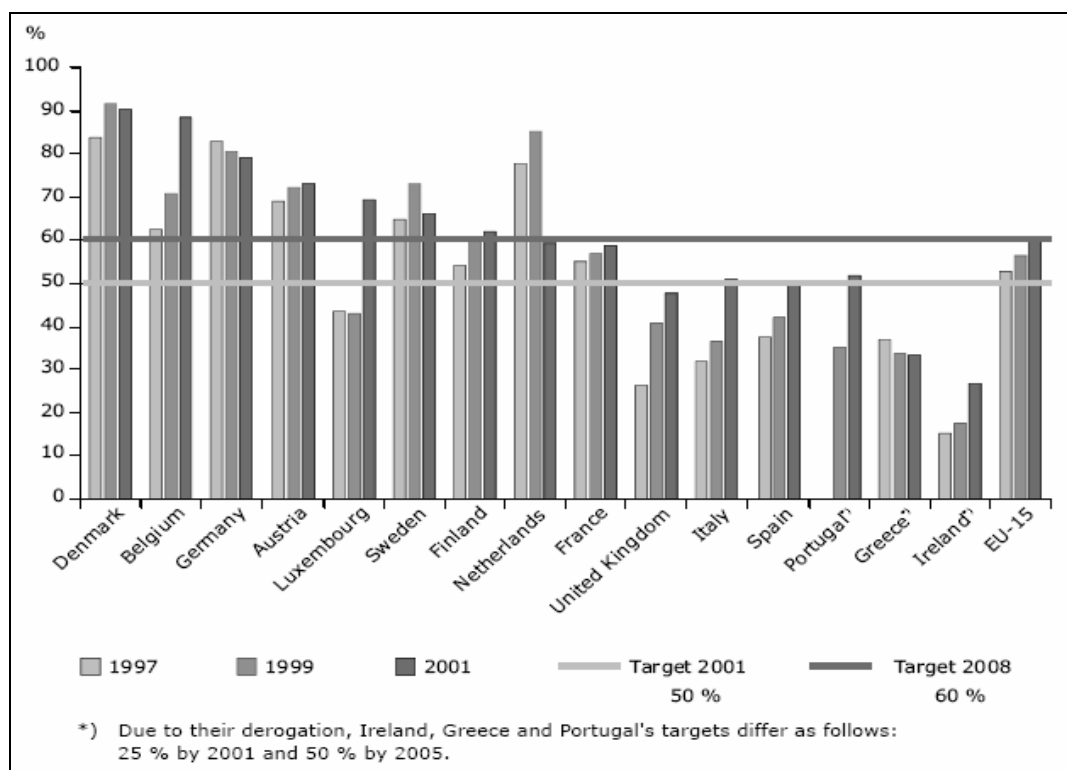


Figure 8: Recovery of packaging waste (Source: EEA Report 3/2005, 2005)

The average EU recycling rate between 1997 and 2001 increased steadily to 53%, very close to the 2008 target (55%). However, it is clear that some countries are still far from the target. Germany has the highest rate at about 75% and Ireland the lowest at 27%. The 25% target of 2001 has been reached for all Member States together, and seven countries have already reached the 2008 target (Figure 9). Greece, Ireland and Portugal received derogations for 2001 (Ibid).

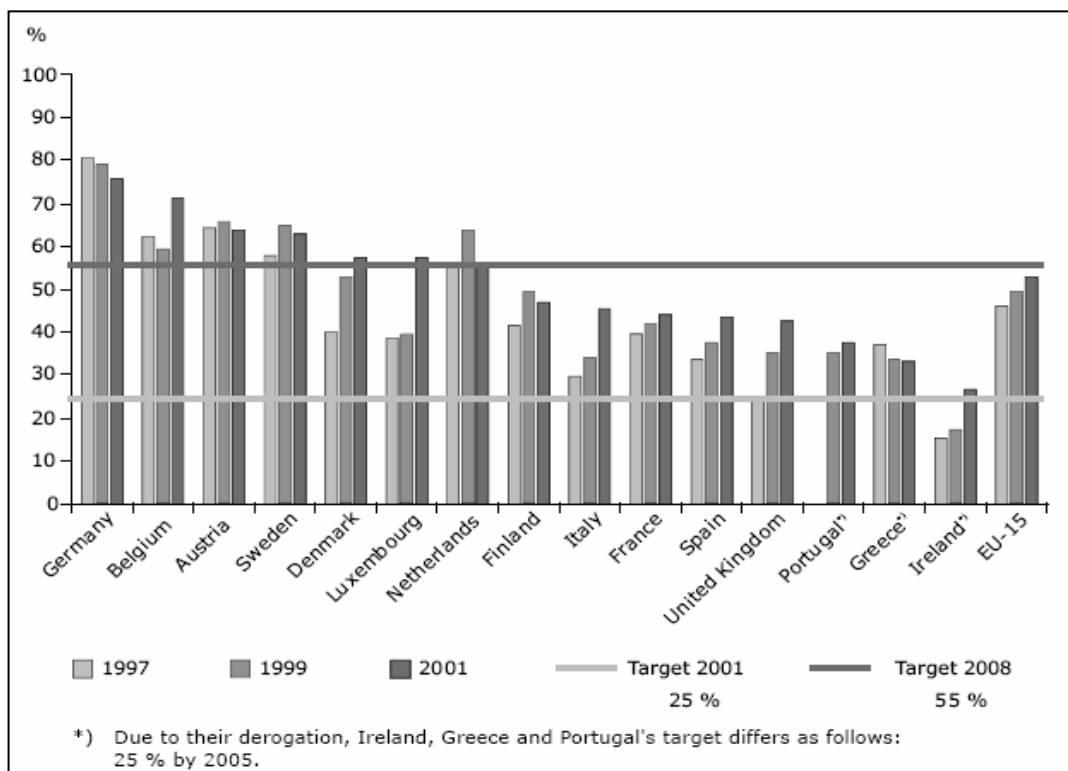


Figure 9: Recycling of packaging waste (Source: EEA Report 3/2005, 2005)

3.5 Packaging Waste Management System in the selected Member States

Since the 94/62/EC packaging directive includes objectives and quantitative targets for the recycling and recovery of packaging waste it became the starting point for separate management of that waste stream for many EU countries. Still, when talking about packaging waste management system, there are some major differences between Member States in terms of (EEA Report 3/2005, 2005):

- when the systems were implemented,
- how stakeholders were involved in the design and setting up of system,
- the level of packaging recycling and recovery in the base year 1997.

In general, when creating packaging waste management systems, Member States have different approaches. Most of them have chosen a scheme that makes producers responsible. Some countries include all packaging waste in the system, while others focus primarily on non-municipal waste. However, all systems include a number of measures which either directly or indirectly support the system and the objectives of the packaging directive. Measures are primarily aimed at increasing recovery and recycling, while efforts to prevent packaging waste are more sporadic. The majority of measures are administrative instruments, such as producer-responsibility, mandatory collection or a ban on landfilling certain waste streams, that aim at improving the market for recycled materials. There are few economic instruments aimed at packaging and packaging waste, like implementation of a landfill tax. A common assumption is that the amount of packaging used will increase with increasing economic activity. As a result, the concept of relative decoupling is used to measure increased efficiency of the packaging

waste management system: if the growth rate of packaging waste generated is lower than that of GDP, relative decoupling is achieved (Ibid).

To do a comparison of Slovenian packaging waste management system to packaging waste management systems of other Member States, Austria, Ireland and Denmark were chosen (Table 5). The selection based on the following reasons:

- all three countries are among the smallest in the EU, with less than 10 million citizens each;
- Austria and Ireland have established a National recovery organization with a producer-responsibility scheme;
- Denmark has applied different taxes on packaging and waste management.

Table 5: Short comparison between selected Member States and Slovenia (Source: EEA Report 3/2005, 2005, Internet 13, Internet 18 and author*)

Member State	Austria	Denmark	Ireland	Slovenia
Area (km ²)	83.870	43.094	70.280	20.273
Population (2005 est.)	8.184.691	5.432.335	4.015.676	2.011.070
GDP (2004 est.)	255,9 billion \$	174,4 billion \$	126,4 billion \$	39,41 billion \$
GDP–composition by sector (2004 est.)	Agriculture: 2,3% Industry: 30,8% Services: 66,9%	Agriculture: 2,2% Industry: 25,5% Services: 72,3%	Agriculture: 5% Industry: 46% Services: 49%	Agriculture: 3% Industry: 36% Services: 60%
Industrial production growth rate (2004 est.)	3,3%	1,7%	7%	3,9%
Year of joining the EU	1995	1973	1973	2004*
Year of implementation of national legislation on handling packaging and packaging waste	1992 (producer responsibility scheme)	1994 (no producer responsibility scheme!)	1997 (producer responsibility scheme)	2000* (producer responsibility scheme)
National recovery organization, year of establishment	ARA, 1993	/	REPAK, 1997	SLOPAK, 2003* and INTERSEROH, 2004*
Costs of handling plastic packaging waste (EUR/ton), 2005	230-700#	/	74	28-75*#

cost depends on the type of packaging (see Chapter 1.2.1)

3.5.1 Austria

Austria had a basic system for managing packaging waste in place before the packaging directive was agreed to in 1994. The Austrian ordinance requires producers, fillers, distributors and importers that put packaging or packed goods on the market to take back their packaging free of charge and to reuse or recover it. The producers can manage this obligation themselves or transfer the obligation to a third party (EEA Report 3/2005, 2005).

To fulfill the take-back obligation on a nation-wide basis, the producer-responsibility scheme for packaging waste (ARA) was established in 1993 by the industry. ARA is a full-cost system, covering more of the costs of collection, sorting and recovery than the other countries investigated. Consequently it is relatively expensive. ARA authorizes the “green dot” logo to be placed on the packaging of products whose manufacturers have paid a given rate. This logo also indicates that the companies have transferred their obligation for the collection and recovery of material to ARA, which finances the collection, sorting and recovery of the

packaging waste. About 60% of the packaging waste collected by ARA is from private households and 40% from industry and commerce. ARA is not the only compliance scheme in Austria, but it is the largest. It covers about 95% of packaging material for which the obligation has been passed to a third party (Ibid).

Overall responsibility for transposing the directive into national legislation lies with the Ministry of the Environment which is also responsible for monitoring whether the directive's and national targets are met. The producers and importers supply data on the quantity of packaging placed on the market, either through ARA or directly to the Ministry of the Environment, which then monitors compliance with the legislation. ARA has also a legal obligation of taking an active part in information activities on management packaging waste (Ibid).

Some companies chose to fulfill their obligations under the legislation individually and not transferring them to a compliance scheme. They are required to meet extremely high recycling targets (in general, over 90% for each packaging material). Such an initiative clearly creates an incentive to join a scheme, provided that the mechanism of control and monitoring works well. However, companies not participating in a scheme and not complying with their obligations are considered "free riders", a generally acknowledged problem in producer-responsibility scheme (Ibid).

In addition to those in the packaging directive, Austria has three sets of targets (Ibid):

- targets for the management of packaging waste,
- recycling targets for companies with individual collection,
- targets for refilling, recycling and energy recovery of beverage containers.

Less than 2% of the total amount of packaging waste in the EU-15 is generated in Austria (Table 6). Austria also has a very low generation of packaging waste per capita of 135 kg, compared to the EU average of 172 kg/capita. Austria succeeded in stabilizing the generation of packaging waste between 1997 and 2001. Thus, despite an increase in GDP of 11%, it seems to have achieved relative decoupling. Austria has a very high recycling rate (64%) which is far beyond the 25% minimum recycling target in the packaging directive and 11 percentage points higher than the EU-15 average. With a recovery rate of 73%, Austria has exceeded the 50% recovery target by 23 percentage points and is already fulfilling the targets for 2008 in the revised packaging directive. The remaining 27% of packaging waste is landfilled or incinerated without energy recovery (Ibid).

3.5.2 Ireland

The Irish system of managing packaging waste was established in 1997 as a direct consequence of packaging directive. The directive initiated a process whereby the system moved from landfilling towards recycling and recovery (EEA Report 3/2005, 2005).

The Irish Packaging Regulations from 1997 impose producer-responsibility obligations on all producers of packaging, with more stringent requirements on major producers. The regulations were amended in 1998 and replaced in 2003. The new regulations lowered the turnover threshold for major producers and introduced a mandatory obligation on all producers to segregate specified backdoor packaging waste materials arising on their own premises and have it collected by authorized operators for recycling. This was complemented by a ban on landfilling the specified commercial packaging waste materials. Nevertheless, Ireland received derogation from the targets, according to Article 6 of the packaging directive, requiring it to achieve the directive's targets by 2005, with a minimum recovery rate of 25% by 2001. With extensive dependence on landfill, recycling is the only current recovery operation (Ibid).

One compliance scheme for the collection and recycling of packaging waste has been established – Repak Ltd. It is producer-responsibility scheme, the main policy measure and the only scheme approved under the Waste Management (Packaging) Regulations of 1997. It commenced operations in 1997 as a result of a voluntary agreement between industry and the Department of the Environment, Heritage and Local Government (DoEHLG) and represents industry's response to the obligations of the directive (Ibid).

The DoEHLG is responsible for adopting legislation and developing the overall policy on prevention, minimization and recovery of packaging waste. It also ensures that compliance schemes meet targets for recycling and recovery and manages the reporting obligations to the EU. The Environmental Protection Agency (EPA) is responsible for reporting figures on packaging consumption and rates for recycling and recovery to DoEHLG. The data are collected from various sources, mainly recycling organizations, local authorities, landfill operators and the compliance scheme Repak. The EPA is responsible for licensing the major recovery operators. Local authorities are responsible for the collection of household waste, with many choosing to provide the service via private operators, and for licensing commercial waste collectors and small waste treatment and recovery operators. Responsibility for arranging the collection and management of commercial waste lies with the waste producers themselves. Local authorities monitor the reuse and recovery of waste from obligated producers who choose not to join Repak (self-compliers). Ultimately, local authorities have the power to ensure that all major producers comply with their obligations (Ibid).

Rather than joining Repak, companies may self-comply, subject to satisfying detailed requirements, which include registering annually with the local authority, payment to the local authority of a fee per ton of packaging handled, and the provision of statistics for each type of packaging placed on the market. Self-complying companies must submit plans to the local authority showing how they propose to comply with the regulations, and report on the steps taken to comply and the results of these steps. The estimated number of companies not complying with their obligations is declining and Repak estimates that some of this can be attributed to increased enforcement by the authorities (Ibid).

Two economic instruments have also been implemented: the landfill levy and the plastic bag levy. The levies together with the restrictions on landfilling specified materials represent prevention measures since they directly impose additional costs and/or deterrents on producers who create wastes (Ibid).

