Plastic Flows from Production to (optimal) Recycling

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Abstract

Total plastic flows in Austria have increased between 1994 and 2004 by 40 % to 3.7 Mio tons. In 2004 the consumption of plastics amounted to ca. 161 kg/capita. The situation in waste treatment has changed significantly. The quantity of plastic waste directed for recycling increased from approx. 50.000 tons in to 130.000 tons and for thermal treatment from 71.000 tons to 564.000 tons. Main driver was not the packaging ordinance but the landfill ordinance. The situation in Poland in 2004 is similar to the situation in Austria 1994. 40 % of plastic waste is collected separately. High rates of mechanical and feedstock recycling and energy recovery are implemented in Austria. Bioplastics do not have a big potential to save greenhousegas emissions. A Sustainability Assessment for different waste management options is necessary.

Keywords

Plastic flows, Austria, Poland, Separate Collection, Material Recycling, Feedstock Recycling, Bioplastics, Greenhousegas Emissions, Sustainability Assessment

1 Introduction

During the last 50 years, plastic materials have become one of the most important types of materials used in various branches. Due to their special features, i.e. low weight, availability and costs, they have substituted or replaced many traditional materials and are at present widely applied in short- and long-life products. They are dominating the packaging market, and are more and more commonly used in automotive and building sectors. Therefore, assessment of plastic flows and their appropriate management, in accordance with the objectives of sustainable development, has recently become an important issue in modern societies, worth more comprehensive investigations.

2 Plastic Flows in Austria 1994 / 2004 and in Poland 2004

In a study conducted by the Austrian Environmental Agency and undertaken by the Vienna University of Technology, Institute for Water Quality, Resource and Waste Management, consumption and waste generation of plastic materials in Austria have been assessed for the year 1994 (FEHRINGER & BRUNNER, 1997). It is shown how plastic consumption grew up in time, how stocks of long-life plastic materials in use increased considerably, and how large amounts of plastic wastes resulted from the consumption pattern. Ten years later ARGEV Verpackungsverwertungs-Ges.m.b.H. conducted an up-

date of this study and a comparison with actual situation in Poland. The three data sets are used to compare the evolution of plastic flows and stocks over time, and to assess potential differences in the plastic management in both countries (BOGUCKA & BRUNNER, 1997). Figure 1 shows plastic flows and stocks in Austria in 1994 and Figure 2 in 2004.

