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CHALLENGES IN PACKAGING WASTE MANAGEMENT: A CASE STUDY IN THE FAST FOOD INDUSTRY

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Thesis for the degree of Doctor of Science (Technology) to be presented with due permission for public examination and criticism in the Auditorium 1382 at Lappeenranta University of Technology, Lappeenranta, Finland on the 18th of August, 2006, at noon.

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ABSTRACT

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The main research problem of this thesis is to find out the means of promoting the recovery of packaging waste generated in the fast food industry. The recovery of packaging waste generated in the fast food industry is demanded by the packaging waste legislation and expected by the public. The means are revealed by the general factors influencing the recovery of packaging waste, analysed by a multidisciplinary literature review and a case study focusing on the packaging waste management of McDonald's Oy operating in Finland.

The existing solid waste infrastructure does not promote the recovery of packaging waste generated in the fast food industry. The theoretical recovery rate of the packaging waste is high, 93 %, while the actual recovery rate is only 29 % consisting of secondary packaging manufactured from cardboard. The total recovery potential of packaging waste is 64 %, resulting in 1 230 tonnes of recoverable packaging waste. The achievable recovery potential of 33 %, equalling 647 tonnes of packaging waste could be recovered, but is not recovered mainly because of non-working waste management practises. The theoretical recovery potential of 31 %, equalling 583 tonnes of packaging waste can not be recovered by the existing solid waste infrastructure because of the obscure status of commecial waste, the improper operation of producer organisations, and the municipal autonomy.

The sorting experiment indicated that it is possible to reach the achievable recovery potential in the existing solid waste infrastructure. The achievement is promoted by waste producer -oriented waste management practises. The theoretical recovery potential can be reached by increasing the consistency of the solid waste infrastructure through governmental action.

Keywords: Packaging waste, recovery rate, recovery potential, commercial waste, fast food industry, McDonald's

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Writing a thesis is like making a 1 000-piece puzzle with a small child. The pieces are there, but some pieces may temporarily disappear and ready parts may be broken into pieces and there is need to restart again and again. The pieces for this thesis were discovered during the years 1996-2003 when I worked as a quality and environmental manager at McDonald's Oy. In that position, I confronted a multitude of contradictory exigencies and expectations. The utilisation of one-way sales packaging and the lack of sorting in the dining area were continuously questioned by consumers and the media. Environment-oriented development of sales packaging was opposed by the marketing department and marketing agency. Some of the sales packaging was chosen by the international mother company. Attempts to change primary and secondary packaging met with international suppliers' reluctance. The question of who would pay for the additional operative costs, and the absence of a suitable facility to recover some sorted waste components put an end to preliminary back-hauling trials with the distributor. It was impossible to give nationally valid sorting instructions to the outlets, because of the variance in local waste regulations. Sorting was demanded by some local authorities. The trial and error-based sorting practises at the outlet ended in chaos. Collectors offered pick-up service and had different specifications for sorted waste components: the contamination level being accepted by one collector was unacceptable by another one, even though the sorted waste component would have been recovered at the same recovery facility. In this situation, the outlets expected measures from the environmental manager to rationalise the waste management operations, to generate operational cost savings, and to increase customer satisfaction.

The financial support of different parties has been vital for finalising this thesis. I am grateful to TEKES, StoraEnso Oy, Huhtamäki Oyj, McDonald's Oy, Paperinkeräys Oy, and Corenso United Oy for funding the case study, and Oscar Öflund's Stiftelse, Liikesivistysrahasto, Alfred Kordelinin yleinen edistys- ja sivistysrahasto, and Suomen Pakkausyhdistys ry for funding my personal study leaves.

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CONTENTS

NOMENCLATURE

Key definitions and word list

Term	Explanation
Achievable recovery potential[c]	Share (in %) of the amount of packaging waste recoverable by the existing solid waste infrastructure, but not recovered, in the total annual amount of packaging waste
Actual recovery rate[c]	Share (in %) of the amount of actually recovered packaging waste in the total annual amount of packaging waste
Biodegradable waste	Also biowaste, putrescibles Waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard (Maastik *et al.* 2004, 42)
Biodegradable waste[c]	Packaging waste that is manufactured from biodegradable paper or wood and that can be recovered by composting
Cardboard	Also corrugated fibreboard (Twede and Goddard 1998, 38)
Collection	Also waste collection, garbage collection Process of collecting various kinds of waste to containers designated for this purpose and transporting it for further treatment (Maastik *et al.* 2004, 172)
Combustible waste[c]	Packaging waste manufactured from plastics and used for energy recovery
Combustion	Also incineration Chemical combining of oxygen with a substance resulting in the production of heat (Tchobanoglous *et al.* 1993, 906)
Commercial waste	Also household assimilated waste, trade waste Waste which, because of its nature or composition, is similar to waste from households (the Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste) and that is typically generated at commercial and institutional establishments.

Term	Explanation
Composite	Packaging material in which one packaging material is combined with another one to tailor specific properties. Typically manufactured by coating or laminating paper, foil, or cellophane with different plastics to form flexible materials (Twede and Goddard 1998, 151)
Composting	Natural biological decomposition of organic material in the presence of air to form a humus-like material (Maastik *et al.* 2004, 244)
Contamination level[c]	Term to illustrate how much a sorted waste component contains missorted waste; the higher the contamination level, the lower the quality of the waste component
Degradability	Rate at which the material degrades spontaneously at landfill sites (Twede and Goddard 1998, 200)
Disposal in a landfill	Also landfilling, landfill (Maastik *et al.* 2004, 182)
Energy recovery	Waste treatment technology to extract useful materials as energy from solid waste (Maastik *et al.* 2004, 171)
Extended producer responsibility	Principle of recognising the producer's (packager's/ manufacturer's) role in reducing the environmental impacts of its product throughout the entire life cycle, including waste management. It shifts part, or all, of this responsibility from taxpayers, local authorities, and conventional waste operators to producers, who are required to accept the waste back after the use (Lindhqvist 2000, 157-160).
Fast food	Also fast service food General term used for a limited menu of foods that lend themselves to production line techniques and that are typically hamburgers, pizzas, chicken or sandwiches (Bender and Bender 2001, 157)
Fast food industry	Also quick service restaurants Companies producing and selling fast food and operating nationally or internationally
Food raw material[c]	Raw materials such as buns, meat patties, lettuce, sauces, pickle and onion that are used to produce food products at fast food outlets
Free-rider	Packager who has placed packaging on the market, but who has not joined pooled take-back scheme and consequently the collection of this packaging waste is financed by other packagers

Term	Explanation
Household waste	Also municipal waste (refuse), domestic waste, household refuse, domestic garbage, residential waste, urban refuse, garbage, trash Solid waste, composed of garbage and rubbish, which normally originates in a private home or apartment house (Maastik *et al.* 2004, 250)
Incinerability	The suitability of the material for incineration including factors such as the generated amounts, the collection, sorting, and incineration costs, sorting easiness, the purity degree of the sorted material, and the existing infrastructure for collection and incineration (Twede and Goddart 1998, 200)
Industrial waste	Waste from any industrial undertaking or organisation (Maastik *et al.* 2004, 593)
Integrated solid waste management	System for waste management that deals with all types of waste materials and all sources of solid waste and includes waste collection and sorting, followed by one or more of the following options: source reduction, recovery of secondary materials (recycling), biological treatment of organic materials, thermal treatment, and disposal of in landfills (Maastik *et al.* 2004, 695)
Kerbside collection	Also curbside collection Collection scheme for collecting waste generated at households; the containers - at least for mixed household waste - are emptied either at the street where the owner or maintenance staff of an establishment has transported them or in the immediate vicinity of a waste storage area (Tchobanoglous *et al.* 1993, 195).
Life cycle (of a product)	Flow of energy and materials through a manufacturing system from raw material in the ground, through processing to shape, the assembly of a finished product and disposal following the use (Maastik *et al.* 2004, 62)
Liquid board	Also aseptic packaging Composite that is manufactured by coating paperboard with PE or with PE and aluminium (Twede and Goddard 1998, 169-170)
Local waste regulations	Regulative waste policy instruments defined by local authorities, which define the waste management practises of residential and commercial waste producers