The generation of packaging waste has increased with the country's economic boom: during the five-year period from 1997-2001, GDP per capita increased by 36% and the quantity of packaging placed on the market per capita increased by 30% (Table 6). 214 kg of packaging waste per capita is significantly higher than EU average of 172 kg and is even higher than in any other EU country. The growth in the amount of packaging waste followed the growth of GDP between 1997 and 2001. However, less than 1,5% of European packaging waste is generated in Ireland. The total recovery rate met the 25% target in 2001, as did the recycling rate, thus meeting the target for 2005. Currently, recycling is the only recovery operation in place, which is why the recovery figures are identical to the recycling figures (Ibid).

3.5.3 Denmark

The packaging directive has had little effect on Denmark's recycling. When the directive came into effect, recycling levels were already well on the way meeting its targets. Local authorities are responsible for establishing the necessary collection and recycling schemes. To meet the new obligations, focus was directed to transport packaging rather than household packaging, and the 2001 targets were successfully met with the exception of 15% recycling plastics waste which was missed by 1%. The regulation on reusable beverage containers, glass packaging and cardboard from industry was introduced several years before the adoption of the packaging directive, and non-recycled mixed household waste was already being incinerated at municipal plants with energy recovery (EEA Report 3/2005, 2005).

Denmark decided to focus on collecting and recovering transport packaging in order to achieve the targets of the directive. This waste stream was considered to be made up of large, homogenous and relatively clean waste streams that are cheaper to manage than packaging from households. The target for plastics waste was to be achieved solely through the recycling of plastic transport packaging waste. Packaging waste from commerce and industry has generally been collected by private companies (Ibid).

The tax on waste treatment, which has been in effect since 1987, and the ban on landfilling waste suitable for incineration, in effect since 1997, support increased recycling. To certain

types of packaging and waste treatment different taxes are applied. Hence, packaging in Denmark is not subject to a producer-responsibility scheme! However, the tax covers only 20-21% of total packaging (including one-way packaging, carrier bags and refillables) placed on the market. The tax has been restricted to product groups, which are easy to identify in order to facilitate administration. The objective is to generate tax revenue and reduce the generation of packaging waste. The tax depends on the volume or the weight and material of the packaging (Ibid).

The Ministry of the Environment is responsible for translating the directive into national legislation. Because of past experience with insufficient waste treatment capacity being established on a private basis and the difficulty in funding treatment facilities, neither industry nor the local authorities were interested in transferring responsibility for packaging waste management from local authorities to industry. Local authorities were therefore given the responsibility of establishing the collection and to some extent recycling schemes necessary to fulfill the targets of the directive. Recycling activities are typically managed by private operators. Thus, local authorities also have responsibility for reporting on the management schemes for packaging waste (Ibid).

Households are required to use facilities made for the management of packaging waste that are established by the local authority. Households pay for the services via a general waste fee. For enterprises, local authorities assign packaging waste either to a specific treatment facility or to recycling. Responsibility for collection and transport of the waste to treatment or recycling plants is assumed by the individual enterprise. In 1994 the industry committed itself to providing data, supporting recycling and establishing capacity for recycling. Responsibility for establishing a collection or assignment scheme for transport packaging, however, lies with local authorities (Ibid).

Generation of packaging waste per capita is 192 kg, 20 kg more than the EU average (Table 6). Denmark produces less than 2% of the total amount of packaging waste in Europe. The increase in waste arising between 1997 and 2001 was very modest, only 2% compared with 8,4% in the EU. This implies that relative decoupling was achieved during the period, since GDP increased by almost 10%. The recycling rate for packaging waste in 2001 was 50%, slightly lower than EU average, but the recovery rate was extremely high because waste that is not recycled is treated at waste incineration plants for energy recovery. While the overall recycling and recovery targets of the packaging directive were achieved in 2001, the recycling target for plastics waste was not met as only 14% was being recycled. All other material targets were more than met, by more than 61 percentage points for glass, 50 for paper and 25 for metal (Ibid).

Table 6: Amounts of packaging waste (PW) generated in 2001 in the selected MS and EU-15
(Source: EEA Report 3/2005, 2005)

Member State	Austria	Denmark	Ireland	EU-15
Total PW generation (tons)	1.097.000	1.029.000	820.000	64.876.000
Generation per capita (kg/capita)	135	192	214 (excl. wood)	172
Change in generation 1997-2001 (%)	-1,0	+2,0	+36,0	+8,4
GDP change 1997-2001 (%)	+11,0	+9,8	+41,0	+11,4
Recycling (EU target 2001=25%) (%)	64	50	27	53
Recovery (EU target 2001=50%) (%)	73	90	27	60

4 PACKAGING WASTE AND PLASTIC PACKAGING WASTE IN SLOVENIA

Both the EARS and SORS data show that in Slovenia approximately 450 kg of municipal waste is generated annually per capita. In addition to municipal waste, there is non-municipal waste from industry sector, crafts and services (Environmental Indicators 2003, 2005). In both types of wastes, packaging waste is present and in the municipal waste stream it represents up to 17% (Internet 2).

The Rules on Handling Packaging and Packaging Waste (OG RS 104/00), reflecting the targets from the European packaging directive 94/62/EC, indicate that a minimum of 50% of packaging waste shall be recovered by the end of 2007. Of that a minimum of 25% shall be recycled and a minimum of 15% of each packaging material shall be recycled. For starting year 2001 data from year 1998 is taken.

The European Commission had accepted Slovenia's request for a transitional period for achieving the targets of the packaging directive as follows:

- For recycling wooden packaging waste till the 31st December 2005.
- For recycling plastic packaging waste till the 31st December 2007.
- For altogether recovery till the 31st December 2007.

To achieve the target shares of recycling and recovering of packaging waste, a difficult task was expected to be on the side of industry since non-municipal packaging waste is cleaner and easier to collect. Also, the costs for reestablishing infrastructure for collection and recover would be much lower than they would be in a case of municipal packaging waste. When The Rules on Handling Packaging and Packaging Waste came into force, handling of municipal packaging waste was already systematically settled by a demand for reestablishing and performing the handling by municipalities and their public waste removal services, along with separately collected fractions of municipal wastes. Still, that kind of packaging waste is more dispersed, contaminated and requires more financial support for reestablishing infrastructure and especially for additional activities to educate citizens (The Operational Programme..., OG RS 29/02).

To achieve the required share of recycled *plastic packaging waste*, the suggestion was made to focus on specific kinds of plastic packaging. An example of non-municipal plastic packaging that can be effectively and easily collected and recycled with a potential market value is PE foil; and for municipal plastic packaging the example would be the beverage bottle. To assure proper recycling, proper devices had to be built or existing devices enabled or recycling must be assured in other EU countries. One option for recovering plastic packaging waste is energy recovery, but that will not be a realistic solution until the incineration plant for municipal waste is built in Slovenia (Ibid).

In spite of measures for minimizing the production of packaging waste and other measures for handling waste a rise in packaging waste quantities was expected so that a Slovenian citizen with 85 kg/year would "catch" an EU citizen with 150-200 kg of annually produced packaging waste in next few years (Ibid).

4.1 Skeleton Dynamic for Achieving Recycling/Recovery Targets by the End of 2007

With The Operational Programme for the Management of Packaging and Packaging Waste for 2002-2007 Period (OG RS 29/02), a step-by-step plan for achieving the target values from The Rules on Handling Packaging and Packaging Waste of recycled and recovered packaging waste for each packaging material was settled and is shown in Table 7. The evaluation was made considering the starting period from 1998-2001 and on the basis of estimation that Slovenia was already achieving a 15% share of recycling packaging waste from paper, glass and metals.

Table 7: Total recovery targets (%) for packaging waste by material till the end of 2007 (Source: The Operational Programme..., OG RS 29/02)

Packaging material	1998-2001	2002	2003	2004	2005	2006	2007
Paper	43	45	50	55	60	65	70
Glass	36	37	40	42	45	48	50
Metal	16	17	21	25	28	32	35
Plastic	5	7	9	12	15	18	20
Wood	10	17	23	28	30	32	35
TOTAL	29	31	36	40	44	48	51

The expected shares of recycled and energetically recovered packaging waste regarding to total recovered packaging waste are shown in Tables 8 and 9. It is clear that energy recovery is acceptable just for wooden packaging waste.

Table 8: Recycling targets (%) for packaging waste by material till the end of 2007 (Source: The Operational Programme..., OG RS 29/02)

Packaging material	1998-2001	2002	2003	2004	2005	2006	2007
Paper	43	45	50	55	55	55	55
Glass	36	37	40	42	45	48	50
Metal	16	17	21	25	28	32	35
Plastic	5	7	9	12	13	14	15
Wood	5	8	11	14	15	16	17
TOTAL	28	30	34	38	39	40	40

Table 9: Energy recovery targets (%) for packaging waste by material till the end of 2007 (Source: The Operational Programme..., OG RS 29/02)

Packaging material	1998-2001	2002	2003	2004	2005	2006	2007
Paper	0	0	0	0	5	10	15
Glass	0	0	0	0	0	0	0
Metal	0	0	0	0	0	0	0
Plastic	0	0	0	0	2	3	5
Wood	5	9	12	14	15	16	18
TOTAL	1	1	2	2	5	8	11

4.2 Trade Companies for Handling Packaging Waste with a Permit from EARS

In 2002 a system of managing packaging waste was established as a direct consequence of the packaging directive and its implementation into Slovenia's legislation. The Rules on Handling Packaging and Packaging Waste (OG RS 104/00) introduced a producer-responsibility scheme.

Legal persons are obliged by The Rules to take care of packaging and packaging waste they place on Slovenian market. They can either do it by themselves (they need to acquire a license from EARS) or they can turn their obligations to a trade company for handling packaging waste from 25th Article of The Rules. The more packaging a legal person handles, the higher is the likely cost of compliance.

Trade companies Slopak and Interseroh were established to better control the system of recovering packaging waste since a trade company has to cover the entire region of Slovenia. Background is in "real life" where it is very difficult for a legal person as a self-complier to assure collection of all its packaging waste from the entire country. By transferring its obligations from The Rules to the trade company, the legal persons fulfill the requirements of The Rules and make achieving the target of recovering packaging waste on national level more reachable.

Both trade companies have a permit from EARS for handling packaging waste on a national level. They are obligated by The Rules on Handling Packaging and Packaging Waste to annually report to EARS on quantities of collected packaging waste and also on quantities given away for further recovery. Slopak did the first reporting in 2005 for the quantities from year 2004. Though for year 2004 the reporting was double (by Slopak and also by companies who

transferred their obligations to it), the data is not comparable since it was the first reporting year for Slopak and some inconsistencies were found.

Slopak was established in 2003 by the most important fillers of Slovenia and began work in 2004. It has a permit from EARS for handling municipal and non-municipal packaging waste. Because it handles municipal packaging waste, some state control is present. Slopak is also a member of Pro-Europe and as such it has a permit to assign a “green-dot” to enterprises that have turned over their obligations to Slopak.

Interseroh was established in 2004 and began work in 2005. It has a permit from EARS to handle non-municipal packaging waste, with an emphasis on packaging waste from branch industries such as the furniture and wood industry, building industry, color industry, and others. Interseroh is a multinational company present in many EU countries (e.g. Austria, Germany,...) and its primary activity is recycling.

4.3 Monitoring and Quantities of Packaging Waste

In general there are two basic approaches to estimate the quantities of waste (Koca and Nilsson-Djerf, 2000):

1. material flow approach (top-down approach),
2. waste analysis approach (bottom-up approach).

In Slovenia the first one is used to estimate the amount of packaging waste on a nationwide basis. The material flow methodology is based on quantities of packaging and packaging waste by packaging materials. The pathway of packaging and packaging waste in Slovenia is shown by Figure 10.

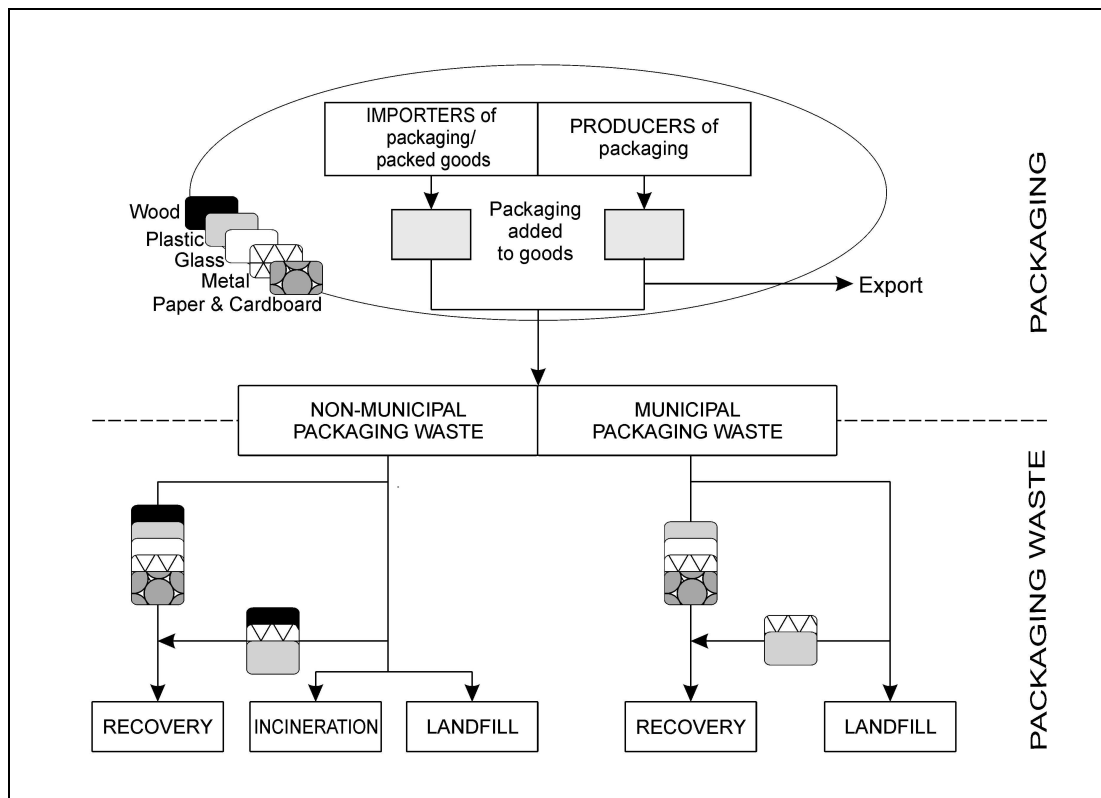


Figure 10: Pathway of packaging and packaging waste in Slovenia (Source: prepared by author)

To provide quantitative information on packaging waste, which is necessary to establish progress and check the implementation of the EU Directive 94/62/EC into national regulations, a monitoring system has been developed.