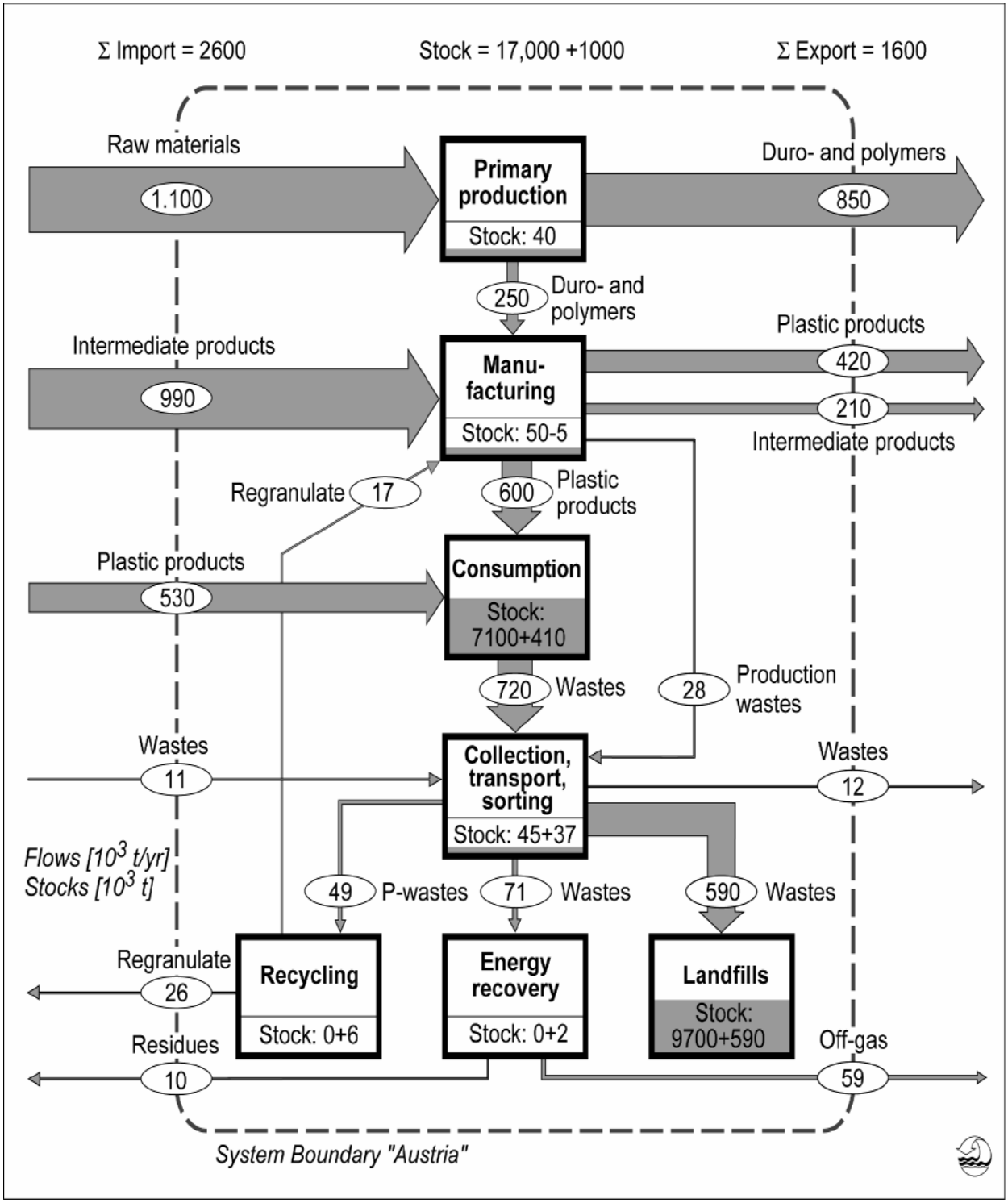

Figure 1 Plastic flows and stocks in Austria in 1994 (FEHRINGER & BRUNNER, 1997)

Besides the fact that almost all flows increased during this 10 years period, major changes can only be seen in the field of waste management.