Term	Explanation
Mass burn	Controlled combustion of unsorted mixed waste (Tchobanoglous *et al.* 1993, 909)
Member state	Member state of the EU Member states were Austria, Belgium, Denmark, Germany, Great Britain, Greece, Finland, France, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, and Sweden in 2002
Mixed mass-burning	Also incineration in mass-fired/mass-burn combustors/ incinerators
Mixed waste	Also mixed municipal waste, commingled waste Mixture of all waste components in one container (Tchobanoglous *et al.* 1993, 906) (Maastik *et al.* 2004, 535)
Mixed waste[c]	Packaging waste that is manufactured from composites and disposed of in landfills, because it cannot be recovered
Municipal waste	Also municipal refuse, urban refuse Waste from households as well as commercial, industrial and institutional waste, which because of its volume and composition is similar to waste from households (Maastik *et al.* 2004, 696)
On-site disposal	Disposal of waste on the property of the generator (producer) (Maastik *et al.* 2004, 173)
One-way packaging	Also one-trip packaging, single-use packaging Containers, bottles, or other forms of packaging intended to be discarded as solid waste when empty (Maastik *et al.* 2004, 217)
Packaging industry	Manufactures of packaging materials and packaging
Plastics	Synthetic materials that can be formed into useful shapes by means of heat, are based on organic chemistry and are generally derived from petrochemical feed stocks, mainly crude oil. The types of plastics used for packaging are PE, PP, PVC, PS, polyester (PET and PEN) and polyamide (nylon) (Twede and Goddard 1998, 69-71)

Term	Explanation
Primary packaging	Also sales or consumer packaging Packaging that is in direct contact with a product and that is used to market the product to the customer, while furnishing information on for example product use, contents, and nutritional value, and to hygienically protect the product, and that typically enters the household, the end user being a consumer (Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste)
Primary packaging[c]	Primary packaging of food raw materials and sales packaging. Primary packaging used by consumers is called sales packaging.
Primary stakeholder	Anyone who directly affects or is directly affected by a company's operations
Purity index[c]	Term to illustrate how much a sorted waste component contains missorted waste; the higher the purity index, the higher the quality of a waste component Share of the amount of correctly sorted waste components in the total amount of sorted waste components
Recoverable	Waste that can be recovered as material or as energy and that is typically paper, cardboard, glass, plastics, ferrous (iron and steel) and non ferrous (such as copper, aluminum, lead) metal, and the organic part of solid waste
Recovery	Also waste recovery (reclamation), waste reclamation (of waste), resource recovery, salvage Extraction of useful materials or energy from solid waste (Maastik *et al.* 2004, 171-172)
Recovery potential[c]	Share (in %) of the amount of packaging waste that could be recovered in the total annual amount of packaging waste Sum of achievable and theoretical recovery potential
Recyclability	The suitability of the material for recycling including factors such as the generated amounts, the collection, sorting, and reprocessing costs, sorting easiness, the purity degree of the sorted material, the existing infrastructures for collection and recycling, and the value and market of recycled material (Twede and Goddart 1998, 200)

Term	Explanation
Recyclable (fibre) waste[c]	Packaging waste that is manufactured from paperboard, liquid board, and cardboard waste and that can be recovered by fibre recycling
Recyclable	Also recyclate, recyclable material, salvage, salvageable material Material recovered from waste for recycling (Maastik *et al.* 2004, 131)
Recycling	Also waste recycling. Process of minimising the generation of waste by recovering usable products that might otherwise become waste (Maastik *et al.* 2004, 226)
Refuse derived fuel	Also RDF Waste pre-treated to make it suitable as a fuel (Maastik *et al.* 2004, 166)
Reusability	The suitability of the material for refillable and reusable packaging (Twede and Goddart 1998, 200)
Reuse	Using a component of municipal waste in its original form more than once, for example refilling a glass bottle that has been returned (Maastik *et al.* 2004, 602)
Sales packaging[c]	Primary packaging used by a consumer (see primary packaging)
Secondary packaging	Also group, retailer, transit, or distribution packaging Packaging that contains more than one unit of primary packaging, that is purely functional and protects the packed products during transportation and storage, that leaves primary packaging of the product unattached at the removal, and that generally enters companies such as retailers and wholesalers, in some cases households. (Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste)
Secondary stakeholder	Anyone who indirectly affects or is indirectly affected by a company's operations through primary stakeholders
Socio-demographics	Also socio-demographic factors Combination of social (such as reference groups, family, roles and status) and personal (such as age and life cycle stage, occupation, economic circumstances, lifestyle, personality and self-concept) factors (Kotler *et al.* 1996, 227-272)

Term	Explanation
Solid waste	Also waste, trash, rubbish, garbage, refuse, post-consumer product Any of a wide variety of solid materials that are disposed or rejected as being spent, useless, worthless, or in excess (Tchobanoglous *et al.* 1993, 911)
Solid waste infrastructure	Framework of services, facilities, and institutions to treat solid waste (Tchobanoglous *et al.* 1993; 12)
Solid waste management	Also waste management, end-of-life management The collection, transport, recovery, and disposal of waste, including the supervision of such operations and aftercare of disposal sites (Maastik *et al.* 2004, 164)
Sorting	Also separation, segregation Dividing of waste into waste components of similar materials (Tchobanolous *et al.* 1993, 911)
Specific cost[c]	Disposal cost of one m^3 of waste (in euros/m^3)
Specific unit weight[c]	Average weight of one m^3 of waste disposed in a fixed dustbin or container (in kg/m^3)
Take-away	Ready-to-eat food that is purchased at fast food outlets but consumed outside, at work or at home
Theoretical recovery potential[c]	Share (in %) of the amount of packaging waste non-recoverable by the existing solid waste infrastructure in the total annual amount of packaging waste
Theoretical recovery rate[c]	Share (in %) of the amount of recoverable packaging waste in the total annual amount of packaging waste Sum of recovery potential and actual recovery rate
Tertiary packaging	Also transport packaging Packaging that eases the handling of secondary packaging, for example by preventing damage during transportation and that is typically a pallet and that is used by distributors and industry, the end user being seldom a household (Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste)
Transport charge[c]	Charge to cover the transport cost of collected waste (in euros)
Treatment charge[c]	Charge to cover the treatment cost of collected waste (in euros)
Unit price[c]	Price that is charged for emptying one dustbin or container and that is a sum of transport and treatment charge (in euros/unit)

Term	Explanation
Waste	Any refuse or waste material, including semisolid sludge, produced from domestic, commercial, or industrial premises or processes including mining and agricultural operations and water treatment plants (Maastik *et al.* 2004, 164)
Waste category[c]	Waste categorised by the disposal location; in this research: Sales packaging disposed of outside the outlets Sales packaging disposed of in the dining area Primary and secondary packaging disposed of in the kitchen area
Waste collection point	Also waste collection site, drop-off center (for waste), drop-off site, recyclable collection center, bring facilities Centralised site for the collection of recyclables that are not covered by establishment-related collection schemes and that are typically generated at households (Maastik *et al.* 2004, 218)
Waste component[c]	Also waste fraction, collectable Waste that is sorted for recovery; in this research: Recyclable (fibre) waste Biodegradable waste Combustible waste Mixed waste
Waste hierarchy	Principle that prioritizes different waste treatment options and has become the basic principle of international and national solid waste legislation (reduce-reuse-recycle-recover as energy-disposal in landfills) Simmons 1991, 156; Tchobanoglous *et al.* 1993; 12)
Waste policy instrument	Instruments that are driven from legislation and work as concrete tools to achieve the legislative objectives (Määttä 1999, 18)
Waste reduction	Also waste prevention, material minimisation, source reduction, material reduction, light weighting
Waste treatment	Also waste treatment process, transformation process, waste processing, waste handling Physical, chemical, thermal, or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery (Maastik *et al.* 2004, 172)

[c] case study-related term

Abbreviations

EC	The European Community
EU	The European Union
HDPE	High Density Polyethylene (plastic)
LDPE	Low Density Polyethylene (plastic)
OECD	The Organisation for Economic Co-operation and Development
PE	Polyethylene (plastic)
PEN	Polyethylene Naphthalene Dicarboxylate (plastic)
PET	Polyethylene Terephthalate (plastic)
PP	Polypropylene (plastic)
PYR	The Environmental Register of Packaging PYR Ltd
PS	Polystyrene (plastics)
PVC	Polyvinyl Chloride (plastic)
PVdC	Polyvinylidene Chloride (plastic)
RDF	Refuse Derived Fuel
RFID	Radio Frequency Identification
Std	Standard Deviation
UN	The United Nations
UNEP	The United Nations Environment Programme
YTV	Pääkaupunkiseudun yhteistyövaltuuskunta [Helsinki Metropolitan Area Council]

1. Introduction

1.1 Background

After the Second World War, the western world has experienced rapid and permanent changes that have influenced the society in many different ways, for example by changing consumption patterns (for example Love 1995, 12-19; Twede and Goddard 1998, 12-15; Soroka 1999, 9-12; Michaelis 2003). Consumption has increased for various reasons. Consumers have higher discretionary incomes than before, the faster life pace has resulted in time-limited consumption, urbanisation has increased the number of one-to-two-person households and resulted in more women in the workforce outside the home, and the population and the share of older age group households has increased significantly, just to mention a few examples. Growing consumption has also been one of the factors contributing to the globalisation of trade and centralisation of production to high-volume units.