The data on quantities of packaging and packaging waste are provided by legal persons (producers and treaters of packaging waste) and since 2005 (the system for handling packaging waste have started to operate in 2004), by trade companies for handling packaging waste in order to assess both pathways (non-municipal and municipal) of packaging waste. Responsible bodies for providing the data are as follows:

- Monitoring the quantity of packaging that is newly placed on the Slovenian market in any one year – information is provided by producers, fillers, importers, traders from 14. Article and final users from 20. Article of The Rules on Handling Packaging and Packaging Waste. It is assumed that the quantity of packaging placed on the market is equal to quantity of produced packaging waste in the same calendar year.
- Monitoring the quantity of treated (recovered and disposed) packaging waste – information is provided by treaters with a permit from EARS according to The Rules on Waste Management.
- Monitoring the quantities of packaging for which legal persons turned their obligations to trade companies for handling packaging waste and monitoring the quantities of municipal packaging waste, collected by public waste removal services – information will be provided for the first time in 2005 for quantities of 2004 by trade companies for handling packaging waste according to The Rules on Handling Packaging and Packaging Waste and to The Order on the Management of Separately Collected Fractions in the Public Service of Urban Waste Management.

All data is send to EARS to be processed in a way to give optimal, reliable and useful results for Slovenia's own waste database and also for reporting to the EU.

4.3.1 Quantities of Produced Packaging Waste

Quantities of packaging waste produced in Slovenia in years 2001, 2002 and 2003 are shown in Table 10. As mentioned above, reporting was done by obligors form The Rules on Handling Packaging and Packaging Waste. First reporting was done for quantities from the year 2001.

Table 10: Quantities in tons of produced packaging waste (PW) and number of obligors that reported (Source: Pušenjak et al., 2004 and Analiza letnih poročil..., 2002-2004*)

Type of PW by packaging material	Total amount of produced PW in tons		
	2001	2002	2003
Paper and cardboard	45.891	57.575	58.000
Glass	24.118	21.842	25.500
Metal	13.329	13.769	16.000
Plastic	29.883	31.463	36.000
Composite	7.364	7.284	8.000
Wood	36.510	44.972	37.500
Other	385	642	1.000
Total	157.481	177.547	182.000
No. of obligors who did the report*	816	996	1.036

Pušenjak et al. (2004) found that about one third of the reports for 2003 were not correctly completed.

The obligors who made some major mistakes (reporting in kilos instead of tons, reporting on quantity of packed goods instead of just packaging, incompatibility between reported quantities) were contacted so the corrigenda was made in agreement with them. The corrected results were estimated by Pušenjak et al. to be suitable and as such are stated in the above table.

Table 10 shows annual growth of total amount of produced packaging waste and also the growth in number of obligors who sent annual report on handling packaging and packaging waste in a particular year. The entire quantity of packaging waste produced in Slovenia in 2003 was around 182.000 tons. In all three years the majority of packaging waste was represented by paper and cardboard, followed by wood, plastic and glass. In 2003, 1.036 obligors reported on quantities of packaging waste. Pušenjak et al. (2004) estimated that number of all obligors is around 1.500. Consequently, it appears around 70% of obligors reported in 2003. Mentioned table also shows the annual growth of a few percentages in the quantity of plastic packaging waste. In 2003, 36.000 tons or almost 20% of produced packaging waste represented plastic packaging waste.

4.3.2 Quantities of Recovered Packaging Waste

Quantities of recovered packaging waste in Slovenia in years 2001, 2002 and 2003 are presented in Table 11. As mentioned at the beginning of this chapter, reporting was done by treaters with a permit from EARS for recovering waste according to The Rules on Waste Management. Because reporting includes all waste treated in a particular calendar year a selection for packaging waste has to be done according to the EWC numbers (see Table 1). Recovery outside Slovenia is not included in this kind of annual reports (Pušenjak et al., 2004).

Table 11: Quantities in tons of recovered packaging waste (PW) (Source: Pušenjak et al., 2004)

Type of PW by packaging material	Paper& cardb.	Plastic	Wood	Metal	Com-posite	Mix	Glass	Tex-tile	Hazar-dous	Haz. metal.	total PW
Recovered in 2001	1.386	3.026	7.028	/	/	812	/	/	/	/	12.252
Recovered in 2002	8.315	4.529	7.625	200	0	727	0	0	/	0	21.396
Recovered in 2003	10.102	2.317	8.333	325	/	128	0	/	40	/	21.245

In 2003, 21.245 tons of packaging waste was recovered in Slovenia. In the previous year the amount was almost equal while the quantity of 2001 is almost half smaller. The quantities of recovered wooden packaging waste did not change much compared to other types of packaging material. A drastic increase (more than 700%) in recovered quantity of paper and cardboard packaging waste happened from 2001 to 2002 and the opposite phenomenon is seen with mixed packaging waste where the amount of recovery has decreased for almost 85%. The quantity of recovered plastic packaging waste in 2001 was 3.026 tons and has increased by 50% in 2002. Next year recovery decreased by almost the same percentages, to 2.317 tons. In 2003, 11% of total recovered packaging waste goes for plastic packaging waste.

Pušenjak et al. (2004) established the quantity of recovered packaging waste in 2003 was too small, and estimated much more of packaging waste was really recovered. They have taken into consideration the quantities of recovered packaging waste of Slovenian origin, estimated quantities of recovered packaging waste when treaters did not report (e.g. they don't have a permit from EARS), quantities of exported packaging waste for recovery (mostly glass and plastic), and quantities of internally recovered packaging waste. The final conclusion was that in year 2003 at least 50.000 tons of packaging waste was recovered in Slovenia (Table 12). When comparing to reported quantities of recovered packaging waste, doubling or more of the quantities of paper and cardboard and plastic packaging waste can be seen. Almost 9.000 tons of recovered glassy packaging waste arises from quantities that were recovered outside the Slovenia.

Table 12: Estimated quantities in tons of recovered packaging waste in Slovenia in 2003 (Source: Pušenjak et al., 2004)

Type of PW by packaging material	Estimation of recovered PW quantities in 2003
Paper and cardboard	26.655
Glass	8.625
Metal	337
Plastic	4.866
Wood	9.285
Other	150
Hazardous packaging waste	40
TOTAL	49.958

The data from Tables 10, 11 and 12 allowed an examination to determine if the actual quantities of produced and recovered packaging waste match the step-by-step targets from The Operational Programme for the Management of Packaging and Packaging Waste for 2002-2007 Period (see Table 7). The estimation for the year 2003 showed 21.245 tons of packaging waste were recovered (or 12% of 182.000 tons produced), which is far from 36%-target. Using the estimated recovered quantity of 49.958 tons from Table 12, the share was much higher (27%) but still not enough. The quantity of produced plastic packaging waste was 36.000 tons of which 6% or 2.317 tons were recovered. The target-share from The Operational Programme is 9%. With the 4.866 tons of estimated recovered quantity from Table 12 the target-share for plastic packaging waste increased to 14%. Values for other packaging material are shown in Table 13.

Table 13: Estimated shares (%) of recovered packaging waste for 2003 (Source: prepared by author)

Type of PW by packaging material	Shares gathered from the actual quantities (Table 11)	Target shares from The Operational Programme... (Table 7)	Shares gathered from the evaluated quantities (Table 12)
Paper and cardboard	17	50	46
Glass	0	40	34
Metal	2	21	2
Plastic	6	9	14
Wood	22	23	25
TOTAL	12	36	27

From the Table 13, the following assumptions could be made:

- Reported recovered quantities of packaging waste in 2003 were really too small as estimated by Pušenjak et al.
- The recovery facilities in Slovenia are still on very low level; they have not met the requirements from The Operational Programme.
- The quantities of packaging waste from 1998, which were taken for "starting quantities" for the preparation of The Operational Programme, were estimated wrongly.
- Recovering of packaging waste is not favorable option of the treaters.

4.4 Results of the Analyzed Data

For the purpose of this thesis an analysis of the following data on packaging waste management in Slovenia was done as follows:

- Raw data, reported on Annual reports on handling packaging and packaging waste and Annual reports on treating waste, from the EARS waste database were analyzed on quantities of produced and treated packaging waste in the year 2004.
- Data obtained through the questionnaire sent to Slovenian handlers of plastic packaging waste were analyzed to find out how collecting and treating of plastic packaging waste was organized in 2002.

4.4.1 Quantities of Produced and Treated Packaging Waste in 2004

4.4.1.1 PRODUCED PACKAGING WASTE

As written by Koca and Nilsson-Djerf (2000), all packaging placed on the market in a particular year is about the same amount as the quantity of packaging waste being generated in the same year. The same assumption is valid for Slovenia as well.

Reporting was done according to The Rules on Handling Packaging and Packaging Waste by 1.068 obligors. Year 2004 was also a starting year for the trade companies that handle packaging waste to report on the amounts. Consequently, the data were gathered from two sides – from obligors themselves (nevertheless if they are self-compliers or members of trade company) and from the trade company Slopak (the second trade company Interseroh will do its first annual report for the year 2005).

Figure 11 shows the shares (%) by materials of produced packaging waste in 2004. Almost one third of the total amount of waste produced was paper and cardboard packaging waste. Plastic packaging waste was next at 20% of the total. Around 17% each represents wooden and glassy packaging waste and the remaining share goes to metal and composite packaging waste. Quantities of other packaging waste, like textile and mix, were negligible (0,1%) what represents the most commonly used packaging material is really the itemized one (paper and cardboard, plastic, wood, glass and metal).

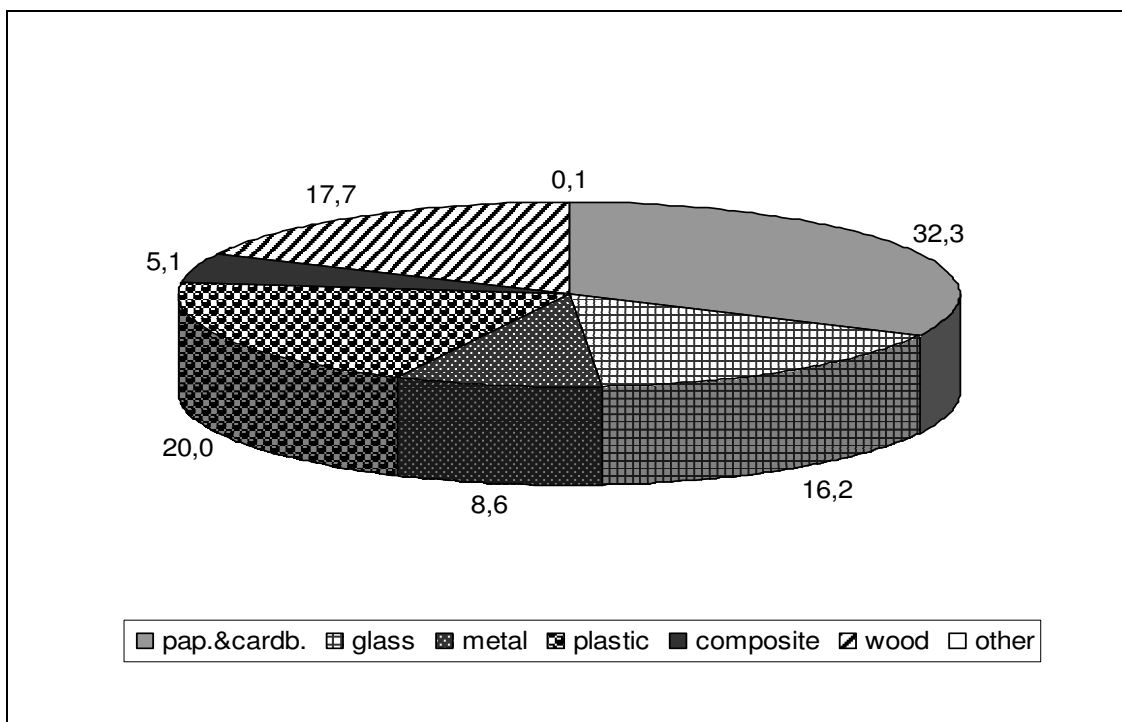


Figure 11: Weight shares (%) by materials of produced packaging waste in 2004 (Source: EARS waste database)

In 2004, 161.507 tons of packaging waste were produced. Regarding the data in Table 14, 80% or 125.712 tons of this quantity was included in the system for handling packaging waste and 20% or 35.795 tons was taken care by obligors themselves. Having in mind the additional 20.000 tons (approximately) of packaging waste from so called “free-riders” (legal persons avoiding their obligations from The Rules), the trade company for handling packaging waste already cover around 70% of total packaging waste produced in Slovenia in a calendar year. That could be considered as a good result for the first year of business.

32.345 tons of plastic packaging waste were produced and almost 90% of it (28.226 tons) was included in the system for handling packaging waste.

Table 14: Quantity in tons of packaging placed on the Slovenian market in 2004 (Source: EARS waste database)

Quantities in tons	PW reported by self-compliers	PW reported by SLOPAK	Total quantity of PW reported for 2004
Paper and cardboard	13.272	38.930	52.202
Glass	1.768	24.460	26.228
Metal	1.794	12.004	13.798
Plastic	4.119	28.226	32.345
Composite	390	7.894	8.284
Wood	14.322	14.198	28.520
Other	130	0	130
Total	35.795	125.712	161.507

Figure 12 represents tons of packaging waste by materials produced in 2004 and was the reporting done by obligors themselves or by the trade company for handling packaging waste. It is clear that the majority of produced packaging waste is handled by a trade company as is also shown above in Table 14. An exception is wooden packaging waste which is equally handled by obligors and by trade company. In a case of obligors or self-compliers, wooden packaging waste is mostly energetically recovered. For this kind of treating, a corresponding permit on internal recovery from EARS is needed but, it is suspected from practice that here a lot of incorrectness could be found.