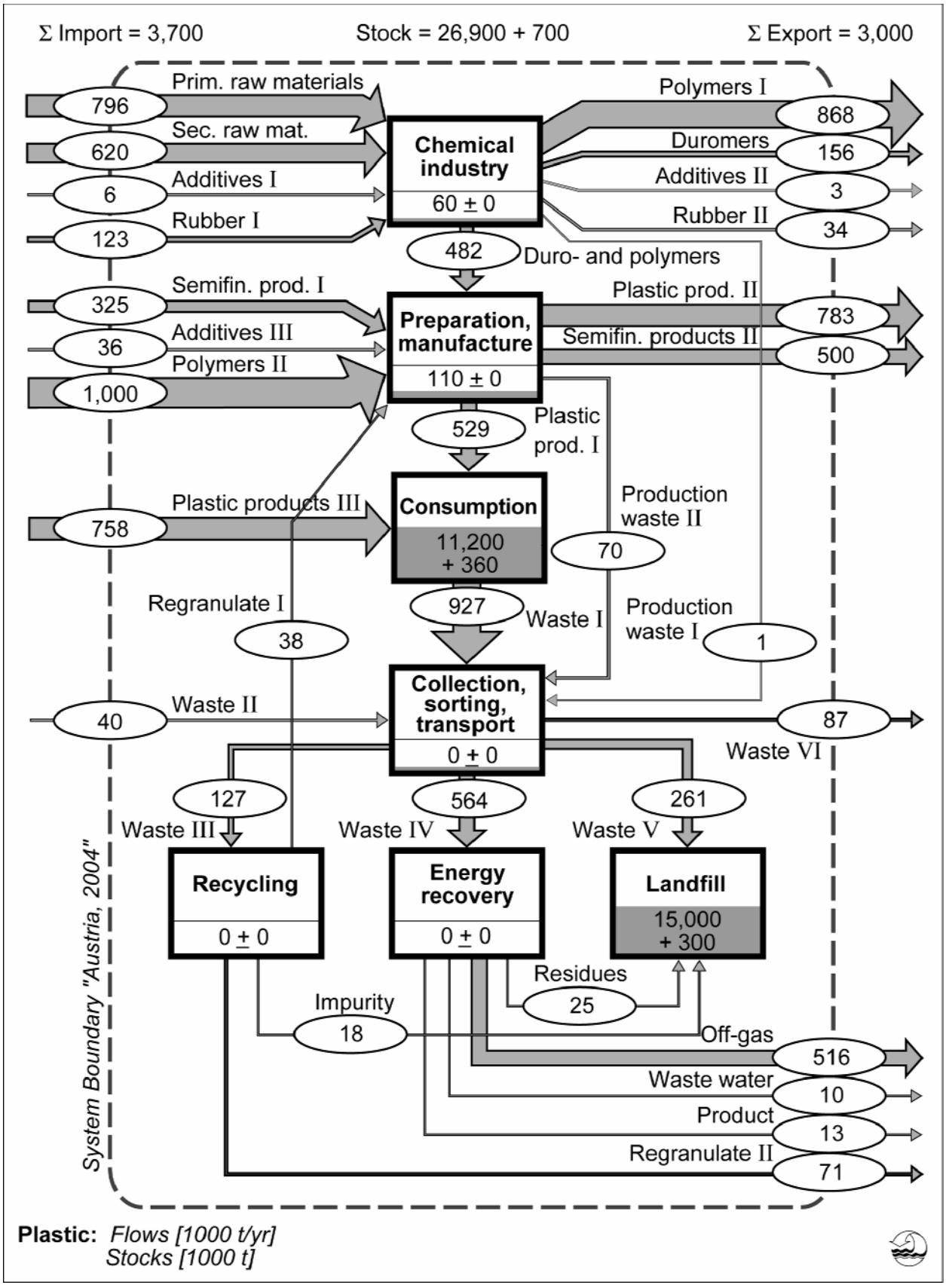

Figure 2 Plastic flows and stocks in Austria in 2004 [BOGUCKA & BRUNNER, 2007]

In 1994, one year after the introduction of the Austrian packaging ordinance only a few tonnes of total plastic waste generated were recycled. Most of plastic waste was landfilled without any use of material or calorific value embedded.

In 2004 the figure changed energy recovery and recycling increased. Main driver for this development was not the packaging ordinance but the landfill directive which was introduced in 2004 with a special approval for an extension till 2008 for some federal states.

Table 1 compares the plastic flows in Austria and Poland for investigated years. It can be seen that the situation on Poland in 2004 is similar to the situation in Austria ten years ago. Most of plastic waste generated is landfilled. The advantage of Poland as a member state of the European Union is the implementation of the European waste framework directive. This saves time and resources which will no longer be landfilled.