The increased consumption results irrevocably in increased waste amounts at production (such as agriculture, forestry, mining and quarrying, manufacturing, energy and water supply, and construction) and at non-producing establishments (such as households, hospitals, and schools). The extensive influence of solid waste on the environment and public health were recognised already some 30 years ago by the Club of Rome (Club of Rome 2005). The first actual measures for influencing solid waste generation internationally were taken in 1972, when the United Nations (UN) Conference on the Human Environment in Stockholm, Sweden addressed environmental issues at the global level and created the UN Environment Programme to negotiate environmental treaties and to help implement them (UNEP 2005). The report Our Common Future, also known as the Bruntland Report was formulated by the World Commission on Environment and Development in 1987 (Bruntland 1987, 1-398). The solution to global environmental problems was the policy of sustainable development, defined as ‘the development that

meets the needs of the present without compromising the ability of future generations to meet their own needs'.

The international cooperation was intensified in the 1990s, especially by the UN Conference on Environment and Development, better known as the Rio Earth Summit that was organised in Rio de Janeiro, Brazil in 1992. Agenda 21 (UN 2004) was signed by 178 nations. It is a nonbinding detailed action plan involving 27 principles to guide countries toward sustainable development and protection of the global environment during the 21st century. Agenda 21 objectives for improving the sustainability of solid waste management include minimising waste, stabilising waste production, quantifying waste flows, implementing waste minimisation policies, and developing national waste minimisation plans.

The European countries have been closely involved in the development, because the EU has been one of the most active forces pursuing sustainable development. It has decided to act within its own jurisdiction, whether or not other authorities in the global community will follow. The principles of international treaties and agreements have been translated to EU Policies. The Community Environment Policy was signed in Paris in 1972, aiming at improving the quality of life, the surroundings, and living conditions (Johnson and Corcelle 1995, 1-2). The EU Waste Management Policy was started in 1975 (Johnson and Corcelle 1995, 184-185). The objectives, targets, timetables, and priority areas within the EU over a certain time period are defined in Environmental Action Programmes based on the Policies. The 1st Action Programme was published in 1973 and covered the years 1973-1976 (Johnson and Corcelle 1995, 13-17). The current Sixth Environment Action Programme covers the years 2001-2010 (EU 2005). It has four priority areas; Climate change (Article 5), Nature and biodiversity (Article 6), Environment and health (Article 7), and Natural resources and waste (Article 8). Article 8 aims at decoupling waste generation from economic activity in such a way that economic growth does not lead to increased waste amounts. The Policies are implemented through EU and national legislation in the member states.

Integrated solid waste management aims at reducing the amount of generated waste and optimises waste management practices by selecting and applying suitable techniques, technologies, and management schemes in order to achieve the objectives and goals set by

international treaties, international agreements, and international and national legislation (Simmons 1991, 156-159; Tchobanoglous *et al.* 1993; 3-18). Integrated solid waste management combines issues of public health, economics, engineering, conservation, public education, aesthetics, and other environmental considerations. Solid waste infrastructure is an operational part of integrated solid waste management and is municipal and country specific (Tchobanoglous *et al.* 1993, 3-36). The minimum requirement of the solid waste infrastructure is to offer means to handle the generated solid waste at the source, to remove it from the immediate vicinity of the source, and to treat it. In the EU, the main guidelines for solid waste infrastructure are defined in four Directives (the Council Directive 75/442/EEC of 15 July 1975 on Waste and the Council Directive 91/156/EEC of 18 March 1991 amending Directive 75/442/EEC on waste; The Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control; the Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste; the Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the Incineration of Waste). The Directives follow the Waste Hierarchy Principle, prioritising waste reduction to waste recovery as material and energy, and having disposal in landfills as the lowest priority. The Directives categorise waste to household, commercial, and industrial waste according to the disposal location. Household waste and commercial waste that is generated in non-industrial commercial (such as offices, retailers, restaurants, hotels) and institutional premises (such as schools and hospitals) form municipal waste. The definition of commercial waste is, however, ambiguous. If commercial waste is collected together with municipal waste, it is subject to municipal waste legislation, whereas if collected by a separate private collector, it is industrial waste and is subject to industrial solid waste legislation. The main consequences of this collector-dependent classification are financial. When subject to municipal waste legislation, the national landfill tax is charged from the waste disposed of in public landfills. The national landfill tax is not charged from industrial waste disposed of in industrial landfills. Another drawback of the present legislation is the Waste Hierarchy Principle that has not been questioned. The recent studies of for example Beigl and Salhofer (2004), Holmgren and Henning (2004), Finnveden *et al.* (2005), Moberg *et al.* (2005), Dahlbo *et al.* (2005a, 85-86), and Bovea and Powell (2006) conclude that the

Waste Hierarchy is valid as a rule of thumb, but the priorities are dependent on the existing conditions.

An optimal solid waste infrastructure involves working conditions, economy, and service to waste producers and is adaptable to local conditions (for example Mattsson *et al.* 2003). Sorting by waste producers is an integral part of solid waste management. There is, however, no legal duty for waste producers to sort their wastes. In other words, sorting is a voluntary action, which creates a social dilemma. The personal benefits of the participants always exceed any personal sacrifices they undergo. From the society's viewpoint, society as a whole receives more benefits if all participate than if all do not (Biswas *et al.* 2000). The most important predictors of sorting intention and behaviour are situational factors (convenience, opportunities, facilities, space, time, and knowledge) (Biswas *et al.* 2000; Mannetti *et al.* 2004; Tonglet *et al.* 2004a; Tonglet *et al.* 2004b) dominated by personal convenience (for example Gamba and Oskamp 1994; Smith *et al.* 1999; Sterner and Bartelings 1999; Mattson *et al.* 2003).

A part of solid waste originates from packaging. According to Soroka (1999, 3), 'packaging is a service function that cannot exist by itself: if there is no product, there is no need for packaging.' Products, from food and consumer products to building materials and car parts, are distributed or sold in a packaging. Many products require the use of a series of packaging during their life cycle from raw materials to finished goods. The packaging industry, manufacturing packaging materials and packaging became an international business in the late 1980s (Pira International 1993b, 1-3) as a result of increased consumption especially by the food industry, which is the largest sector to use packaging and which is also the most sensitive sector to changes in lifestyle and demography, because changed eating habits create a demand for new packaging applications (Paine and Paine 1992, 5-17).

Modern packaging has a variety of technical and marketing functions. Packaging acts functionally as a barrier between the surroundings and the product. It protects the packed product from undesired alterations, such as contamination with impurities, during transportation and storage until the packed product is used at its final destination. The preservation and protection function is especially important in food packaging. Without packaging, up to 50 % of food would never survive to be consumed safely. Packaging is

one precondition for mass production. Its introduction has remarkably decreased production losses and increased shelf lives. On the other hand, packaging has an important marketing function. It is a communication link between the user of the packed product and the packager, which in most cases is the manufacturer of the product. It attracts a user and promotes sales. Legislation identifies the contents of labelling that must inform the end user on the contents of the packaging, materials, quantity, price, operating instructions, and warnings, just to name a few requirements. Other characteristics of packaging are the need for appropriate design that allows technical applicability during production, transportation, storage, and usage, and the need for appropriate printing characteristics and for proper prime costs that are in right correlation to the value of the packed product. (Paine and Paine 1992, 5-17; Reynods 1993, 29; Twede and Goddard 1998, 5; Soroka 1999, 19-36; Peri 2006)

Packaging also needs to be easily disposable after use, because most packaging is one-way and it is one of the most significant factors in the total environmental impact of goods (for example Andersson and Ohlsson 1999; Lewis 2005; De Monte *et al.* 2005). The constantly increasing consumption increased packaging amounts in the 1970s and 1980s, which resulted in packaging to be the focus of intense public scrutiny especially from the mid-1980s to the mid-1990s. The visibility of packaging waste in the household dustbins as litter resulted in charges, such as excessive packaging and wasteful use of resources. The increased use of packaging contributed to the burden of waste disposal, resulting in the imminent exhaustion of landfill sites near urban populations (Reynolds 1993, 1; Twede and Goddart 1998, 9-12; Gidarakos *et al.* 2005). These charges brought packaging waste to publicity and to the national and international political scene, even though packaging waste *per se* represented about 1 % of total waste in EC countries in 1991 (Pira International 1993a, 20). Good packaging reduces waste (Soroka 1999, 12-15), and most growth in household waste was - and is - caused by quantitative growth in consumption (Thøgersen 1996).