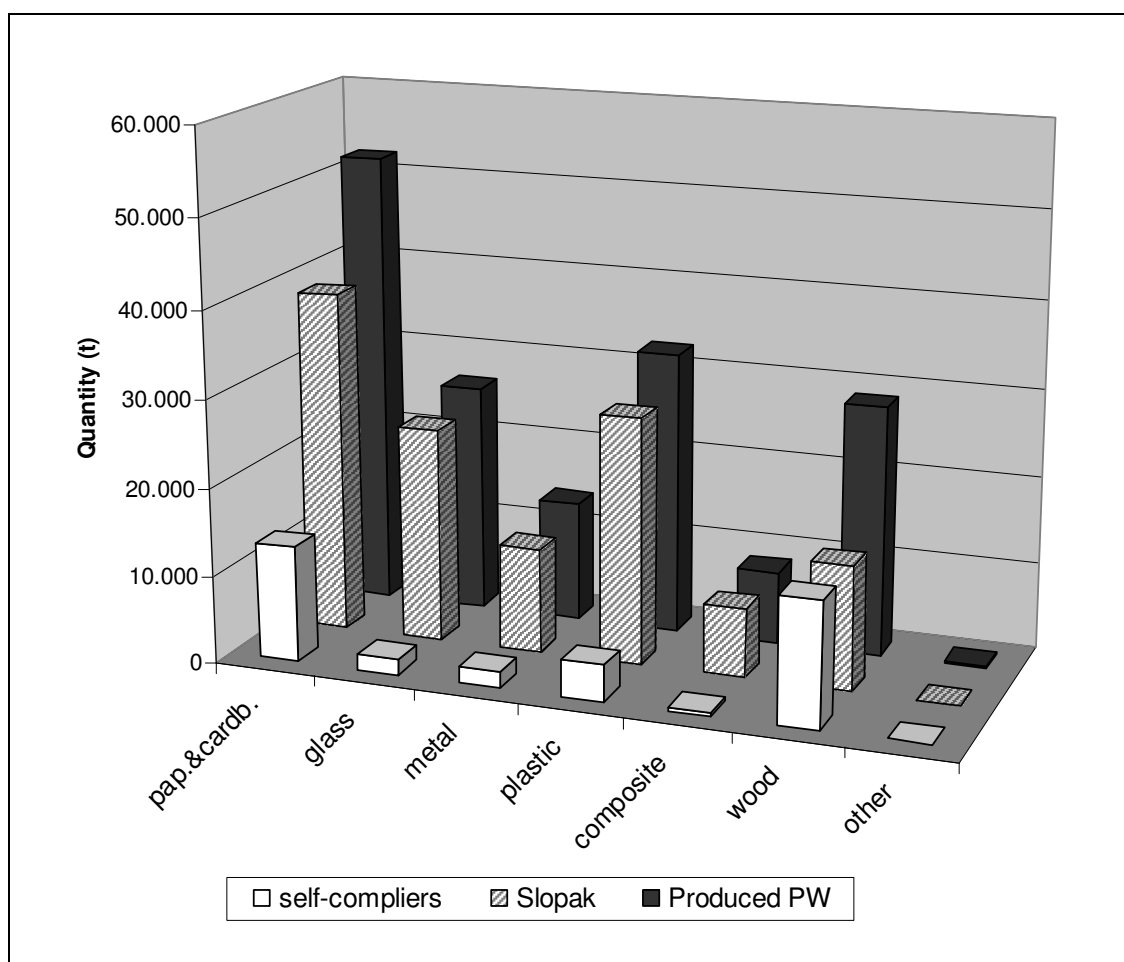


Figure 12: Quantities in tons of produced packaging waste reported to be handled by self-compliers and by SLOPAK, 2004 (Source: EARS waste database)

4.4.1.2 TREATED PACKAGING WASTE

Reporting was done according to The Rules on Waste Management. 124 treaters of waste filed reports and 23 of them reported on packaging waste. Those treaters were mostly specialized in treating (recovering/disposing) one type of packaging waste, four of them reported on treating more than one type of packaging waste. 21 of 23 packaging waste treaters reported on treating paper and cardboard, plastic and/or wooden packaging waste which is in accordance with the data from Figure 11. Only one treater reported recovering glassy packaging waste. This reflects that in Slovenia recovery facilities for glass are very poor. Consequently, glass must be exported if it is to be treated.

Weight shares by packaging material of treated packaging waste are shown in Figure 13. In 2004, 39.185,7 tons of packaging waste were recovered or disposed, and this amount represents 24% of total packaging waste produced. In other words, approximately one quarter of produced packaging waste was separated and collected with the intention of avoiding dumping.

The greatest share (43,7% or around 17.110 tons) goes to paper and cardboard packaging waste, which is followed by plastic (27,4%) and wooden (25,8%) packaging waste. Least of all were treated glassy and hazardous packaging wastes, while there was no treating on composite and other packaging waste.

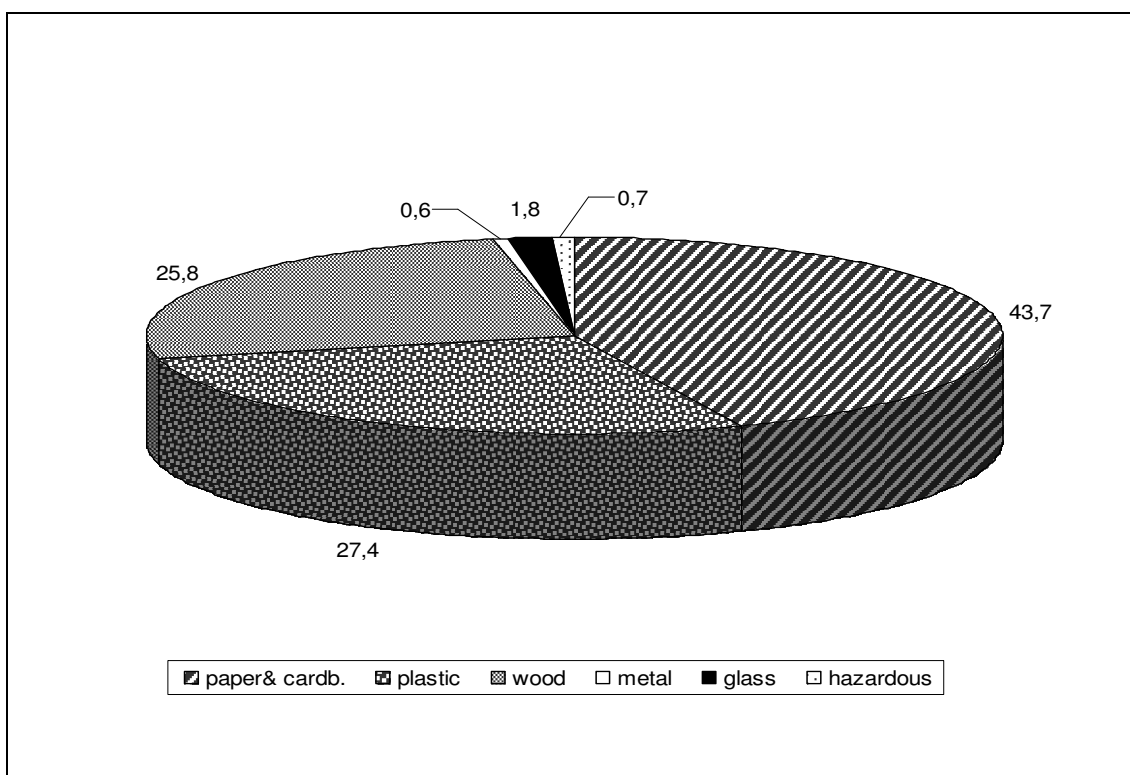


Figure 13: Weight shares (%) by materials of treated packaging waste, 2004 (Source: EARS waste database)

In what way packaging waste was treated is more precisely shown in Table 15 and Figures 14, 15 and 16.

In 2004, almost the entire quantity (99,2%) of 39.185,7 tons of treated packaging waste was recovered. Disposed were just 296,0 tons (0,8%) and 79,5% of that was packaging waste contaminated with hazardous substances.

Table 15: Quantities in tons and method of treating packaging waste (PW), 2004 (Source: EARS waste database)

Type of packaging waste	Paper & cardboard	Plastic	Wood	Metal	Composite	Glass	Hazardous	Other	total PW
Together recovery	17.101,1	10.757,3	10.042,3	240,0	/	720,0	28,9	/	38.889,7
Energy recovery	0	0	9.763,6	0	/	0	0	/	9.763,6
Organic recycling or other R3 process	5.569,9	6.767,7	278,7	0	/	0	0	/	12.616,3
Other ways of recovery	11.531,2	3.989,6	0	240,0	/	720,0	28,9	/	16.509,7
Together disposal	8,2	1,4	50,8	0	/	0	235,7	/	296,0
Incineration	8,2	1,4	50,8	0	/	0	46,3	/	106,6
Landfill	0	0	0	0	/	0	0	/	0
Permanent storing	0	0	0	0	/	0	0	/	0
Other ways of disposing	0	0	0	0	/	0	189,4	/	189,4
Together treated	17.109,3	10.758,7	10.093,1	240,0	/	720,0	264,5	/	39.185,7

Of the 38.889,7 tons of all recovered packaging waste, 25,1% went to energy recovery, 32,4% to composting or other R3 process and the rest 42,5% were recovered in some other way. Figure 14 represents the shares of recovered packaging waste by packaging material. The main groups of packaging waste which were recovered are paper and cardboard, plastic and wooden packaging waste. Paper and cardboard packaging waste was recovered through organic recycling and other ways of recovery (like production of recycled paper), thus there was no energy recovery. It was a very similar situation with the 10.757,3 tons of plastic packaging waste since there was no energy recovery. 97,2% of all treated wooden packaging waste was used for heating (energy recovery) and the rest was organically recycled. Glassy and hazardous packaging waste were recovered through other methods.

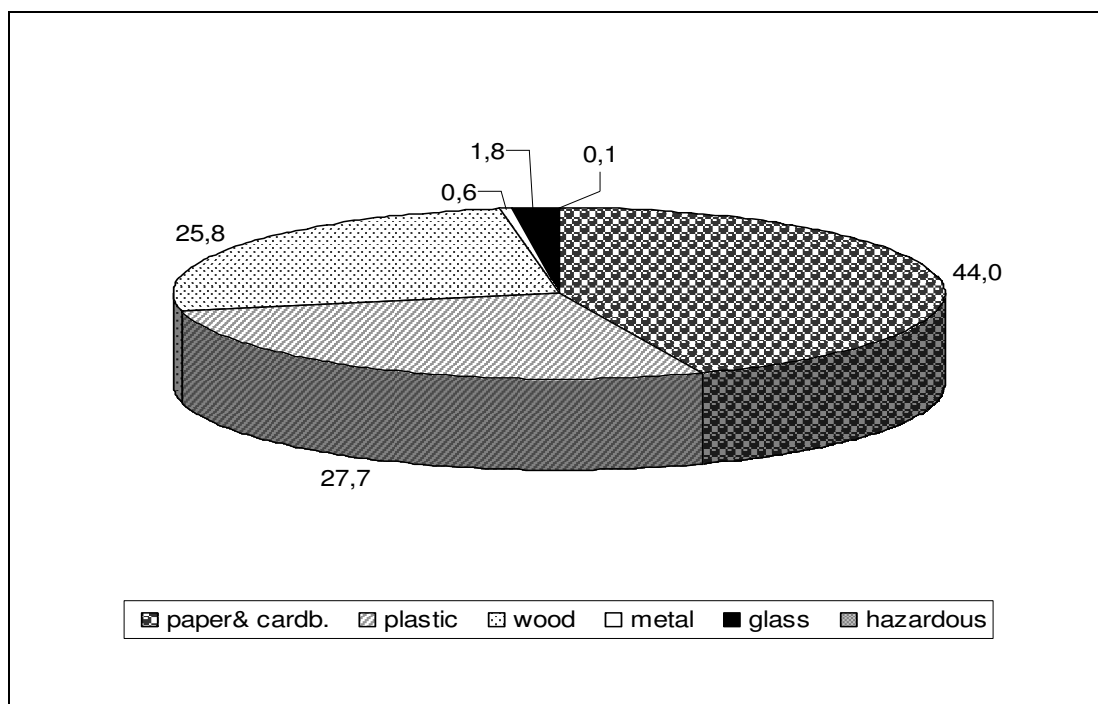


Figure 14: Weight shares (%) by materials of recovered packaging waste, 2004 (Source: EARS waste database)

Disposal included 296 tons of packaging waste. 36% was incinerated and the remaining 64% were disposed in other ways. There was no landfilling nor permanent storing of packaging waste meant for treating.

The shares of recovered packaging waste by packaging material are presented by Figure 15. The largest quantity (235,7 tons or 79,6%) disposed was hazardous packaging waste. Approximately 20% of it was incinerated and the remaining 80% was disposed in some other way.

Incineration was used for 50,8 tons of wooden packaging waste. Because exact data on quality of that wooden packaging waste are not available, we can only assume it was too contaminated to be energetically recovered. A minor quantity for paper and cardboard and plastic packaging waste (less than 10 tons together) was incinerated. The explanation could be the same as for the wooden packaging waste.

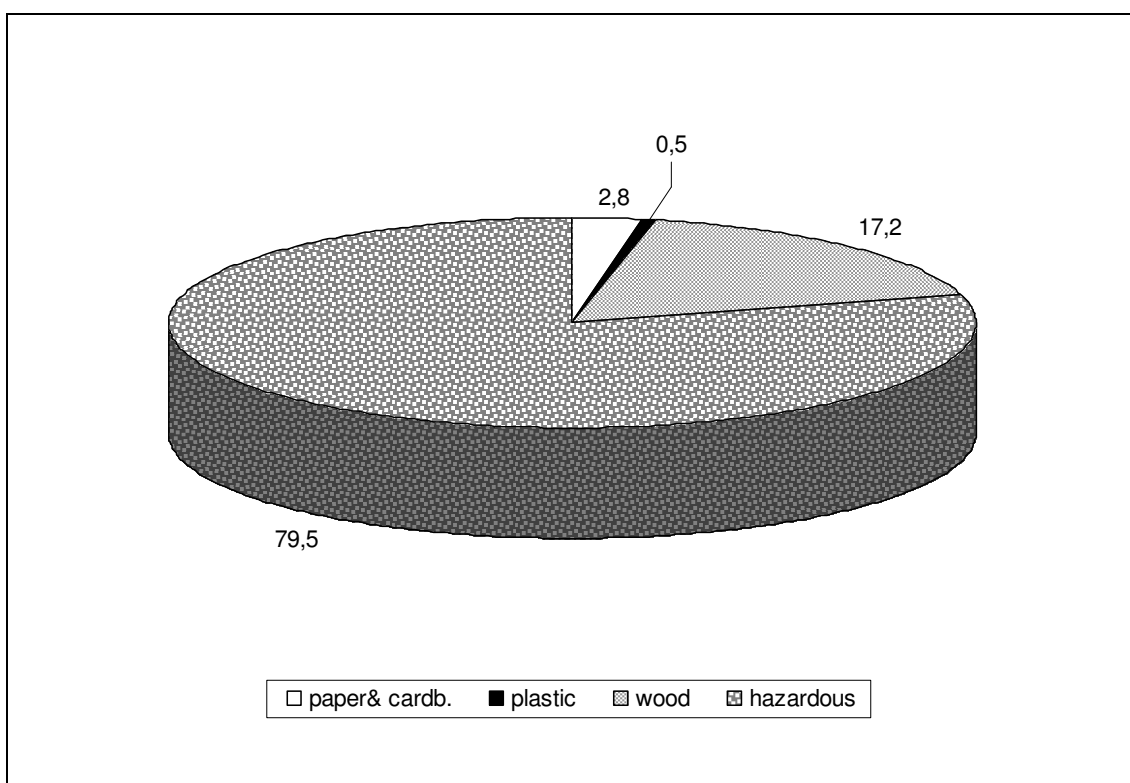


Figure 15: Weight shares (%) by materials of disposed packaging waste, 2004 (Source: EARS waste database)

How plastic packaging waste was treated compared to all packaging waste is shown in Figure 16. The majority of the 10.758,7 tons of treated plastic packaging waste was recycled and just a negligible quantity (1,4 tons) was disposed by incineration. Almost two thirds or 6.767,7 tons were recycled by method R3 from the Annex 4 of The Rules on Waste Management and the rest 3.989,6 tons were recycled through other methods from the same Annex.