*Table 1 Comparison of plastic flows per capita in Austria and Poland (*BOGUCKA & BRUNNER*, 2007)*

	Austria [kg/cap]		**Poland [kg/cap]**
	1994	**2004**	**2004**
Total plastic import plus domestic production	329	463	146
Total plastic export	188	302	48
Plastic consumption	141	161	98
Plastics to stock “in use”	51	45	46
Total plastics in stock “in use”	888	1.400	605
Plastic waste flow (incl. import-export of waste)	94	119	54
Plastic waste flow to Recycling	6	16	3
Plastic waste flow to Energy Recovery	9	71	2
Plastic waste flow to Landfilling	74	33	49
Total plastic stock in landfills	1.213	1.938	789

3 Plastic waste management in Austria

3.1 Plastic waste generation in Austria

Figures on plastic flows and stocks in Austria and Poland given in 2 include plastic polymers, elastomeres and materials based on polymeres. All following figures do not include elastomeres, fibres, varnish, non-plastics in plastic composites, dirt and moisture. With this definition plastic waste generation rate in Austria is about 600.000 t in 2007 (FEHRINGER ET AL, 2010).

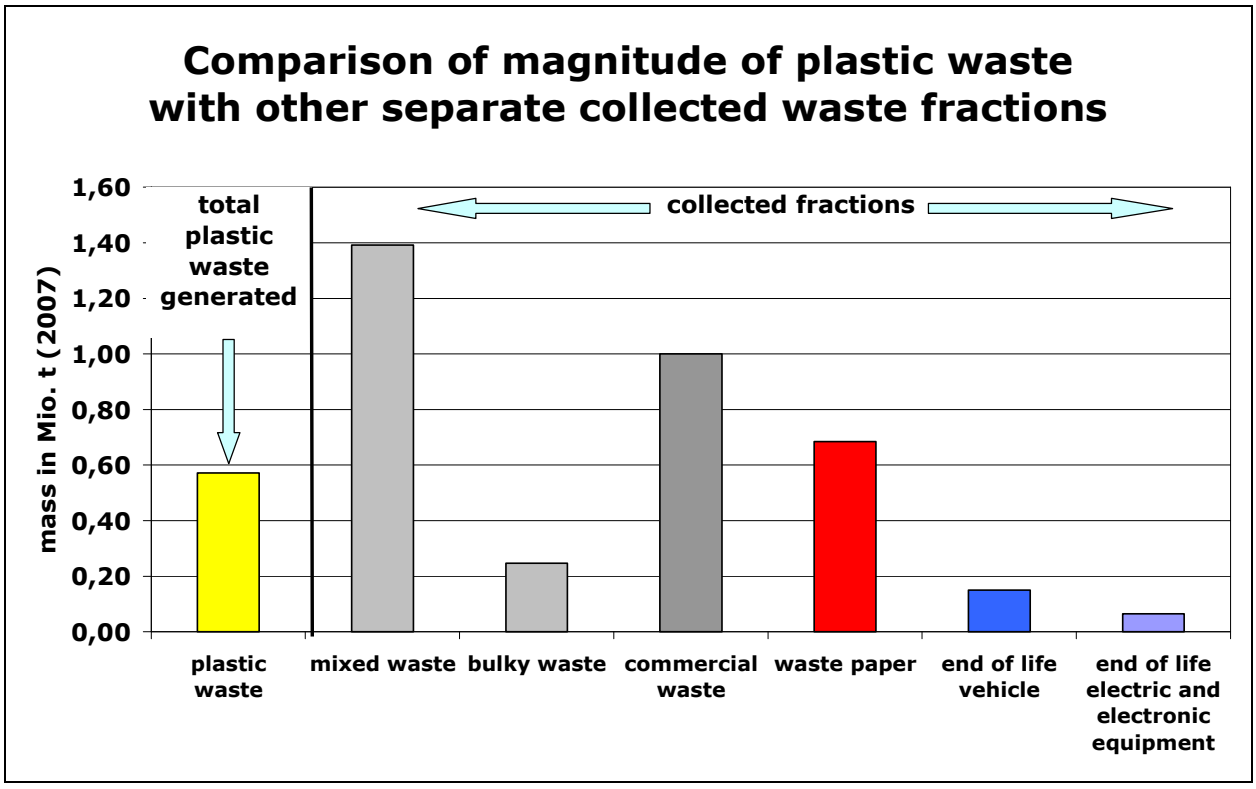

Figure 3 *Comparison of magnitude of plastic waste (all collection schemes) with other separately collected waste fractions (FEHRINGER ET AL, 2010)*