These factors contributed to the development of packaging and packaging waste management -specific legislation. The main legislative tool in the EU is the Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste that covers all packaging and packaging waste that a packager (producer/manufacturer) has placed on the market in the EU. The Directive is based on the Extended producer responsibility –

principle. The principle recognises the producer's role in reducing the environmental impacts of its product throughout its entire life cycle, including waste management. This way, it shifts part, or all, of this responsibility from taxpayers, local authorities, and conventional waste operators to producers, who are required to accept the waste back after the use (Lindhqvist 2000, 157-160). The Directive also sets numeric recovery targets for the packaging waste generated in the member states. The recoverability of packaging waste is primaly dependent on the packaging materials the packaging is manufactured from.

A part of packaging waste is generated by the fast food industry, which was founded to meet the needs of modern eating habits that have been influenced by societal changes (for example Love 1995, 12-19; Michaelis 2003; Scherwitz and Kesten 2005). They have created a habit of taking care of every day routines as fast and as conveniently as possible. Meals with family members are being replaced with snacks that are more often eaten outside the home and self-prepared meals have been replaced by convenience and prepared food and home-delivered products.

The fast food industry offers consumers a limited menu of food products that are easily and time-efficiently attainable because of efficient production technologies. A part of products is sold as take-away, which means ready-to-eat food products that are purchased at an outlet but consumed outside at work or at home. The fast food industry is specialised in food products such as hamburgers, pizzas, chicken, or sandwiches (Bender and Bender 2001, 157). They are generally franchised chains operating nationally or internationally, each chain having the same food products on the menu, manufactured by identical food production techniques.

1.2 Research problem and objectives

The recovery of packaging waste generated in the fast food industry is demanded by the packaging waste legislation, because the fast food industry is a packager, packing products to one-way sales packaging and releasing them on the market. The fast food industry also produces packaging waste at production. The recovery of packaging waste is also expected by the public. Practical experiences show that the packaging waste is mostly disposed of in landfills despite of the high recoverability.

The main research problem is to find out means of promoting the recovery of the packaging waste generated in the fast food industry. In order to define these means, a literature review and a case study are combined (Figure 1). The general factors influencing packaging waste management are analysed by a multidisciplinary literature review on legislation, packaging and solid waste technology, behavioural studies, and food science. The literature review focuses on the following factors influencing the recovery of packaging waste:

1. Packaging waste legislation

   Packaging waste legislation has been enacted internationally and nationally to control the generation and treatment of packaging waste.

2. Packaging materials

   The recoverability of packaging waste is directly dependent on the material the packaging is manufactured from, because every recovery process has tight raw material specifications, in this case concerning packaging waste.

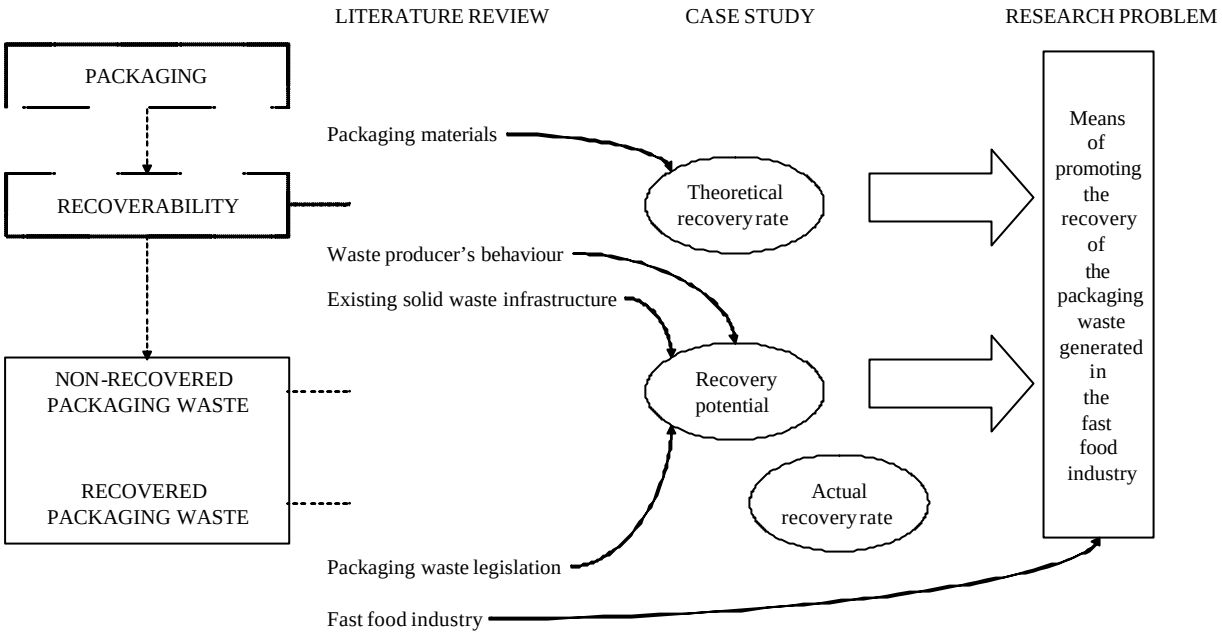


Figure 1. Research problem of the study.

3. Waste producers' behaviour

The choice of recoverable packaging material *per se* does not quarantee that the packaging waste is recovered. At the disposal point, the packaging waste is generally sorted for recovery by waste producers, whose behaviour contributes directly to such factors as the amount and the quality of sorted waste components.

4. Existing solid waste infrastructure

The existing solid waste infrastructure has an influence on, how much of the recoverable packaging waste can be recovered. The minimum requirement of the solid waste infrastructure is to offer means to handle the generated solid waste at the source, to remove it from the immediate vicinity of the source, and to treat it.

The general factors are studied in the fast food industry by a case study that combines data collected from different sources and reveals the relationships between the different factors (Yin 1994, 1-253). McDonald's Oy operating in Finland was chosen as the case company, because detailed data on packaging waste management was available for research purposes.

The main research problem is approached through the following three subproblems of the research.

1. What is the theoretical recovery rate of packaging waste generated in the case company presently?

   The theoretical recovery rate of packaging waste illustrates how much of the packaging waste can be recovered. The recoverability of packaging waste is significantly influenced by the used packaging materials.

2. What is the actual recovery rate of packaging waste generated in the case company presently?

   The actual recovery rate of packaging waste illustrates how much of the packaging waste is actually recovered by the existing solid waste infrastructure.

3. What is the recovery potential of packaging waste generated in the case company presently?

   The recovery potential of packaging waste illustrates how much of the packaging waste could be recovered, in other words, it is the difference between the theoretical and the actual recovery rate. The recovery potential is influenced by the waste producers' behaviour, the existing solid waste infrastructure, and the packaging waste legislation.

The means of promoting the recovery of packaging waste generated in the fast food industry are revealed by factors for reaching the recovery potential and general factors found in the literature review.

1.3 Scope of the research

The research focuses on the means of recovering the packaging waste generated in the fast food industry. The classification of the fast food industry is difficult. It resembles food industry from the production point of view, and the restaurant and retail sector from the selling and consumption point of view. In principle, the operation pattern of a nationally operating fast food company mimics a food factory, whose production is dispersed to a number of small production units. In this research, the term fast food industry refers to companies operating as national or international chains with a number of identically operating outlets. Individually operating outlets such as hot-dog stands are not included, because they show too wide variation in operational concepts, offering no reliable primary data for research purposes.

The fast food industry was chosen for the research, because the legislation, in particular Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste, demands the recovery of packaging waste, but practical experiences have shown challenges in the packaging waste management. For example most packaging waste is generated at the outlets as commercial waste, whose status is collector-dependent, the packaging waste practises are steered by the property and the municipality the outlet is located at, and intense public scrutiny has accused the fast food industry for littering; for example, the term 'junk food' has been introduced to refer not only to the low nutritional value of fast food but also to the use of one-way sales packaging. Simultaneously, the fast food industry has gained a permanent position in meeting the needs of modern eating habits. Its packaging waste management has also received no large academic interest.