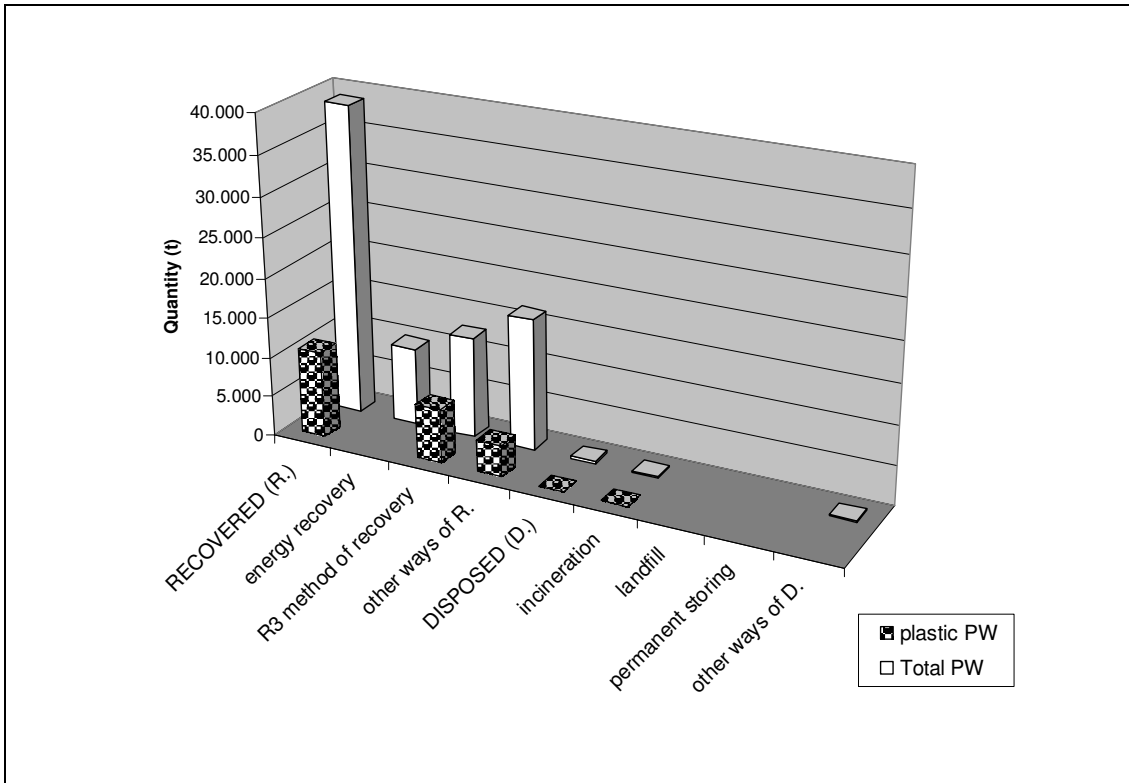


Figure 16: Quantities in tons and treating of plastic packaging waste (PW) and total PW, 2004
(Source: EARS waste database)

4.4.1.3 STATE OF PACKAGING WASTE IN 2004

The overall quantities of packaging waste produced and treated in Slovenia during 2004 are shown in Figure 17 and Table 16. The amount of produced packaging waste that was later internally recovered or disposed was not added to the quantities of packaging waste that were reported to be treated by official treaters. The intention was to have comparable quantities of packaging waste from previous years (2001-2003) where internal recovery/dispose was not included (Pušenjak et al., 2004) and the year 2004. But, because almost 2.000 tons of packaging waste were reported to be internally treated, some words on it are said at the end of this chapter.

Treated packaging waste was 39.186 tons. Regarding 161.507 tons of packaging waste produced, recovery in 2004 was 24% which is far from the 40% recovery target for 2004 in The Operational Programme (see Table 7). The recovery share of plastic and wooden packaging waste (33% each) was met and even exceed the required targets from The Operational Programme (12% and 28%). All other types of packaging waste were recovered in much lower amounts than those needed to reach the target shares mentioned in the Table 7. The 3% (instead of 42%) recovered glassy packaging waste could be explained by the fact that the majority is recovered outside the Slovenia (Pušenjak et al., 2004). The 2% of metal packaging waste recovered are extremely low compared to 25%-target. Similar situation is with the paper and cardboard packaging waste where instead of 55% just 33% were recovered. To explain this numbers some further research would be needed.

As discussed in chapter 4.3.2, the total quantity of packaging waste recovered in 2003 was evaluated to be too small by almost 60%. The situation in 2004 is better with the recovery of 38.889 tons of packaging waste, but still does not meet the evaluated 49.958 tons of 2003. Only plastic, wooden and hazardous packaging waste were recovered in higher amounts as evaluated for 2003. That raises a question whether reported recovered quantities of packaging waste are too small also for 2004.

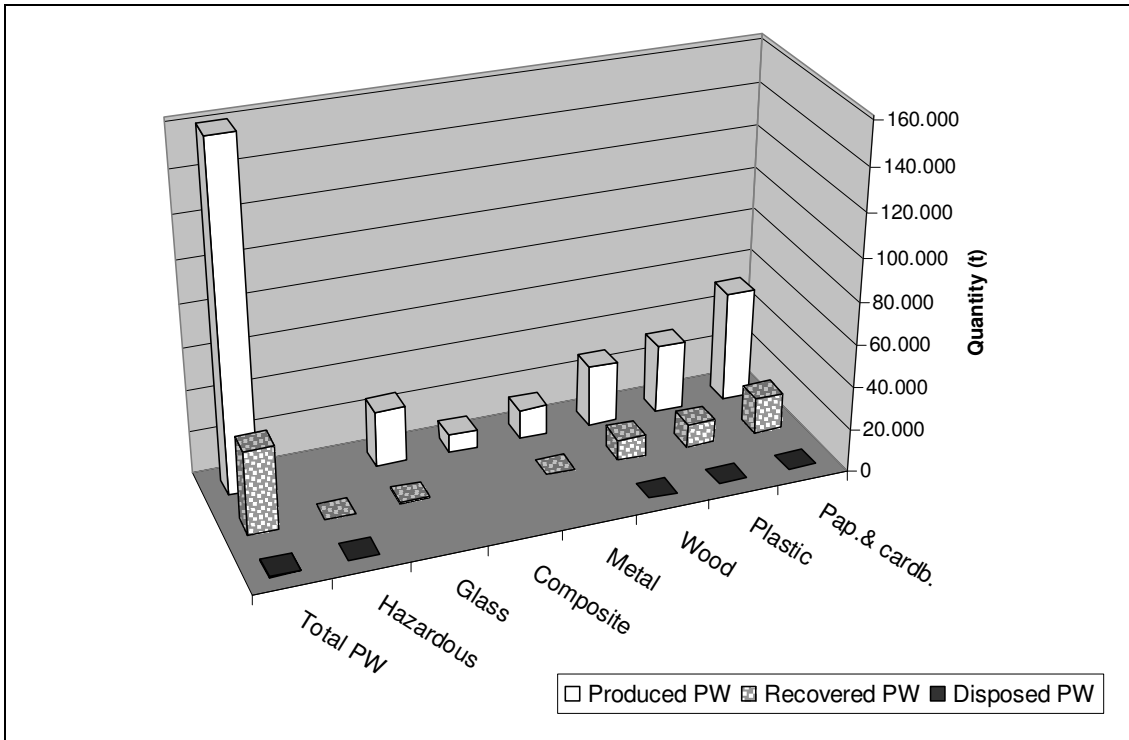


Figure 17: Quantities in tons of produced, recovered and disposed packaging waste by packaging materials in 2004 (Source: EARS waste database)

No treating was done on 8.284 tons of composite packaging waste. Hazardous packaging waste was mostly disposed which is the most common method of its treatment. Regarding the production of no hazardous packaging waste in 2004, the 265 tons treated were probably stored from the previous year.

Table 16: Quantities in tons of produced and treated packaging waste in 2004 (Source: EARS waste database)

Type of packaging waste (PW)	Paper & cardboard	Plastic	Wood	Metal	Composite	Glass	Hazardous	Other	total PW
Produced	52.202	32.345	28.520	13.798	8.284	26.228	/	/	161.507
Treated (R+D)	17.109	10.758	10.093	240	/	720	265	/	39.186
Recovered (R)	17.101	10.757	10.042	240	/	720	29	/	38.889
Disposed (D)	8	1	51	0	/	0	236	/	296

As mentioned above, 1.865 tons of packaging waste had been reported to be *internally treated*, 79% or 1.474 tons were recovered and the rest 21% (391 tons) were disposed. Internally recovered was mostly wooden packaging waste (1.134 tons). Energy recovery is assumed. That is probably true also for 82 tons of internally recovered paper and cardboard packaging waste, but is difficult to say for 235 tons of plastic packaging waste. Some metal and composite packaging waste (less than 25 tons both) was recovered internally also. The data on 196 tons of hazardous packaging waste being internally disposed is of concern because its proper disposal cannot be confirmed. Not only hazardous but also wooden and paper and cardboard packaging waste were internally disposed. Here is another doubt – was this really internal disposing or was a misunderstanding of methods of recovery and dispose thus the correct naming would be an internal (energy) recovery?

Nevertheless, even with the internally recovered quantities of packaging waste included, the 40% target share for 2004 from step-by-step plan of The Operational Programme was not met.

4.4.2 Handling of Plastic Packaging Waste in Slovenia in 2002

In 2003, a questionnaire was sent to chosen handlers of plastic packaging waste about how this waste was managed in the past calendar year. The selection was done according to the database of the Chamber of Commerce and Industry of Slovenia where a search was done to find legal persons with a valid EARS permit to handle (collect and recover) plastic packaging waste. 70 handlers were found who had EWC number 15 01 02 for plastic packaging waste included in their permit. Thus, the sample was made of 70 units. Each of the units was sent a questionnaire, together with an explanation letter and an envelope for returning the answers. The questionnaire consisted of 11 fixed-choice questions and 3 questions were open-ended. A more detailed construction of the questionnaire is shown in Annex II. Handlers were asked about origin, quantity, quality and type of plastic packaging waste; which part of Slovenia they cover, is there any quality standard, what they do with plastic packaging waste after collection, who are their buyers and why, do they envisage expansion of the company and why,...

27 or 38,6% of 70 sent questionnaires came back. Three of them were useless since they were handlers of hazardous packaging waste, and the primary activity of three more was not handling plastic packaging waste. From these results we can presume that the registration of a legal person for handling plastic packaging waste does not necessarily mean that an enterprise really works with it.

The number of useful returned questionnaires was 21, which is 30% of all the questionnaires sent out. Regarding to information from "wikipedia" (Internet 7), a usual response rate of postal survey is 5-30%. Having in mind that all handlers, thus the whole population of them, were invited to cooperate in this survey, the response rate was good.

Slovenia has twelve statistical regions. The majority of handlers officiate in their own region, some are also covering neighboring regions and only a few are covering the whole country. Most often their main activity is the collection of plastic packaging waste and its sorting in their own collecting-sorting center to prepare it for transition to treaters who are specialized in recovery. Just a few handlers also do the recovery of plastic packaging waste by themselves. None of handlers do energy recovery of plastic packaging waste which is in accordance with The Operational Programme where just wooden packaging waste is supposed to be energetically recovered in the year 2002.

Two thirds of handlers have or are in the phase of implementation of ISO 9001 certificate for "quality" or/and ISO 14001 certificate for "environmental-friendly business". This was evaluated as a positive attitude since having at least one of those certificates give a potential customer a kind of insurance on company's operation so it could be trusted on quality of their products.

Almost 80% of the plastic packaging waste is gathered by the handlers themselves or is handed over to them by legal persons who produce the packaging waste (e.g., industry). A small part is handed over by local public waste services.

Around 50% of plastics, which are meant for recovering, represent foils. Another 40% represent different bottles of drinks and cleansers. The remaining 10% of recovered plastic packaging waste are mostly bigger pieces of packaging (>20 liters) like big-bags and other kinds of packaging waste (from cosmetics, boxes for fruits and vegetables, etc.), including styropor (EPS). 75% of handled plastic packaging waste is represented by PET, HDPE, PVC, LDPE and PP type of plastic. The highest share (almost 20%) goes to PET type of plastic, 30% to HDPE and PVC and 26% to LDPE and PP types of plastic. The quantity of types of plastic packaging waste handled is distributed a little bit differently: almost 70% goes to HDPE and LDPE, followed by PET with 13% and PP type with 9%. The total quantity of reported handled plastic packaging waste was around 7.500 tons.

End-products of the recovery process are pellets and granulates. Buyers of recycled plastic from plastic packaging waste are national companies of all sizes and middle-sized foreign companies. Decisions on buying are made on the basis of quality and favorable price.

Also considered was the question if handlers have any kind of benefits regarding what they do, like treat packaging waste and as an outcome, the quantity of waste being landfilled is reduced. It has shown that being a handler is just one more option for a business and Slovenia as a state treat them as any other company. In spite of that, the majority of handlers intend to extend their business. Mostly they would like to introduce new processes / technologies (like more precise sorting of plastic packaging waste and later baling of it) or make the current ones better and, of course, they would like to be able to handle bigger quantities of plastic packaging waste and also have more clients. Just two of all investigated handlers didn't foresee growing of their activities in next 5 years.

The results of the questionnaire are summarized in Figure 18 where the pathway of plastic packaging waste in Slovenia is shown. The dotted arrows represent the part of the pathway that was not included in the questionnaire but is indicated to close the loop.