3.2 Collection and recovery of plastic waste in Austria

Figure 4 gives an overview of collection schemes. 38 % of plastic waste generated is collected separately. This is compared to other countries a considerable share. But not all separately collected fractions consist of plastics only. Most of them consist of composites (end of life electric and electronic equipment) with a certain share of plastics. Mode of recycling depends on pre-treatment and therefore separately collected does not imply material recycling.

A better view of recycling and recovery of plastic waste is given in Figure 5. 44 % of total plastic waste is plastic packaging waste and 24 % goes into material recycling.

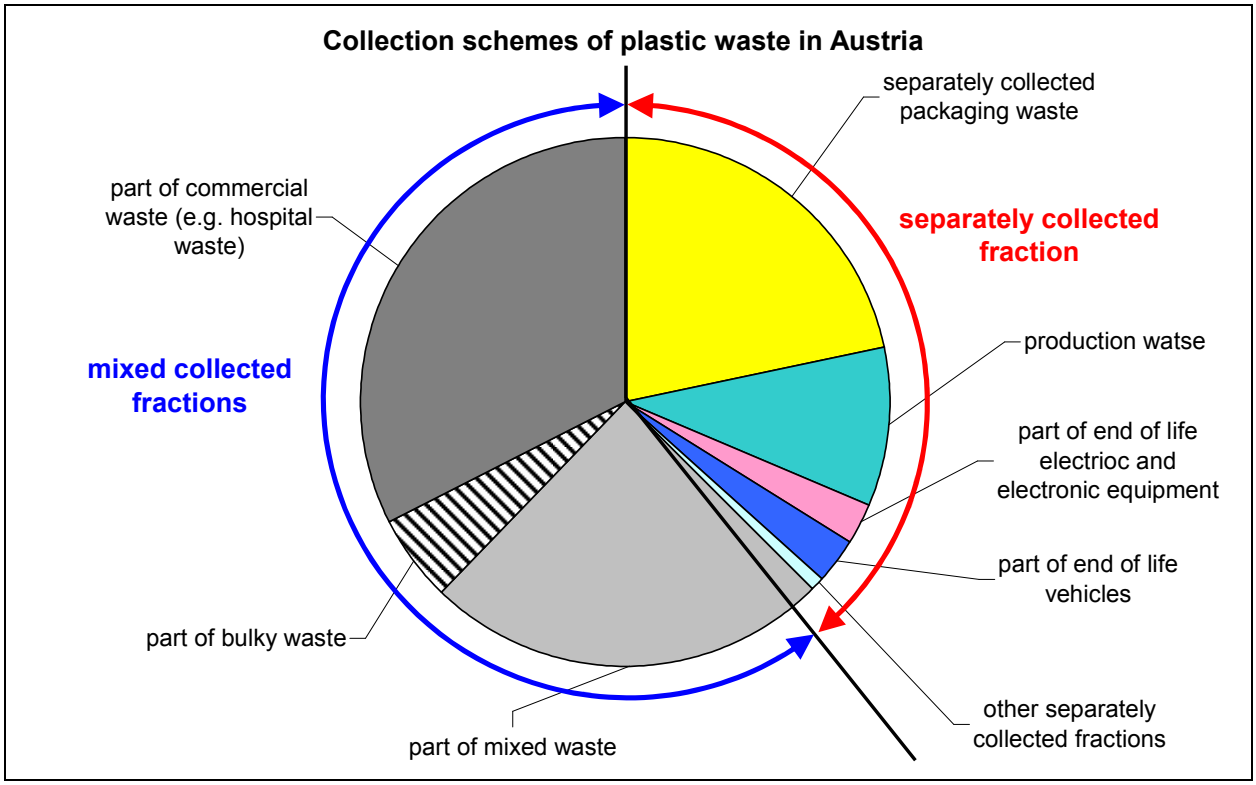

Figure 4 *Collection schemes of plastic waste in Austria (FEHRINGER ET AL, 2010)*