The research is limited to the sales packaging and the primary and secondary packaging of food, food raw materials and sales packaging, because their usage is directly related to the amount of sold products and sales and they are used at all outlets. Packaging of such goods as detergents, toys, and utensils, have been excluded, because their usage is not directly correlated to the sales, and some detergents and untensils are not equally used at all outlets. Tertiary packaging, in other words wooden pallets, and secondary packaging of buns and dairy products, in other words plastic trays, are also excluded, because they are

back-hauled from the outlets to the distribution centre in the case of wooden pallets and to the bakery and dairy factory in the case of plastics trays. The distribution centre, the bakery, and the dairy factory are responsible for their disposal. The research is also limited to factors that can be studied at the outlets. For example a detailed consumer survey on sorting behaviour outside the outlets has been excluded from this study, because of the difficulty to collect reliable prelimary data.

Packaging waste management is a part of integrated solid waste management. Because of the extent of integrated solid waste management, only the main principles and the general factors that are preconditions for a working management of packaging waste generated as commercial or household waste are included in the study. The focus is on the recovery of packaging waste, with secondary focus on packaging waste reduction and reuse.

The research is restricted to the EU, because the principles of integrated solid waste management show wide global variation that is dependent on factors such as life style and demography. In the EU, integrated solid waste management is based on EU environmental legislation, whose scope is wide. The principles of integrated solid waste management specified in four Directives (the Council Directive 75/442/EEC of 15 July 1975 on Waste and the Council Directive 91/156/EEC of 18 March 1991 amending Directive 75/442/EEC on waste; The Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control; the Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste; the Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the Incineration of Waste) are focused on in this study.

The general features of packaging waste management and the fast food industry are combined by a case study that focuses on one fast food company operating in Finland, which is an EU member state. The results of this study are especially applicable to the fast food industry that resembles the case company and whose packaging waste is managed by the solid waste infrastructure resembling that of Finland. The applicability of the results is influenced by the country-dependent waste producer behaviour, specially at the point of disposing used packaging.

The literature used in this study is limited to European countries, especially concerning waste producer behaviour and solid waste infrastructures, because they are country- and

continent-specific. The literature on fast food industry originates mainly from the United States, because of the strong position the fast food industry has in this country. The origin of the literature on technical issues, such as the newest packaging material innovations is not restricted because of their universal applicability.

1.4 Structure of the research

The principles of packaging waste management are discussed in Chapter 2. Packaging waste legislation in the EU (Section 2.1) is based on the EU Waste Management Policy (Section 2.1.1) that is implemented through EU legislation (Section 2.1.2). The packaging waste legislation is described in Section 2.1.3.

The packaging waste legislation has set recovery targets for the packaging waste. The recoverability of packaging waste is significantly influenced by the packaging materials it is manufactured from. The basic packaging materials and their recoverability are described in Section 2.2. The influence of waste producer behaviour and solid waste infrastructure on the recovery rate of packaging waste is discussed in Sections 2.3 and 2.4, respectively. The principles (Section 2.4.1) and technical factors of the solid waste infrastructure (Section 2.4.2) are described in dedicated Sections.

The fast food industry (Section 3.1) and its packaging waste management (Section 3.2) are discussed in Chapter 3.

The research framework is specified in Chapter 4. The case study (Section 4.1) focuses on the recovery of packaging waste in the case company (Section 4.3) located in Finland. The Finnish packaging waste management is described in Section 4.2, the principles in Section 4.2.1 and the solid waste infrastructure in Section 4.2.2. The used methods are presented in Section 4.4, the collection of primary and secondary data in Section 4.4.1, mathematical calculations in Section 4.4.2, and customer surveys and observations in Section 4.4.3.

The results are presented in Chapter 5 and Appendixes 1…7. The theoretical recovery rate is determined in Section 5.1, the actual recovery rate in Section 5.2, and the recovery

potential in Section 5.3. The recovery potential (Section 5.3.1) is a sum of the achievable recovery potential and the theoretical recovery potential that are presented in Sections 5.3.2 and 5.3.3, respectively. The influence of packaging materials on the theoretical recovery rate is discussed in Section 5.4.

Discussion and conclusions of the study are presented in Chapter 6. The results at the national level, based on the case study in Finland are presented in Sections 6.1…6.4. The theoretical and actual recovery rates and the influence of packaging materials on the theoretical recovery rate are discussed in Section 6.1. The factors for reaching the achievable and theoretical recovery potential are revealed in Section 6.2 and 6.3, respectively. Packaging waste management as a part of the solid waste infrastructure is discussed in Section 6.4. Conclusions and recommendations are given in Section 6.5. The research is summarised in Chapter 7.

2. Packaging waste management

2.1 Packaging waste legislation in the EU

2.1.1 Waste Management Policy

Most packaging is one-way, which generates packaging waste. In the past, packaging waste was dumped in landfills. Today, one significant disabler of dumping is packaging waste -related legislation. In the EU, the packaging waste legislation is derived from the Waste Management Policy that is described in this section.

The Waste Management Policy was started in the EU in 1975, inspired by the rapidly growing amounts of solid waste (Johnson and Corcelle 1995, 184-185). The objectives of the Waste Management Policy are the achievement of environmental protection without distorting the internal market, and the removal or diminishment of possible trade-offs between environmental protection and economic development. The objectives of the Policy are formed by five principles. Waste production is to be minimised and avoided when possible (the Preventive principle) and environmental damage should be rectified at source (the Source principle). Precautionary measures are to be taken before there is a problem, even if the evidence on cause and effect is not scientifically established (the Precautionary principle). The Integration principle co-ordinates the policy of the member states in order to avoid competition distortions in the single market. (Weidenfeld and Wessels 1997, 212-215; Hitiris 2003, 323-324)

The fifth principle is the Extended producer responsibility -principle that requires those who produce waste or pollute to pay the full cost of it. The principle is based on the Polluter pays -principle (OECD 1975), which was one of the earliest developmental tools towards less waste amounts and decreasing disposal of solid waste in landfills. The objectives of the Polluter pays -principle are to reduce the total amount of generated waste by favouring reuse and recycling technologies, and to minimise the impact of waste on the

environment. The Extended producer responsibility -principle recognises the producer's (manufacturer's) role in reducing the environmental impacts of their product throughout its entire life cycle, including waste management. This way, it shifts part, or all, of this responsibility from taxpayers, local authorities, and conventional waste operators to producers, who are required to accept the waste back after the use (Lindhqvist 2000, 157-160). By inserting the external costs of environmental degradation (for example the costs of waste management) to the costs of products and services, the principle encourages the producers to take measures such as source reduction and redesign of products, product recyclability, packaging, weight (Fullerton and Wu 1998; Choe and Fraser 1999; Calcott and Walls 2000), material content (Eichner and Pethig 2001), and product durability (Runkel 2003; van Schaik and Reuter 2004) to reduce the amount of waste.

The Extended producer responsibility –principle is usually implemented through formal legislation, but it can be voluntarily executed by companies that lease their products and take-back discards for refurbishment and reuse (McKerlie *et al.* 2006). Today, the principle is widely used and concerns such waste components as packaging, lubricating oils, batteries, tyres, cars, plastics, home appliances (for example TV sets, refrigerators, air conditioners, and washing machines), vehicles, and waste electronics and electrical equipment (Mayers and France 1999). Different schemes are used to organise the take-back. In a pooled take-back scheme, physical and economic responsibility for waste is assumed by consortia of producers, usually grouped by materials and/or products. These consortia are a form of producer organisations that often have their own recovery facilities. As a member of a producer responsibility organisation, a producer pays a recovery fee whose amount is based on a calculated estimate of the true costs of recovery. (Ferrer and Whybark 2000; Spicer and Johnson 2004)

In the third party take-back scheme, the original manufacturers pay a recovery fee to a product responsibility provider, which ensures that the producers' materials and/or products released on the market are disposed of in an environmentally responsible way, fulfilling the existing legislation. The waste is collected and recycled to a local recoverer who works in partnership with the product responsibility provider. The recoverer treats the waste and receives payment from the product responsibility provider. The recovery fees are paid on the sale of a product. (Ferrer and Whybark 2000; Spicer and Johnson 2004)

In the take-back by the original manufacturer scheme, the original manufacturers themselves take physical and economic responsibility for the products that they have manufactured. Each company manages their own recovery facilities in which their products are recovered. It is, however, a highly specialized scheme that is applicable to a relatively small array of products, typically long lasting ones, such as electric equipment. (Ferrer and Whybark 2000; Spicer and Johnson 2004)

The Waste Management Policy and its objectives and principles are implemented in member states through EU environmental legislation, whose general principles will be described in next section.

2.1.2 Principles of EU environmental legislation

The EU environmental legislation encompasses a multitude of regulations, decisions, and directives defining the minimum level for polluters' social responsibilities (EU 2004). Regulations and decisions are directly applicable and binding in all member states. They aim at the unification of the legislation in the member states. This section focuses on the directives, because the integrated solid waste management in the member states, including packaging waste management, is significantly steered by them. The implementation of the directives is supported by waste policy instruments that work as concrete tools to achieve the objectives set in the directives and that are the second focus of this section.