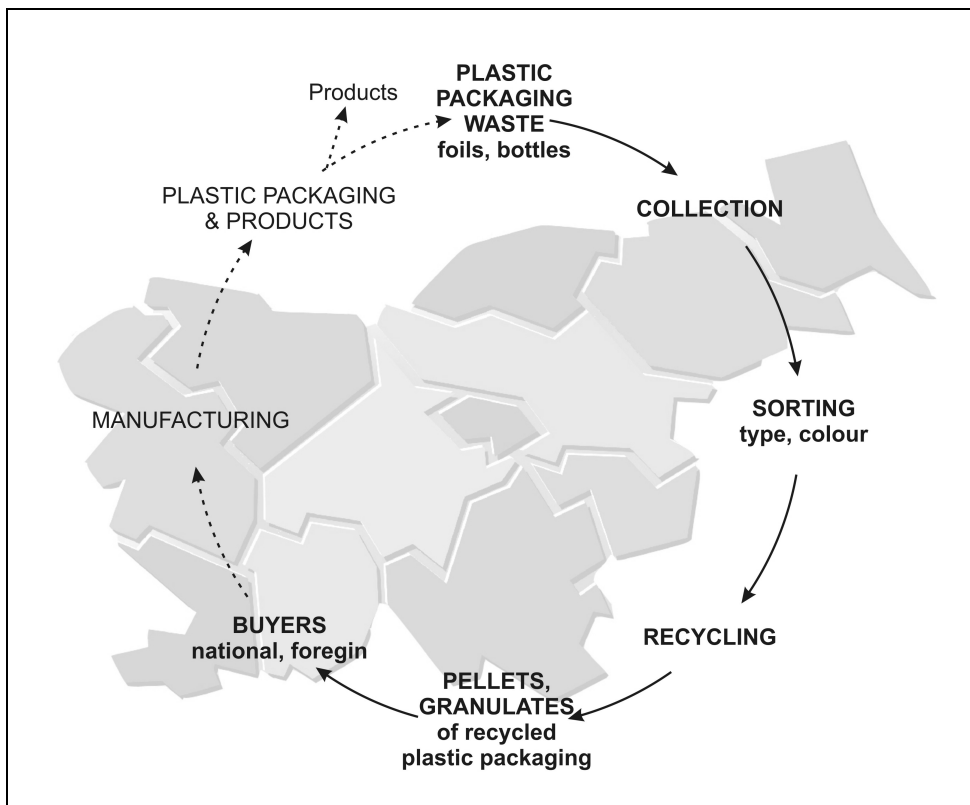


Figure 18: Pathway of plastic packaging waste in Slovenia (Source: prepared by author)

4.5 Packaging Waste Management System in Slovenia compared to the other EU Countries

Slovenian producer-responsibility packaging waste management system began work in 2001 when The Rules on Handling Packaging and Packaging Waste (OG RS 104/00) came into force. As mentioned in Chapter 4.2 the first trade company for handling packaging waste with a permit from EARS began work in 2004, thus it could be said that since then the loop of the packaging waste flow is closed.

A summary of the quantities of packaging waste produced and recovered from the first year of active packaging waste management system till 2004 is shown in Table 17. The amounts of plastic packaging waste are additionally emphasized. In general, the quantities of produced and recovered packaging waste are growing annually but the target total recovery shares from The Operational Programme were not met in any one year. The situation is a bit different with the recovery targets for the plastic packaging waste where the achieved ones in 2001, 2002 and 2004 are even higher from those targeted (Table 18).

Table 17: Quantities in tons of produced and recovered packaging waste (PW) in 2001-2004 period (Source: EARS waste database)

Year	2001	2002	2003	2004
Produced PW	157.481	177.547	182.000	161.507
Recovered PW	12.252	21.396	21.245	38.890
Produced plastic PW	29.883	31.463	36.000	32.345
Recovered plastic PW	3.026	4.529	2.317	10.757

Table 18: Targets from The Operational Programme and achieved recovery shares for packaging and plastic packaging waste (PW), 2001-2004 (Source: EARS waste database and The Operational Programme..., OG RS 29/02)

Year and shares (%)	2001		2002		2003		2004	
	Target recovery share	Achieved recovery share	Target recovery share	Achieved recovery share	Target recovery share	Achieved recovery share	Target recovery share	Achieved recovery share
Total PW	29	7,8	31	12,1	36	11,7	40	24,1
Plastic PW	5	10,1	7	14,4	9	6,4	12	33,3

Like in the EU, the packaging waste quantity has followed the growth of the GDP (Figure 19). The exception is the last year (2004) when the amount of generated packaging waste represents 89% of the amount of the previous year. This could be interpreted as a start of decoupling economical growth and packaging waste production which is a measure of the fulfillment of the basic aim of the EU packaging directive – reducing the generation of packaging waste. But, having in mind estimated 20.000 tons of packaging waste to be produced in 2004 by “free-riders”, a more realistic comment would be that in 2004 the quantity of packaging waste produced has stabilized compared to 2003 and the GDP still grew.

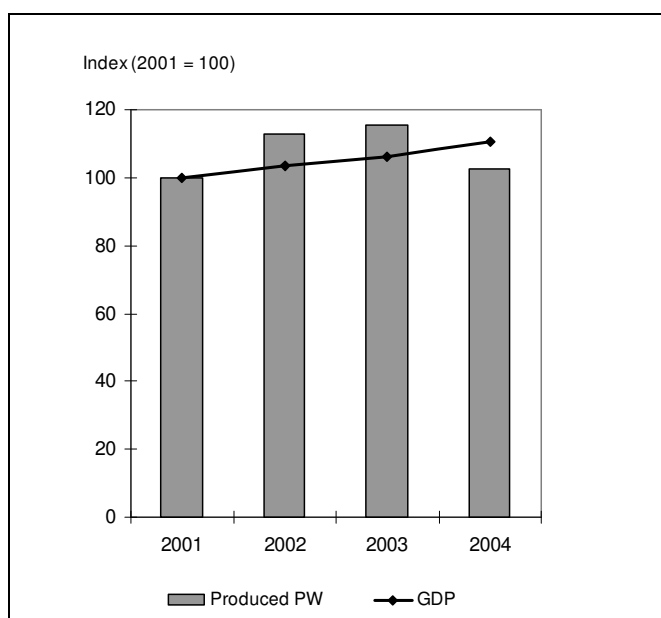


Figure 19: Produced packaging waste in Slovenia and GDP, 2001-2004 (Source: EARS waste database and Internet 14)

To get an impression if Slovenia's "raw and young" packaging waste management system works and is designed in the correct and also a realistic way, a comparison with the systems of the following selected EU countries: Austria, Ireland and Denmark was made.

Austria was chosen because it borders to Slovenia and the general life style of its citizens is known to Slovenians. Austria also has a long and successful tradition in handling packaging waste. Besides being small, Ireland was interesting for this research because it has started from a very beginning on setting the packaging waste management system. It has gone through a similar process of implementing the EU packaging directive and building a system to manage packaging and packaging waste just as Slovenia has. The story of Denmark is different. It does not have a producer-responsibility scheme for packaging but is managing it through a general fee/ tax on packaging. Thus, Denmark was selected to represent a different approach and to check if it could be applicable also in Slovenia.

A brief review of packaging waste management systems in the Member States mentioned follows. A more detailed presentation was made in the Chapters 3.5.1, 3.5.2 and 3.5.3.

The Austrian and Danish packaging waste management systems were fully or partly implemented before the introduction of the packaging directive. Austria was in a transposition phase before entering the EU in 1995, and was therefore implementing several ordinances on waste which increased the cost of waste management. Thus, Austria decided on a producer-responsibility system covering all types of packaging waste which obliged the producers to cover the costs. In Denmark, local authorities are in charge of management of all waste. In practice, however, only household packaging waste is collected on behalf of the authorities while commercial packaging waste is often the responsibility of the companies themselves. Both systems have been amended to comply with the requirements of the packaging directive. Ireland had implemented its packaging waste management system in 1997 as a direct consequence of the packaging directive. Because of its geographic specifics Ireland received a derogation from the targets which meant that it was only obliged to achieve 25% recovery by 2001 (EEA Report 3/2005, 2005).

Austria, as one of the most successful EU country in recycling packaging waste, has in 2001 already achieved 73% share of recovered packaging waste which was far above the target from the packaging waste directive of minimum 50% recovery (and maximum 65%). Denmark was even more successful with 90% and both countries have exceeded also the minimum 60% target from the packaging directive amendment 2004/12/EC. Ireland achieved 27% share of recovery packaging waste so the derogated target of 25% mentioned above, was fully met as it is presented in the Table 19. For Slovenia the data for 2001 and 2004 is shown for a comparison with the quantities of the selected Member States and to show that Slovenia's system is making progress since the share of recovered packaging waste increased significantly.

Table 19: Recovery of total packaging waste in 2001 and packaging directive targets (Source: EEA Report 3/2005, 2005 and EARS waste database*)

Member State	Recovery in tons	Share of recovery (%)	Packaging directive target 2001 (%)	Packaging directive target 2008 (%)
Austria	800.810	73	50	60
Denmark	926.100	90	50	60
Ireland	221.400	27	50	60
Slovenia*	2001	12.252	8	60
	2004	38.890	24	60

Table 20 shows that in 2001, Austria already achieved the recycling target 22,5% of the packaging directive amendment 2004/12/EC for the plastic packaging waste. Denmark has missed the 2001 recycling target 15 % for plastic packaging waste by just 1 percent. Having in mind the totally new system for managing packaging waste in Ireland, 12 percent of recycled plastic packaging waste (instead of 15 for 2001) demonstrates progress is being made. That packaging waste management system in Slovenia is really young could be again seen from the data for 2001 when 10% of plastic packaging waste were recycled/recovered but the data from 2004 show that 33% of generated plastic packaging waste were recycled/recovered what is already higher than 2008 packaging directive target of 22,5% from the amendment 2004/12/EC.

As showed in Table 5 (Chapter 3.5), the costs of handling plastic packaging waste in Austria are the highest (230 EUR/ton for non-municipal and up to 700 EUR/ton for small municipal plastic packaging). Slovenia has the lowest costs by 28 to 75 EUR/ton, but it also has the youngest packaging waste management system. The 74 EUR/ton, needed for handling plastic packaging waste in Ireland could also be reflecting the young system for handling packaging waste. Denmark does not have a producer-responsibility scheme, but has introduced a general landfill tax (50 EUR/ton) and incineration tax (44 EUR/ton) for waste, and some very high extra taxes on plastic packaging (1.000-3.000 EUR/ton).

Table 20: Recycling of plastic packaging waste in 2001 and packaging directive targets (Source: EEA Report 3/2005, 2005 and EARS waste database*)

Member State	Recovery in tons	Share of recovery (%)	Packaging directive target 2001 (%)	Packaging directive target 2008 (%)
Austria	59.000	29	15	22,5
Denmark	17.100	14	15	22,5
Ireland	20.000	12	15	22,5
Slovenia*	2001**	3.026	10	22,5
	2004	10.757	33	22,5

** it was assumed (regarding to the data form 2004) that the quantities of recovered and recycled plastic packaging waste were equal

Measures for encouraging prevention of produced packaging waste and measures for encouraging recycling/recovery of packaging waste introduced in the selected countries and in Slovenia are shown in Table 21. Interesting is that Austria has just one prevention measure – producers' responsibility, and other measures are focused on recycling/recovery goals. In Denmark and Ireland measures are rather equally aimed at prevention and recycling/recovery. Current situation in Slovenia is more favorable to recycle/recovery measures but two measures of prevention are in preparation so a balance would be reached.

Table 21: Measures aimed at prevention (P) and recycling/recovery (R) (Source: EEA Report 3/2005, 2005 and prepared by author*)

Type of Measures	Austria		Denmark		Ireland		Slovenia*	
	P	R	P	R	P	R	P	R
Administrative instruments								
Producer responsibility	✓	✓			✓	✓	✓	✓
Prevention programmes								
Awareness raising			✓	✓	✓	✓		✓
Mandatory collection		✓		✓				
Landfill ban for certain wastes		✓		✓	✓	✓	✓**	
Support to cleaner production			✓	✓				
Improving markets for recyclables								
Economic instruments								
Landfill tax		✓		✓	✓	✓		✓
Packaging/plastic bag tax			✓		✓		✓**	
Tax on the use of certain resources			✓					
Subsidy for collection of recyclables								

** in preparation

5 DISCUSSION

Packaging waste is an important and growing waste stream (EEA Report 3/2005, 2005). Because packaging waste cannot be avoided, its management is necessary for health protection and also for social, economic and environmental reasons. Packaging protects products from contamination and from damage during transportation, handling and storage. Without packaging, many products would be inadequately protected and as a result would also become waste, having more severe consequences for the environment than packaging and packaging production. The functions that are performed by packaging are taken for granted by society even though their true value is not always appreciated. The only thing that people consciously perceive is the empty packaging because they buy products, not packaging. After product consumption, only packaging is left, thus many consumers then consider it to be useless. This constitutes a packaging paradox: packaging effectively protects products and, afterwards, it becomes a material that needs to be managed (Pro Europe, 2005).

A general method for organizing information about the state of the environment is a DPSIR (driving forces, pressures, state, impacts, responses) framework assessment (Figure 24). It is a logical and good way to structure the information with the purpose of making visible the links between the causes of environmental problems, their effects on the state of the environment, and relevant societal responses. The use of this framework increases the comparability of information, but it does not require a full harmonization of themes and indicators (UNEP/GRID-Arendal, 2000).

Packaging waste is an issue in every European country, and its quantities are generally growing (EEA Report No.10, 2003). The same phenomenon could be already seen also in Slovenia since the data on the quantities of produced packaging waste are available. A probable explanation would be increasing standard of living together with the growing buying power of citizens. Another and very believable reason is also annually growing number of reports on packaging and packaging waste to EARS.

Figure 20 shows the motion of packaging waste produced in Slovenia, GDP and number of obligors who reported from 2001 to 2004. In all four years, the number of obligors who reported on packaging waste and the GDP was growing. Very similar was also with the moving of quantities of packaging waste produced since the growth decreased just in 2004. As mentioned in the chapter 4.5 this could be interpreted as a first year of fulfillment of the primary purpose of the EU packaging directive on packaging waste prevention. When taking in consideration around 20.000 tons or 12% of packaging waste from “free-riders” that were not reported, the more likely explanation would probably be that generation of packaging waste in 2004 has stabilized regarding to the previous year and the decoupling has not yet began.

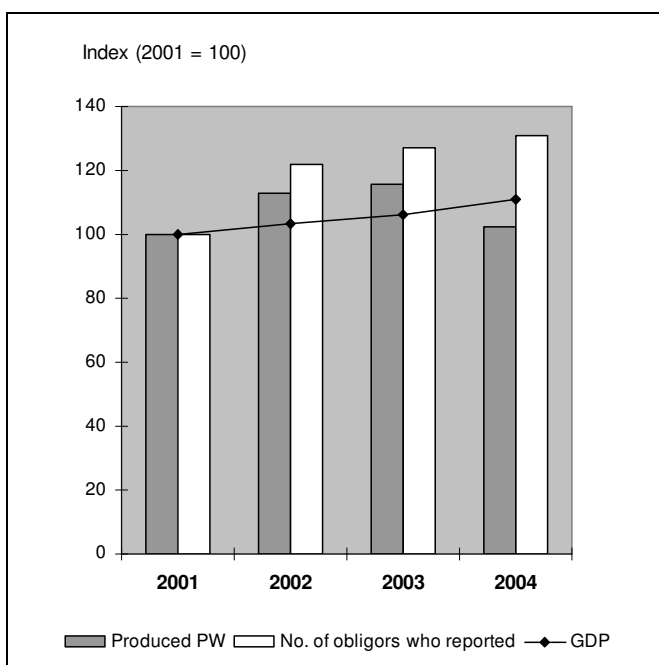


Figure 20: Growing of quantities of produced packaging waste (PW), GDP and number of obligors who reported, 2001-2004 (Source: EARS waste database and Internet 14)

The first reporting on produced packaging waste was done for the year 2001 according to The Rules on Handling Packaging and Packaging Waste and the reported quantity was 157.481

tons. The next year quantity increased by almost 13%, but in 2003 the growth was just 2,5%. From Figure 20 is evident that the quantity of packaging waste produced decreased for a good 11% or to 161.507 tons but the number of obligors who reported still increased. In 2004, 1068 of approximately 1200 obligors filed their reports so almost 90% performed their obligation on reporting from The Rules.