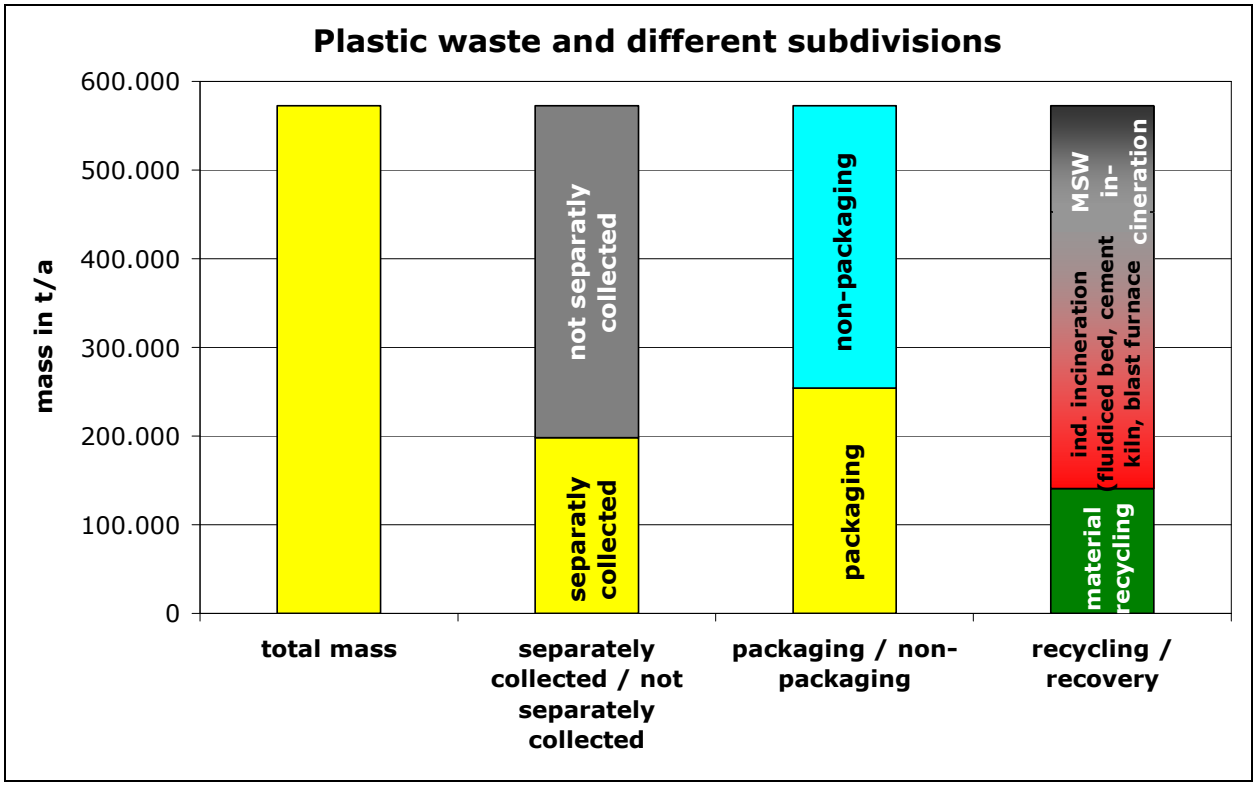

Figure 5 *Total plastic waste generated, collection scheme, share of packaging and recovery options (FEHRINGER ET AL, 2010)*

Due to large benefits (saved primary production) material recycling has the highest net benefit expressed in crude oil equivalent. Feedstock recycling and industrial co-

incineration in cement kiln or fluidized bed incineration plants have also a higher net benefit compared to municipal solid waste incineration. Nevertheless the share of suitable plastic waste decreased the other way round (PILZ, 2007). In total up to 600.000 t crude oil equivalent could be saved year by year with an optimized allocation of plastic waste to recycling and recovery technologies.