The purpose of directives is to secure the necessary uniformity of Community law. The ultimate objective is to remove contradictions and conflicts between national legislation and regulations so that, as far as possible, the same material conditions prevail in all the member states. Directives are one of the primary means deployed in building the single market. On the other hand, they bind the member states to objectives that are to be achieved within a certain time limit (typically three years). They respect the diversity of national traditions and structures by leaving the national authorities with the possibility to choose the forms and means of implementation. The means can be ecological (such the sensitivity of the soil towards acidification), economical (such as taxes and fees), or

societal (such as politically decided goals for environmental aspects). Consequently, directives bind polluters indirectly through the national legislation, waste policies, and waste policy instruments. (Weidenfeld and Wessels 1997, 212-215; EU 2004; Hollo 2004, 101-124)

Waste policy instruments are driven from legislation and work as concrete tools to achieve the legislative objectives. The instruments do not generally involve bans but rather set limits or targets aiming at protecting (saving) or changing (consuming) the ecosystems (Määttä 1999, 18-21). The waste policy instruments are regulative, economic, or informative. The primary objective of regulative waste policy instruments (such as regulations, permits, and prohibitions) is to change the present status by obligatory means. Examples are regulations on products and their quantities, technologies and locations, environmental agreements, eco labelling, and environmental insurances. In the past, regulative instruments were dominantly used in the member states. Being based on centralised decision-making, they were considered as a safe choice by the government. The instruments were used as efficient 'command-and-control' tools by obligation. Furthermore, they were applicable when the target was to ban the utilisation of an environmentally harmful product. On the other hand, the companies could affect the content and principles of the instrument. Because of time-consuming enforcement, their use allowed companies a long time for adaptation. They were, however, economically inefficient, because they imposed uniform obligations on companies regardless of the companies' ability to control environmentally damaging practises. They also gave companies few incentives to produce pollution beyond the standards set by the government and offered prohibitions and/or requirements to use particular technologies. In some cases, they increased companies' compliance costs and resistance toward future environmental regulation. (Hoffrén 1994, 83-86; Määttä 1999, 18-27; Hollo 2004, 65-66)

The use of economic waste policy instruments has not been preferred by the member states. Because of the need for high value taxes and fees, governments have considered them to operate only in theory and to result in a deterioration of environmental quality and/or an increase in economic costs and inflation and/or undesirable social consequences, such as the deterioration of the status of low income residents. The instruments are, however, based on centralised decision-making. For example the value of landfill tax is based on centralised governmental decision-making. The actual amount of landfill tax

paid is based on scattered decision making by individual waste producers; the higher the amount of solid waste they produce and dispose of in landfills, the higher the landfill tax they pay. (Hoffrén 1994, 86-95; Määttä 1999, 59-125)

Economic instruments are also applicable when the target is to reduce the utilisation of environmentally harmful products. A constant price pressure for companies is created to improve their operations, which may give an impulse for new technological innovations and behavioural changes. In addition, economic instruments are based on the predominant economic system and need a low level of bureaucracy and expenses. They can also be easily iterated in order to meet the target levels. The potential inflatory impact of environmental taxes may, however, hinder economic performance and competitiveness, particularly in sectors that rely heavily on processes or products targeted by environmental taxes. (Hoffrén 1994, 86-95; Määttä 1999, 59-125)

Economic instruments are incentives (such as benefits and subsidies) or charges (such as taxes and fees). Environmental taxes are levied with the intention of changing environmentally damaging behaviour by increasing the marginal cost of polluting. They have immediate influence on waste producers, but the environment is affected after a longer time period when the waste producer may not exist any more. (Hoffrén 1994, 86-95)

There is a clear ideological dilemma between traditional and environmental taxation. By contrast to traditional taxation, in which the source of taxation must not be destroyed in order to guarantee the continuity and high level of tax revenues, the objective of environmental taxation is to make the taxation dispense with itself because of reduced pollution and waste generation. Consequently, the primary objective of environmental taxation is the reduction of environmental load, and only secondarily the generation of tax revenues to the government. The fact that taxation is always a political issue with contradictory interests has, however, hindered the use of environmental taxes and fees. The development of environmental taxation has also been slowed down by the lack of experiences and the time frame. (Määttä 1999, 59-125)

The EU encourages the member states to increase the use of economic waste policy instruments, which has resulted in a gradual move towards using a combination of regulative and economic instruments in the member states. The definition of correct

standards for an environmental effect (regulatory instrument) and correct sanctions (economic instrument) is, however, difficult. If the standards and sanctions are too high, a waste producer may overreduce its operations, leading to an overall welfare loss. If the sanctions are too low, it is worth paying them and the waste producer can continue its operations without any changes. In the latter case the instruments have no steering effect (Turner *et al.* 1998; Määttä 1999, 59-125).

Economic instruments do, however, promote environmentally responsible behaviour (Joos *et al.* 1999). Even a small increase in economic waste policy instruments can work as a sufficient signal of the anticipated developments to industrial waste producers and result in activities to reduce waste amounts (Kautto and Melanen 2003). In some cases, industrial and residential waste producers are reluctant to pay taxes, which may lead to a potential of environmentally harmful practises such as illegal dumping (Mizuno 2001; Casares *et al.* 2005). The combination of regulative and economic instruments does not, however, affect the competitiveness of manufactures that withstand high compliance costs (Triebswetter and Hitchens 2005). In the public sector, the use of a feebate (fee plus rebate) scheme can positively encourage municipalities to reduce waste and to increase recovery (Puig-Ventosa 2004). In the scheme, municipalities achieving better results in their waste management performance are recompensated with a rebate obtained from a fee charged of those municipalities that are less environmentally sound.

Informative waste policy instruments (such as education, publicity, and promotion) are used to support regulative and economic instruments in particular (Porter 2002; 29). They aim at changing the behaviour by transfer of knowledge, argumentation, or persuasion and are especially significant in promoting sorting at households. Successful informative instruments targeting households are based on creating a branded image and publicity for sorting (Mee *et al.* 2004) by continuous, regular marketing and promotional campaigns (Shrum *et al.* 1994; Joos *et al.* 1999; Evison and Read 2001; Lyas *et al.* 2005; Robinson and Read 2005). The best communication tools are leaflets, newspapers, personalised letters, and information available on the Internet (Mee *et al.* 2004) giving detailed information on local practises (what recoverables are sorted and where and how they are collected) (Barr *et al.* 2003). They should be targeted at the lower-participating consumers in society (Evison and Read 2001). Best results are achieved when local campaigns are supported by sophisticated, long term education with nationally standardised education

materials (Coggins 2001). It is also important to educate all participants in the collection practises before new waste management practises are introduced to consumers (Woodard *et al.* 2001), and to show transparency of economic instruments (Coggins 2001). One form of informative instrument are waste minimisation clubs that target mainly at industrial waste producers and are used for example in the United Kingdom (Phillips *et al.* 2001; Ackroyd *et al.* 2003; Phillips *et al.* 2004; Coskeran and Phillips 2005).

EU environmental legislation has experienced a fast development in recent decades. It has had a significant influence on the national legislation. For example about 85 % of the national environmental legislation was revised in Finland in the 1990s (Hollo 2004, 11). The development has also resulted in special legislation, such as legislation on packaging waste.

2.1.3 Packaging waste legislation

The constantly increasing packaging amounts in the 1970s and 1980s resulted in packaging to be the focus of intense public scrutiny especially from the mid-1980s to the mid-1990s. The visibility of packaging waste in the household dustbins as litter resulted in charges, such as excessive packaging and wasteful use of resources, which added to the burden of waste disposal resulting in the imminent exhaustion of landfill sites near urban populations (for example Reynolds 1993, 1; Twede and Goddart 1998, 9-12; Lewis 2005). These charges brought packaging waste to publicity and to the national and international political scene, even though packaging waste *per se* represented about 1 % of total waste in EC countries in 1991 (Pira International 1993a, 20). Good packaging reduces waste (Soroka 1999, 12-15), and most growth in household waste was – and is – caused by quantitative growth in consumption (Thøgersen 1996). The EU, as one of the the most active forces pursuing sustainable development, has reacted to the pressures by enacting packaging waste legislation to control the generation and treatment of packaging waste. The main legislative tool, the Council Directive 94/62/EC of 20 December 1994 on

Packaging and Packaging Waste, is discussed in this section, because it forms the basis of packaging waste management in the member states.

The Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste (the latest amendment on March 16, 2005) was one of the earliest tools to influence on the use and disposal of packaging. The Directive is based on the Extended producer responsibility -principle aims at harmonising national measures for the management of packaging and packaging waste in the member states in order to prevent and minimize the environmental effects and to guarantee a high level of environmental protection. It also ensures a functioning internal market, which prevents packaging from becoming a barrier to free trade in the internal market (see Section 2.1.1).

The Directive covers all packaging and packaging waste a packager has placed on the market in the EU. It defines producer responsibility for packaging and packaging waste, prevention of packaging waste generation, promotion of packaging waste recovery given to packagers, and numeric recovery targets. The Directive sets four objectives to the member states. The first objective is numeric targets for different packaging materials, which are revised every 5 years. A share of 60 % of total packaging waste, covering all packaging material from any source should be recovered by the end of 2008. The recycling target is between 55 % and 80 %, with the minimum recycling rate of 60 % for fibre or paper and glass, 50 % for metals, 22.5 % for plastics, and 15 % for wood. The member states may set higher targets as long as this does not distort the internal market. Member states Greece, Ireland, and Portugal have extended the time until the end of 2011.

According to the second objective, the member states must fulfil the requirements for efficient recovery, recycling, and reuse of packaging. The third and fourth objective require the member states to collect the necessary data for monitoring the implementation of the objectives and to ensure that packaging material users are given necessary information regarding the management of packaging materials and packaging waste.

The Directive has been introduced differently within the EU. In Austria, Germany, and Sweden, industry is fully responsible for covering all the costs. Municipalities can be involved in collecting sorted waste components on behalf of the industry. In Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Portugal, and Spain, industry and municipalities share the responsibility. Industry covers the sorting and recovery costs, and

municipalities are in charge of collection. Their costs are completely or partially reimbursed. Also British and Dutch industry and municipalities share the responsibility. Industry covers the recovery costs, and municipalities are in charge of collection. They receive revenues through selling the collected materials. The practise in Greece is still under development. (Chick 2002)

The Directive has succeeded in working as a driver for packaging waste decrease and recovery (for example Chappin *et al.* 2005). The implementation of the Directive has, however, encountered some national and international drawbacks. The definitions of compostable[1] and biodegradable packaging materials[2] show controversy, which has complicated for example the development of biodegradable packaging materials (Avella *et al.* 2001). In some cases, the take-back schemes have led to worse overall environmental performance and increased costs, especially when packaging waste has been transported long distances from dispersed sources to recovery facilities (Mayers and France 1999). Pooled take-back has confronted a problem of free-riders (Melanen *et al.* 2002). The demands may also result in positive changes in packaging waste management in the short run, but there is a threat that innovations are restricted, and the capacity for system flexibility and optimisation are reduced in the long term (Wilson *et al.* 2001). On international level the Directive has to some extent distorted the competition because of the different implementation of the Directive in the member states (Bailey 2002).

[1] Compostability is defined as organic recycling that can take place only under controlled conditions and not in landfills.
[2] Biodegradable packaging is defined as a material that must have a physical, chemical, thermal, and biological degradation so that decomposing ultimately in carbon dioxide and water can take place in the compost.

2.2 Packaging materials

The recoverability of packaging waste is a significant precondition for reaching the recovery targets set in the Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste (presented in the previous section). Recoverability is directly dependent on the packaging material the packaging is manufactured from, because every recovery process has tight raw material specifications, in this case concerning packaging waste. Technically, all packaging materials can be recovered. Besides the used packaging materials, the economics and feasibility of packaging waste recovery vary by such factors as sorting practises and the homogenity of the sorted packaging waste. (Twede and Goddard 1998, 27-35)

This section focuses on packaging materials and their recovery potential. There are four basic packaging materials. Wood-based packaging materials are paper, paperboard, cardboard, wood, and cork. Their unit weights are moderate. Paper represents the largest proportion of materials used for packaging, because it performs well at a low cost and is stiff, opaque, easy to print on, and versatile. (Paine and Paine 1992, 53-58; Twede and Goddard 1998, 27-35; Soroka 1999, 83-130)

Paperboard provides a versatile and economical packaging material that is not readily matched by other packaging media. It includes a variety of packaging materials for different purposes. Paperboard dominates food packaging materials. They are often coated to improve material performance. For example two layers of PE are used on liquid board to produce a printable rigid structure and to protect the paperboard from getting wet. Aluminium foil lamination can also be used to inhibit gas or light transmission. (Twede and Goddard 1998, 36-37; Soroka 1999, 83-130)

Cardboard is the most common distribution container material (Reynolds 1993, 30; Twede and Goddard 1998, 37-43; Soroka 1999, 309-332). The regular slotted container is the most common design. Cardboard containers have become a standard element of most logistical systems, as nearly 95 % of all the world's goods are shipped in them (Tan and Khoo 2005). A range of materials are available for different needs of crush resistance,

vertical stacking strength, or ease of printing and folding. Cardboard loses, however, its strength when it is wet.

Pallets are the primary application for wood in packaging. The benefits of wooden pallets are versatility, reusability, and repairability. Today, the most important use of cork is for closing wine bottles, but, in recent years, wine bottle closures have increasingly been made from plastic and composite materials. (Twede and Goddard 1998, 44-47).

The recoverability of wood-based packaging materials is high. Recycling has a long history. Paper industry has traditionally utilised used newspaper, magazines, and cardboard boxes as raw material, because they are economical to collect in large homogeneous amounts and to recycle. The recycled fibres are, however, shorter than virgin fibres, which makes the paper made with recycled fibres weaker and easier to tear. (Twede and Goddart 1998, 9-12, 199-202)

Recycling has been taken as given to be the best recovery option for wood-based packaging waste (for example Ross and Evans 2002), even though they are also suitable for incineration (Finnveden and Ekvall 1998). The study of Ibenholt and Lindhjem (2003) revealed that the environmental costs of disposal in landfill or incineration were smaller than the costs of recycling liquid board containers. The best alternative was to incinerate the containers with energy recovery. In the case wood-based packaging is not recovered, it degrades slowly when disposed of in landfills (Twede and Goddart 1998, 9-12).

The second basic packaging material is plastic. Plastics are the youngest of the packaging technologies used in mass production since the 1950s. Today, plastics are the second largest material used for packaging and have been gaining a market share at the expense of other materials in the past decades. There are about a dozen plastic materials commonly used in packaging, producing a spectrum of properties to match the needs. PE, PP, PVC, PS, PET, PEN, and polyamide (nylon) are the most often used plastic materials. They are almost all oil based and offer durability, lightness, clarity, economy, and ease of processing. They also present a variety of design opportunities and are generally lighter than the alternatives manufactured from other packaging materials. The main limitations of plastics are in barrier performance and heat tolerance. (Paine and Paine 1992, 59-77; Twede and Goddard 1998, 69-169; Soroka 1999, 171-254, 291-308)

Plastics can be combined in many different types of other materials to provide levels of performance not available from any single material. These composites provide superior functions at low cost and at low unit weight and are often used in the production of flexible packaging and liquid board (Twede and Goddard 1998, 69-169; Soroka 1999, 171-254). Their use has, however, increased the weight of secondary packaging in order to guarantee the same durability during distribution and storage (Hanssen *et al.* 2003).

Recent innovations are biodegradable plastics that are mainly manufactured from natural renewable raw materials such as starch from corn, wheat, potatoes, cellulose, and sugars (for example Schroeter 1997; Scott 2000; Tharanathan 2003; Fang *et al.* 2005; Del-Valle *et al.* 2005; Parra *et al.* 2005; Cinelli *et al.* 2006). Biodegradable plastics are in use in supermarkets in for instance the Netherlands, Great Britain, and Italy, replacing 10…15 % of the conventional plastics packaging (Anon. 2005a; Anon. 2005b). Biodegradable plactics have the greatest potential in countries where most waste is disposed of in landfills (Petersen *et al.* 1999).

The recoverability of plastics is high (Twede and Goddart 1998, 199-202). They are easy to recycle by remelting. They must, however, be sorted by type and colour, which increases collection and sorting costs (Twede and Goddart 1998, 9-12, 89-93; Paula *et al.* 2005). Because of their multi-material structure, composites are difficult to recycle (Pira International 1993a, 5). They also increase the contamination level of recyclables (Twede and Goddart 1998, 9-12, 89-93). Contaminated or mixed plastics can be melted only into low-value materials (Twede and Goddart 1998, 9-12, 89-93). They can also be used to manufacture materials containing natural fibres and waste plastics (Jayaraman and Bhattacharyya 2004). New technologies, such as cryo-comminution (Gente *et al.* 2004) and froth flotation (Alter 2005), have recently been developed for increasing the recycling of plastics.