The reason for the decrease in the quantity of 2004 could be the non-reported 20.000 tons as mentioned above or, as Pušenjak et al. (2004) have estimated for the situation in 2003, the obligors are still making significant mistakes when filling out the reports. The latter could mean those who legally manage packaging waste are still not comfortable with The Rules. However, the average 80-90 kg of packaging waste produced per capita is almost half of the EU-15 average of 172 kg per capita (EEA Report 3/2005, 2005).

The quantities of plastic packaging waste are following the movement of total produced packaging waste through all period 2001-2004. In 2004, 32.345 tons of plastic packaging waste were generated, and the majority (almost 90%) was included in the system of trade companies for handling packaging waste.

In general, the generation of waste reflects a loss of materials and energy, and imposes economic and environmental costs on society for its collection, treatment and disposal (EEA Report No.10, 2003). Waste separation is a first step to improving environmental behavior as it is a daily task that everyone accepts. Today more than 230 million Europeans sort their packaging waste for recovery, and consequently, less is being deposited in landfill sites. The volume of recovered packaging increased from 31 million tons in 1997 to 39 million tons in 2001 (Pro Europe, 2005).

Although Slovenia adopted The Rules on Handling Packaging and Packaging Waste before joining the European Union in May 2004, the system for managing packaging waste was not yet fully established. Some separate collection of packaging waste was present for a long time, especially for materials such as paper and cardboard and glass, but there was no united system for the whole country. The changes began in 2000 with the adoption of The Rules when the first targets for recovery rate in Slovenia were defined. With The Rules was also decided that packaging waste management system will be based on a "producer-responsibility" scheme. The Operational Programme for the Management of Packaging and Packaging Waste for 2002 – 2007 Period (OG RS 29/02) introduced a step-by-step plan for achieving recovery targets to fulfill the requirements of the Rules and also of the packaging directive.

Figure 21 shows that planned recovery targets for total packaging waste were not met in any one year, but the share of recovery is generally growing. The shares achieved for plastic packaging waste recovery were even higher than demanded in The Operational Programme and are also generally growing. In 2004, 38.889 tons of packaging waste were recovered, almost 28% or 10.757 tons were of plastic packaging waste. The share of total recovery was 24,1% and for plastic packaging waste was 33,3%. A general decrease in recovery in 2003 could be interpreted as a result of verified correction of produced packaging waste quantities (Pušenjak et al., 2004) and since the recovered quantities were just estimated to be too small they were left out of consideration and the reported ones were used to calculate the recovery share. If the

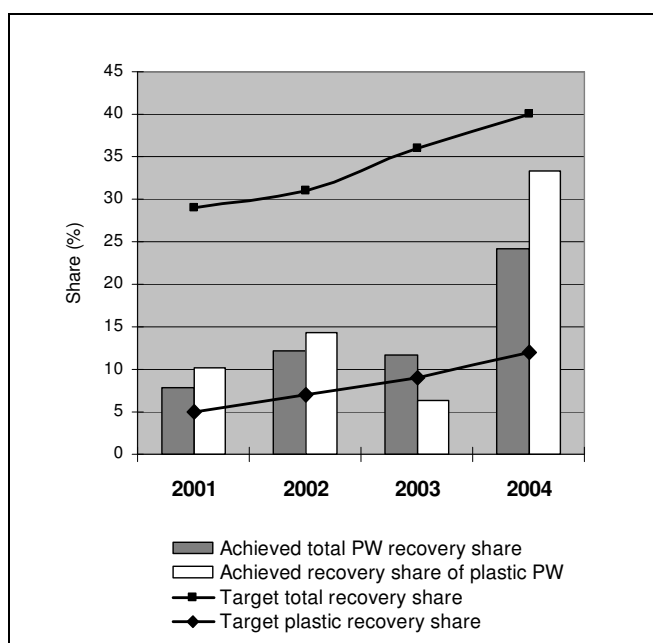


Figure 21: Achieving the total and plastic recovery target from The Operational Programme, 2001-2004 (Source: EARS waste database and The Operational Programme..., OG RS 29/02)

estimated quantities of recovered packaging waste would be considered, the recovery share for 2003 would be 27,4% for total packaging waste and 13,5% for plastic packaging waste so there would be no decrease in recovery share regarding to the previous year.

The average total recovery share in the EU-15 in 2001 was 60%, and the target share of the packaging directive 94/62/EC is 50%. In Ireland, which established the packaging waste management system in 1997 as a consequence of the implementation of the packaging directive, the recovery share of packaging waste achieved in 2001 was 27%. Regarding these data, it could be concluded that reaching a 24% recovery share in just three years of the establishment of the Slovenian packaging waste management system is not a bad achievement. Anyway, based on the experiences of Austria and its successful packaging waste management system, it can be estimated that Slovenian system will fully operate in about 10 years from now. The trade company for handling packaging waste *Slopak* has reported for the first year of activity on handling around 78% (125.712 tons) of total packaging waste produced in 2004 and the other company *Interseroh* anticipates collection of approximately 5.000 tons of packaging waste in their first year (2005) and 10.000 in the second. Still, the major and general goal is increasing recovery/recycling shares to be able to fulfill the requirements of Slovenian and European legislation. After that goal is reached, efforts should be directed to the decoupling process to reduce the quantities of generated packaging waste.

In our opinion, the EU packaging directive recycling and recovery targets for 2001 are not so relevant for Slovenia while it has joined the EU in 2004 and the targets were supposed to be met no later than 30.06.2001. This means the focus should be on the targets for 2008 from the amendment 2004/12/EC on the packaging directive although a derogation until 2012 was approved for Slovenia and other nine new Member States.

Figures 22 and 23 are presenting how successful Slovenia is in meeting the 2008 EU recovery targets – a minimum of 60% for total recovery and 22,5% for recycling of plastic packaging waste.

For total packaging waste annual growth of recovery share is shown. As mentioned above, the recovery share in 2004 was 24% which is not even a half of the target share of 60% (Figure 22). It is assumed the share will continuously grow but to predict if the target share will be achieved some further research should be done.

When analyzing the shares of recycled plastic packaging waste an assumption on the recycled quantities was done. The data from 2004 show that plastic packaging waste was not energetically recovered. Therefore, it could be said recovery was equal to recycling. The same assumption was made for the quantities of 2001 – 2003 so a comparison to the EU target was possible.

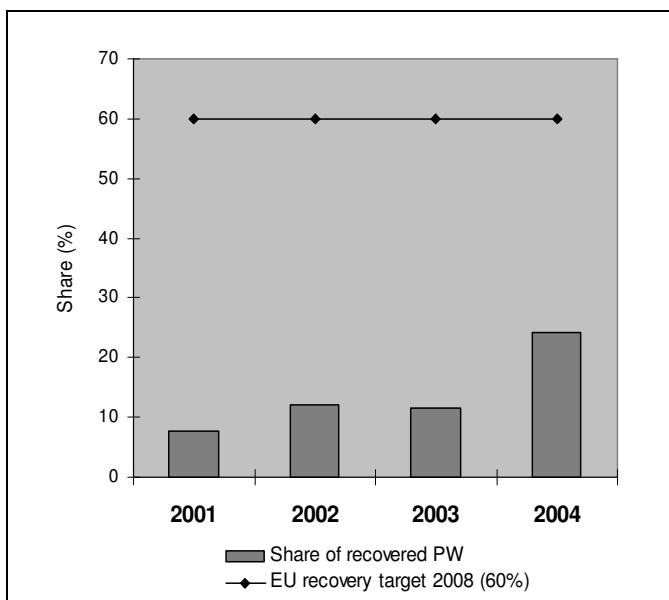


Figure 22: Shares of recovered packaging waste regarding to the EU recovery target 60%, 2001-2004 (Source: EARS waste database and the Directive 94/62/EC)

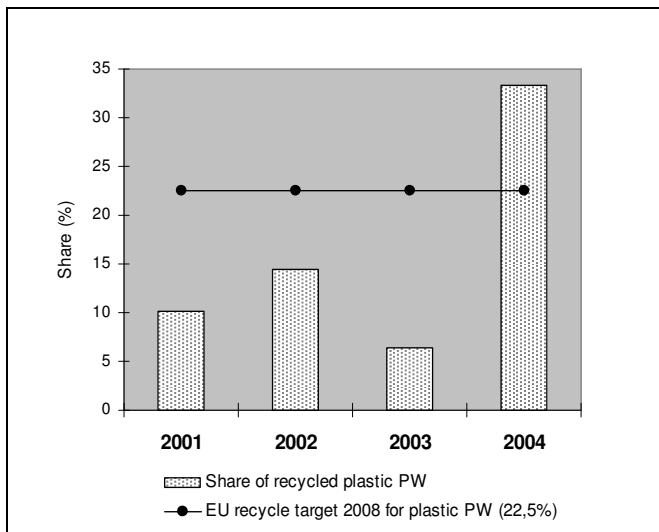


Figure 23: Shares of recycled plastic packaging waste regarding to the EU recycling target 22,5%, 2001-2004
(Source: EARS waste database and the Directive 94/62/EC)

Figure 23 shows the annual growth of recycled plastic packaging waste shares and in 2004, the achieved share of 33,3% exceeded the target one for almost 50%. Thus, for 2004 Slovenia has met the EU target of 22,5% recycled plastic packaging waste and regarding to the “over-plus” we estimate that the target will be reached any one year until the 2008.

The decrease in the year 2003 was already discussed with Figures 20 and 21.

A major challenge to increase the level of recycling in the EU countries is the establishment of a more comprehensive collection and recycling schemes (EEA Report No.10, 2003). The challenge for the Member States in the coming years will rather be to utilize each other's experiences than to find new solutions while there is a large potential for continuous cooperation and exchange of technological and organizational experiences to reach important progress in packaging waste management (Jacobsen and Kristoffersen, 2002). Perhaps the greatest challenge will be a development of “more friendly” markets for recycled materials and products that will ensure the long-term viability of recycling systems (EEA Report No.10, 2003).

When talking about plastic packaging waste it must be taken into account that when plastic packaging waste is recycled, it is made available for use in several future life cycles and can therefore replace virgin material more than just once. A recycled material is not at the “end-of-life” phase of the life cycle, it is entering a new life cycle as a raw material (Internet 15).

Through this research on methods of handling plastic packaging waste in Slovenia in 2002 it was found that the main activity of the handlers is collection and sorting plastic packaging waste for subsequent transfer to the treaters. About 50% of plastic packaging waste collected represent foils and another 10% is represented by bigger pieces of packaging. This speaks on behalf of less problematic non-municipal packaging waste which is, compared to municipal one, much cleaner and less contaminated. In a light of further treating, it means less time and energy needed to prepare the material for final recovery process. As discussed in the chapter 4.4.2, the end-products of recovery are pellets and granulates which are manufactured into new products by Slovenian or foreign companies.

An example of how an ordinary and daily thing such as a telephone card influences on the generation of waste is given below. Although it is not a packaging it is made from plastic material and we believe it is representative enough to show how a small change in manufacturing and managing of the product could make a significant difference in the perception of waste-treatment.

In 2001, a small research was done by Orlando et al. on using public-payphone and mobile telephone cards in Slovenia and their environmental impact was evaluated. Based on the data on quantity of public-payphone cards sold and on the information that this quantity is negligible compared to sold mobile cards, the estimated total amount of all disposed phone cards in 2000 was between 30 and 3.000 tons. Possible alternatives, suggested to diminish the environmental impact, included a redesign of the public-payphone cards to be refillable and made from recyclable plastic while for mobile phone cards avoidance was shown to be the best option. To be successful in decreasing the amount of landfilled cards a cooperation among phone-companies, government and public was emphasized.

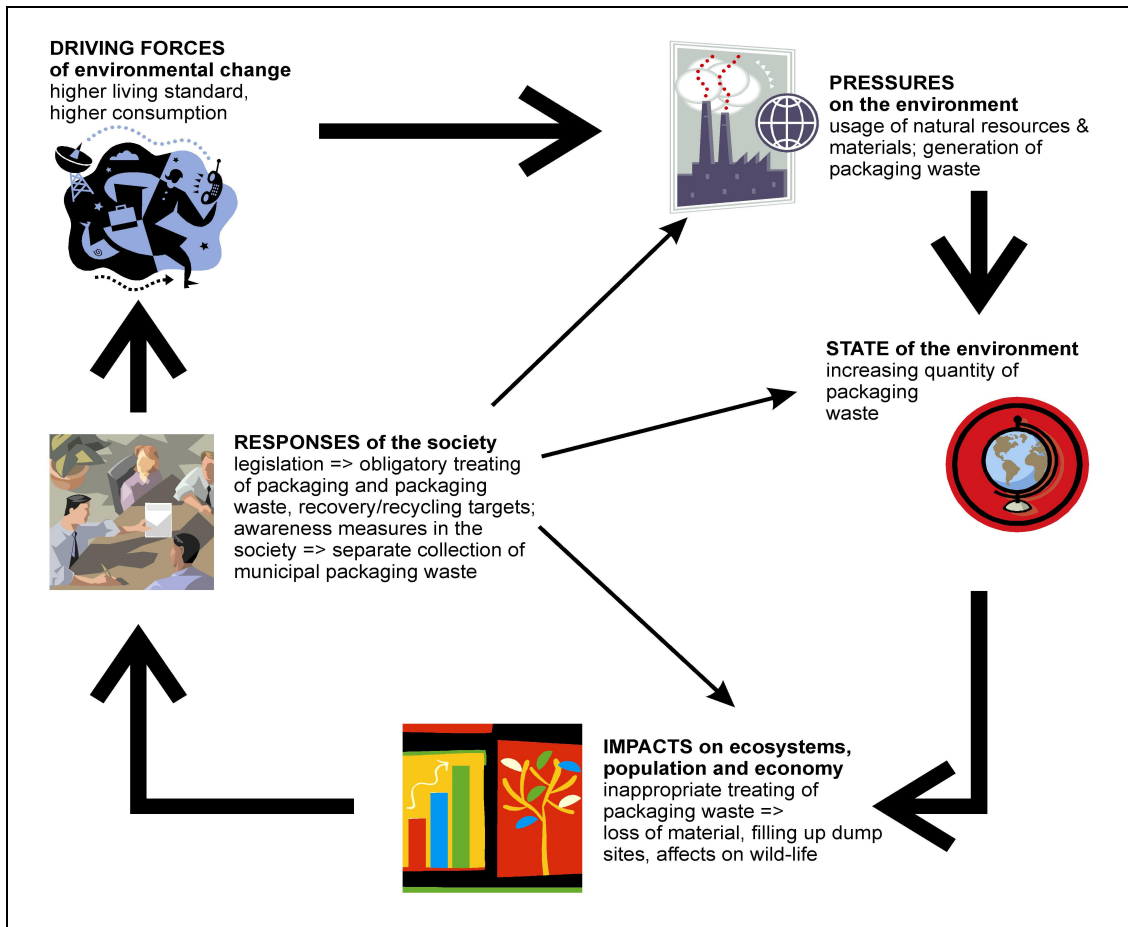


Figure 24: DPSIR assessment framework for packaging waste in Slovenia (Source: prepared by author)

As seen so far, the purpose of the DPSIR framework could be understood not just as forecasting cause-effect relationships between interacting components of the social, economic and environmental systems, but also as an information base for raising awareness about the environmental issue and for planning corresponding actions or responses to make the state of the environment better. The audience should be administrators, politicians, media, schools, universities, industry, businesses, and the general public (UNEP/GRID-Arendal, 2000).