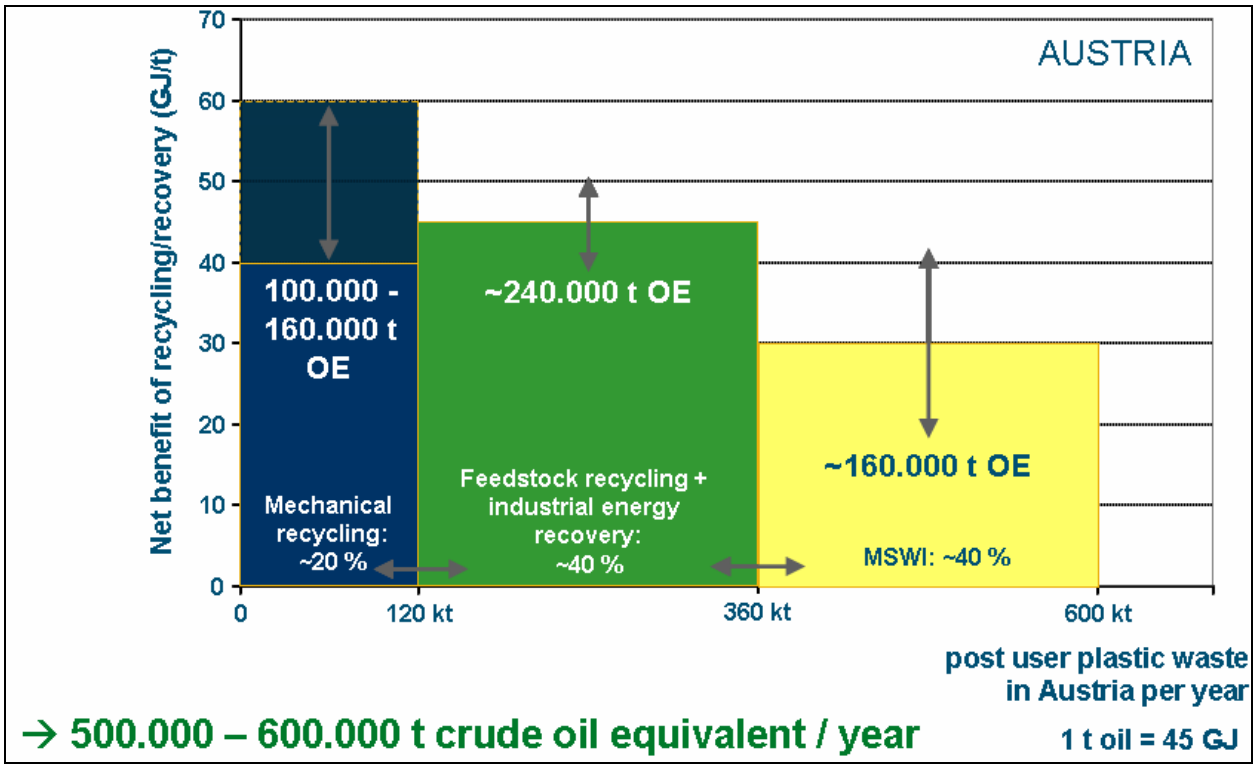

Figure 6 *Potential of different recycling and recovery options and net benefit expressed in saved crude oil equivalent (PILZ, 2007)*

4 Bioplastics

A study founded by the Austrian Klima- und Energiefond investigates the potential of bioplastics to protect the climate. A main finding is that today's bioplastics do not have significantly higher potential to save greenhousegas emissions than conventional plastics as the production of bioplastic polymeres is still energy intensive and production of products is similar.

Figure 7 shows the greenhousegas emissions of conventional and bioplastics in total life cycle. The difference is rather small, but as bioplastic is a very young material improvements in the future could increase the gap.

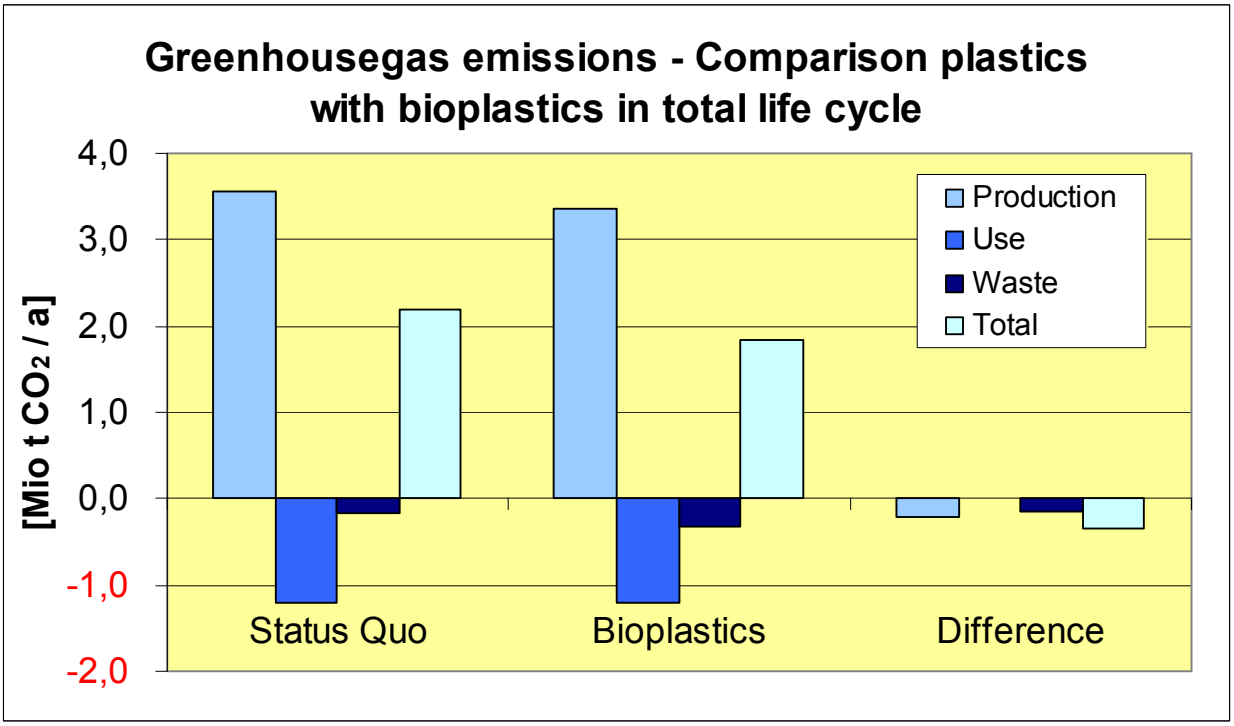

Figure 7 *Comparison of greenhousegas emissions of conventional plastics and bioplastics (BRANDT ET AL., 2010)*

5 Strengths and opportunities of Austrian plastic waste management

Relevant stakeholders see the strengths of Austrian plastic waste management in: (FEHRINGER ET AL., 2010)

- No landfilling of plastic waste in 2010
- Strong legislation (packaging ordinance and landfill directive)
- Reasonable share of separate collection (not too much)
- Large share of material recycled plastic waste
- Numerous plats for pre-treatment, feedstock recycling and energy recovery
- Innovative companies producing recycling technologies (PET recycling, bottle-to-bottle recycling)

During the same stakeholder dialogue the most supported opportunity was:

- Plastic waste management should be based on comprehensive assessment including ecologic and economic aspects for decisions. Indicators for a sustainability assessment of waste management options should be developed.

6 Literature

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