As mentioned at the beginning of this chapter, the Slovenian average of around 85 kg of packaging waste generated per capita annually is at the bottom of the European average (172 kg/capita in 2001). Large variations between Member States are present, e.g. less than 100 kg per capita in Greece and Finland and more than 200 kg per capita in Ireland and France (EEA Report 3/2005, 2005). In spite of that, it is not realistic to expect some greater increase in Slovenian average since, compared to other EU citizens, Slovenes are not so powerful consumers. This could be substantiated by a lower living standard and another explanation is probably more historical – no more than a decade ago a lot of returnable glass packaging was used in Slovenia, but Europe was already using a lot of plastic packaging. Nowadays the plastic packaging already started to replace the glassy one, thus, an increase in the quantity of the plastic packaging waste is expected. This phenomenon is already recognized by 3,6-times increased quantity of the recovered plastic packaging waste from 2001 to 2004.

By adopting The Rules on Handling Packaging and Packaging Waste in 2000 a producer-responsibility for packaging waste was introduced and the system for managing packaging waste was established. For non-municipal packaging waste the change was not so dramatic since some types of packaging (wood, paper, metal) were already separately collected. In 2004, a separate collection of municipal packaging waste by material started in urban areas of Slovenia with the aim to increase the total share of recovered packaging waste.

Although a separate collection of packaging waste is a big step forward for Slovenia, it is not in line with the primary objective of The Rules and of the EU packaging directive, which aims to preventing the production of packaging waste (Internet 16). Decreasing of packaging could be achieved by introducing a general packaging tax. A weight-related packaging tax or fee paid to the authorities gives the producers incentives to minimize the weight and volume of packaging (Jacobsen and Kristoffersen, 2002). Taxes on packaging are foreseen in the new Rules on Handling Packaging and Packaging Waste.

Regarding the pretentiousness of the packaging field, it could be said that responsibility of MESP/EARS for implementing the packaging directive into national legislation and for corresponding monitoring is necessary and suitable. Annual reporting by obligors on quantities of packaging and packaging waste in these past years has shown difficulties in understanding the national legislation on handling packaging and packaging waste. The most common problems are: the determination of obligors' business activity (importer, producer, filler), the recognition whether packaging waste is meant for recovery or disposal, the classification of packaging itself (what is actually packaging of their products and for what are they responsible at all), a responsibility is meant for all kinds of obligor's packaging, not just for the sales-packaging... Some progress can be seen while the number of report forms sent to EARS is increasing year by year and also mistakes made in reporting are smaller and less frequent.

When asking ourselves whether the Danish system for managing packaging waste with local authorities being responsible for establishing the system be more suitable for Slovenia as the producer-responsibility scheme, a negative conclusion was reached. The decision came from a fact that in general, public is not in favor of handling any kind of waste near to their homes and a packaging waste is no exception. Maybe the collection and sorting of packaging waste could be acceptable, but the treating processes would have almost no chance... This is recognized as a case of typical NIMBY syndrome – everybody would like to be a model of environmental-friendly handling and treating of packaging waste if it will be going on somewhere other than in their backyard. That is why we believe the supervision of the local authorities is not appropriate since the will of local residents is usually taken into account when deciding on development of their community. Making any kind of decisions regarding waste should be done on governmental level where the benefit for all country is a priority goal.

We also feel the need to stress the necessity of a constant education of the public on the correct handling of packaging waste, on the importance of its separate collection and also on the environmental impact of packaging. This public education should focus mostly on raising awareness of the citizens since the packaging waste represents around 20% by weight and 40% by volume of municipal waste (Internet 9) and the non-municipal packaging waste is not so problematic to collect since it is cleaner and often represent an extra income for the company when it is handed over to the treaters. In Slovenia the average annual amount of municipal waste per capita is about 418 kg where more than 10% goes just to the plastic packaging waste (Vzemite manj – lmejte več, 2005). The results of a study by Ipsos in 2003 (Internet 17) show that everyday actions such as waste separation, which are learned and performed with conviction, are more effective than acts performed as a result of orders, bans and quota requirements. A good approach is educating children in kindergartens and schools while they will influence on the manners of their parents who usually do not want to be a bad example for their children. Furthermore, by educating consumers on the meaning and importance of recyclable types of plastic used for packaging, they could make a decision to buy a product with smaller environmental impact, and this would also be a signal to the manufacturers of packaging and packed goods to carefully think on what packaging they would use.

With a general packaging waste prevention, a reduction in the generation of packaging waste at source would consequently reduce the need for collection and treatment and the associated costs and environmental impacts. Beside that, natural resources and materials would be saved, bearing in mind that waste is "wasted" raw material. Waste prevention translates into a need to design materials, goods and services in such way that their manufacture, use, re-use, recycling and end-of-life disposal results in the least possible generation of waste (EEA Report No.10, 2003). As already mentioned above, there is also a need for better exchange of information between product developers and producers and the waste management sector in order to develop a system whereby products and waste management fit better together. At the moment,

for life-cycle analysis of products, there is a lack of systematic knowledge of the connection between the composition of individual products and resulting emissions from different treatment types when they end-up in the waste stream (Ibid).

To summarize, Slovenia has not yet achieved the target recovery share for packaging waste from the European packaging directive, but the increasing in recovered quantities is present since 2001, when first reporting was done on produced and treated quantities of packaging waste. An exception is the quantity of the plastic packaging waste, where the 33,3% recycling share achieved in 2004 exceeded the EU-target of 22,5%. Having in mind that costs of Slovenian system for handling plastic packaging waste are the lowest compared to the costs of the three selected Member States, we estimate the reached plastic recycling share is as a good indicator while the quantity of used plastic in packaging manufacturing is also increasing. The research on handling plastic packaging waste in 2002 showed that situation in Slovenia was similar to the one in the EU countries selected for a comparison, where handlers collect and sort packaging waste to prepare it for further treating, done by themselves or, more often, by specialized treaters of plastic packaging waste. In the whole process of packaging waste management the public should be included more continuously by different educational initiatives, like talk-shows on a television, carefully prepared leaflets about this topic, rewarding contests in schools etc.

6 CONCLUSIONS

- Slovenia has introduced a producer-responsibility packaging waste management system in 2002 and it was estimated to become fully active in next ten years.
- The target shares for recycling/recovery of packaging waste that needed to be achieved, were laid down by the EU packaging directive 94/62/EC and by The Rules on Handling Packaging and Packaging Waste (OG RS 104/00). A step-by-step plan to reach the targets was settled with The Operational Programme for the Management of Packaging and Packaging Waste for 2002 – 2007 Period (OG RS 29/02).
- With the annual average of produced packaging waste around 85 kg per capita, Slovenia is at the bottom of European average of around 170 kg per capita, but the phenomenon of increasing quantities of packaging waste could already be observed.
- In 2004, 161.507 tons of packaging waste were generated in Slovenia. Additional 20.000 tons are evaluated to be contributed by “free-riders”.
- The recovery shares of total packaging waste from The Operational Programme were not yet met in any one year but are growing. In 2004, the recovery target achieved was 24% or 38.890 tons and the target was 40%.
- The recovery shares of plastic packaging waste from The Operational Programme were met and have even exceeded the targets. In 2004, 10.757 tons or 33,3% of plastic packaging waste were recovered and the target share was 12%.
- The packaging directive recovery target for 2008 of 60% for total recovery was not yet met and is hard to predict if it would be although a derogation of time-limit for Slovenia was accepted till the end of 2012. Some further research should be done.
- The packaging directive recycling target for plastic packaging waste for 2008 is 22,5%. In 2004, Slovenia already achieved 33,3% recycling share and the goal should be to maintain the reached level.
- Handlers of plastic packaging waste mostly cover their own region of Slovenia and their main activity is collection and sorting. The majority of collected plastic packaging waste represents foils and by bottles of drinks and cleansers made of PET, HDPE, PVC, LDPE and PP type of plastic. End-products of recovery processes are pellets and granulates bought by Slovenian and foreign companies.
- To reach better shares of recovery and handling packaging waste in general, more intense and constant involvement of the public is needed what should be achieved through different projects of education on this topic.

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Annex

**RAVNANJE Z ODPADNO PLASTIČNO EMBALAŽO (OPE) V SLOVENIJI
LETA 2002**
HANDLING ON PLASTIC PACKAGING WASTE (PPW) IN SLOVENIA IN THE year 2002

**ANKETA
SURVEY**

(kjer je mogoče, lahko izberete več odgovorov)
(where possible, you may pick more answers)

1. Kaj je vaša dejavnost?

What is your activity?

Zbirni center

A. *Collecting center*

Zbirno-sortirni center (ZSC)

B. *Collecting-sorting center (CSC)*

Predelava oz. reciklaža

C. *Recovery or recycling*

Drugo: _____

D. *Other: _____*

2. Ali ste že pridobili ISO oz. katerikoli drug standard?

Do you have a certificate of ISO standard or any other?

Da. Katerega?

A. *Yes. Which one?*

Ne.

B. *No.*

Smo v fazi sprejemanja
standarda:

C. *We are implementing
standard:*

3. Kateri predel Slovenije pokrivata ter približno število prebivalcev tega predela?

Which region of Slovenia you cover and what is the approximate number of citizens there?

4. Kdo zbira odpadno plastično embalažo, ki jo nato vi tretirate dalje?

Who collects PPW which you than treat further?

Vi sami

A. *Yourself.*

Komunalno podjetje. Katero?

B. *Public waste service. Which one?*

Podjetje, ki je povzročitelj OPE
(industrijski odpadki)

C. *Enterprise who is a producer of PPW
(industrial waste).*

Drugo: _____

D. *Other: _____*

5. Letna vhodna količina odpadne plastične embalaže?

What is the annual incoming amount of PPW?

Vrsta oz. tip OPE	Količina (kg)	Type of PPW	Amount (kg)
Folije		Foils	
Plastenke pijač in živil		Plastic bottles of drinks and foods	
Plastenke čistil in pralnih sredstev		Plastic bottles of cleansers and washers	
Kozmetična embalaža		Cosmetics packaging	
Velike shranjevalne posode (>20 L)		Big storage containers (>20 L)	
Zabojčki za sadje/zelenjavo		Boxes for fruits and vegetables	
Stiropor		Styropor	
Drugo (kaj?)		Other (What?)	

6. Kateri tip plastike prevladuje pri vhodni OPE, delež/količina?

Which type of plastic is dominant in incoming PPW, share/amount?

Tip plastike	Type of plastic	Delež (%) Share (%)	Količina (kg) Amount (kg)
PET	PET		
HDPE	HDPE		
PVC	PVC		
LDPE	LDPE		
PP	PP		
PS	PS		
Ekspandirani PS (stiropor)	Expanded PS (styropor)		
Drugo – mešana odpadna frakcija	Other – mixed waste fraction		

7. Ravnanje z OPE:

Handling of PPW:

Zbiranje

A. Collecting

Sortiranje oz. razvrščanje

B. Sorting

Baliranje

C. Baling

Snovna predelava - ekstruzija

D. Extrusion

št. stopenj pranja	1	2	3	4	___
način sušenja					

number of washings	1	2	3	4	___
type of drying					

Sežiganje – energetska oz. termična predelava

E. Energy recovery

Drugo: _____

F. Other:

8. Vaši produkti:

- Regenerati
- Izdelki iz odpadne plastike
- Sortirana plastika (pripravljena za posredovanje)
- Drugo: _____
- Energija

Your products:

- A. Pellets, granulates, ...
- B. Products from recycled plastics
- C. Sorted plastics (ready for handing over)
- D. Other: _____
- E. Energy

9. Kdo so vaši kupci?

- A. Domača podjetja manjša srednja večja
- B. Tuja podjetja manjša srednja večja

Who are your buyers?

- A. National companies small middle big
- B. Foreign companies small middle big

10. Zakaj se odločijo za nakup pri vas?

- Boljša kvaliteta
- Ugodna cena
- Ekološka osveščenost
- Drugo: _____

Why they decide to buy from you?

- A. Better quality
- B. Favorable price
- C. Ecological awareness
- D. Other: _____

11. Vas država kot zbiralca/ZSC oz. predelovalca OPE tretira drugače?

Does the state treat you differently for being a handler of PPW?

- A. Ne.
- B. Da. Kako? (Imate kakšno korist oz. prednost v smislu zmanjšanih prispevkov/davkov, možnost ugodnejšega posojila za posodobitev tehnologije, razširitev dejavnosti,...?)

- A. No.
- B. Yes. How? (Do you have any benefit or privilege in a way of lower taxes, possibility to get a special loan for modernizing technology, growing activity, ...?)

12. Kakšni so okvirni stroški zbiranja / sortiranja / predelave 1 kg OPE (od prevzema OPE do vašega končnega izdelka)?

What is an approximate cost of collecting/ sorting/ recovering of 1 kg PPW (from taking over PPW till your final product)?

Zbiranje: _____	A.	Collecting: _____
Sortiranje: _____	B.	Sorting: _____
Predelava: _____	C.	Recovering: _____
Drugo: _____	D.	Other: _____

13. Predvidevate širitev podjetja oz. dejavnosti v prihodnjih 5-ih letih?

Do you foresee growing of your company or activities in next 5 years?

A. Da. Na kakšen način oz. v kateri smeri?

Yes. How? In which direction?

B. Ne. Kateri so bistveni razlogi?

No. What are the main reasons?

14. Vaši predlogi, kritike:

Your suggestions, critics:

Za sodelovanje se vam najlepše zahvaljujem!

Thank you very much for your cooperation!

S spoštovanjem,

Best regards,

Eva Ančik