In theory, plastics such as PE are compostable over a long time period, but the studies of Davis *et al.* (2004), Davis (2005), and Davis and Song (2006) revealed that the PE bin liners used in collecting biodegradable waste from households were not degraded at composting facilities. The waste treatment of recently invented biodegradable plastic packaging materials is controversial (Ren 2003). The study of Klauss and Bidlingmaier (2004) showed that biopolymer addition to organic waste did not affect the compost

quality at all, whereas the study of Körner *et al.* (2005) showed that biodegradable plastics were not composted at all in composting facilities. As a consequence, they must be sorted from biodegradable waste before or after composting.

Plastics are suitable for energy recovery because of their high latent heat values (for example Patel *et al.* 2000; Ross and Evans 2003). PVC and PVdC cannot, however, be incinerated, because they contain chlorine that generates hydrogen chloride gas and show traces of dioxin[3] at incineration (for example Leadbitter 2002). Incineration of plactics is a slightly worse treatment alternative than recycling (Eriksson *et al.* 2005). Some plastic packaging such as PET bottles has high reusability. In the case plastic packaging is disposed of in landfills, it degrades extremely slowly (Twede and Goddart 1998, 9-12, 89-93, 104).

The third basic packaging material is glass, which is strong, durable, transparent, chemically inert, and an absolute barrier to moisture and gas. The drawback of glass is its weight, despite of the recent developments in light weighting. It is also breakable, which has resulted in glass packaging being replaced with plastics and aluminium alternatives in the past decades. (Twede and Goddard 1998, 49-54)

The recyclability of glass is high. Glass has a long history of recycling, which has little influence on its performance. The processing costs are low, but the collection and sorting costs are high. Glass packaging cannot be incinerated. On the other hand, glass packaging, such as glass bottles, can be reused several times, because it can be sterilised and it withstands high food processing temperatures. One of the most recent applications is to use glass packaging in concrete as a aggregate (Shayan and Xu 2004). Glass packaging does not degrade at landfill sites, because glass is an absolutely inert material. (Paine and Paine 1992, 78-82; Reynolds 1993, 37; Twede and Goddard 1998, 49-54, 199-202; Soroka 1999, 153-170)

The fourth basic packaging material is metal. The most important metals used in packaging are steel, tin, and aluminium. The unit weight of steel and tin packaging is moderate, and that of aluminium light. Tinplated steel food cans and aluminium beverage containers are the most prevalent applications. Of all packaging materials, metals have the highest absolute performance in heat tolerance, physical strength and durability, barrier

[3] Dioxin increases the impacts of acid rain and poses health risks.

and absence of flavour or odour, and stiffness. Equal to glass, the recyclability of metal packaging is high and it cannot be incinerated. Its reusability and degradability are low. (Paine and Paine 1992, 83-93; Reynolds 1993, 33; Twede and Goddard 1998, 55-65; Soroka 1999, 131-152, 275-290)

Today's packaging materials are under continuous development, because modern packaging is required to have new functions, such as showing tamper evidence, indicating quality, and interacting with the product and protecting against counterfeiting (product authenticity), parallel trading, and theft (Reynolds 1993, 41). Among the newest innovations are the integration of recycling information to bar codes (Saar *et al.* 2004), product identification by a Radio Frequency Identification (RFID) technique (for example RFID Lab Finland 2005; UPM Rafsec 2005), oxygen scavengers for improved barried packaging, antimicrobials for slow microbiological degradation of food products, and UV absorbers for protecting the packed food from UV light degradation (Vermeiren *et al.* 1999; Markarian 2004).

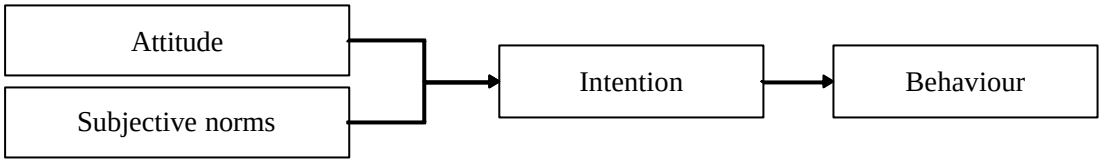
The applicability of new packaging materials to existing recovery processes is, however, not always analysed in detail, as indicated for example by the controversial results on waste treatment of biodegradable plastic packaging materials described above and by the recent study of Wäger *et al.* (2005). The study concluded that a broad application of smart labels such as RFID labels bears a risk of dissipating both toxic and valuable substances, and of disrupting the established recovery processes. The main reason for the unsuitablity to recovery processes is the long life cycle of packaging and the many involved stakeholders, which leads to packaging industry not necessarily having all relevant data for product development (Lambert *et al.* 2004). As a consequence, packaging development should be directed by improved dialogue between the producers, retailers, and consumers (Hennigsson *et al.* 2004) and integrating the Precautionary Principle (see Section 2.1.1) as early as possible in the development process in order to avoid irreversible development dissrupting the established solid waste infrastructures (Wäger *et al.* 2005).

2.3 Waste producer behaviour

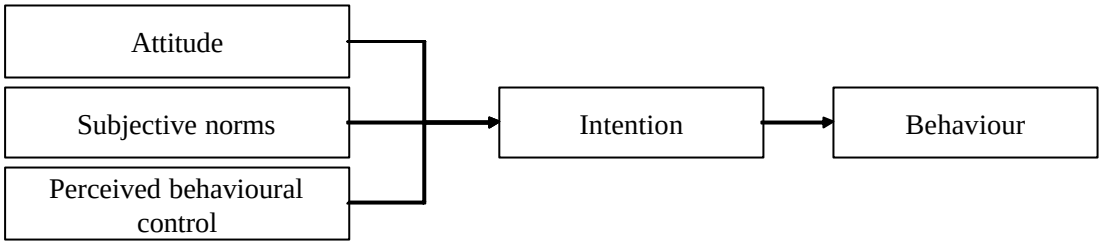
As described in the previous section, the precondition for the packaging waste recovery is the recoverability of the packaging waste. The choice of recoverable packaging material *per se* does not quarantee that the packaging waste is recovered. At the disposal point, packaging waste is generally sorted for recovery by the waste producers, whose behaviour contributes directly to such factors as the amount and quality of sorted waste components. On the other hand, the generation of packaging waste is dependent on the choices the waste producers have made at the point of purchasing. This section focuses especially on consumer behaviour at the point of disposing a used packaging.

At the point of purchasing a packed product and the point of disposing a used packaging, the consumer's choice is steered by environmental behaviour, according to the Theory of Reasoned Action (Fishbein and Ajzen 1975, 47-68) (Figure 2A). The theory assumes that most behaviour is under volitional control in that a consumer can decide whether or not to perform the behaviour. The behaviour is steered by attitude, in other words, the consumer's favourable or unfavourable evaluation of performing the behaviour, and subjective norms, in other words, the consumer's perception of social pressure to perform or not to perform the behaviour. Because there may be the lack of appropriate opportunities, skills, and resources, the theory has been extended to the Theory of Planned Behaviour (Ajzen 1991) (Figure 2B) by including a third variable, perceived behavioural control, in other words a measure of a consumer's perception of the ability to perform the behaviour.

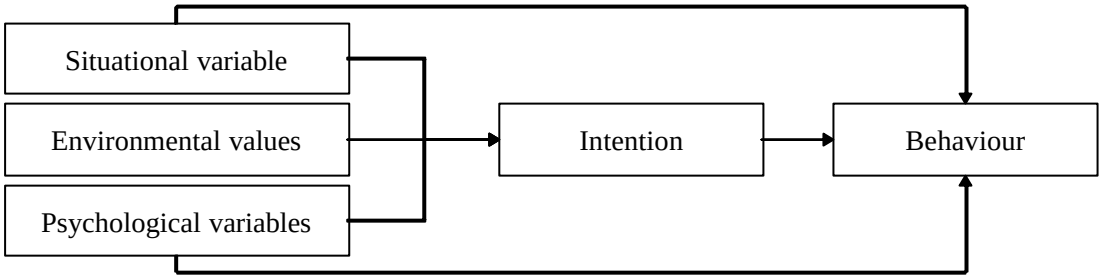
A. Theory of Reasoned Action (Fishbein and Ajzen 1975, 47-68)



B. Theory of Planned Behaviour (Ajzen 1991)



C. Theory of Barr *et al.* (2003)



Situational variables are enabler/disablers (context, socio-demographics, knowledge, and experience)
Psychological variables are motivators/barriers (for example subjective norms, altruism, intrinsic motivation, environmental threat, response efficacy, citizenship)

D. Theory of Tonglet *et al.* (2004a, 2004b)

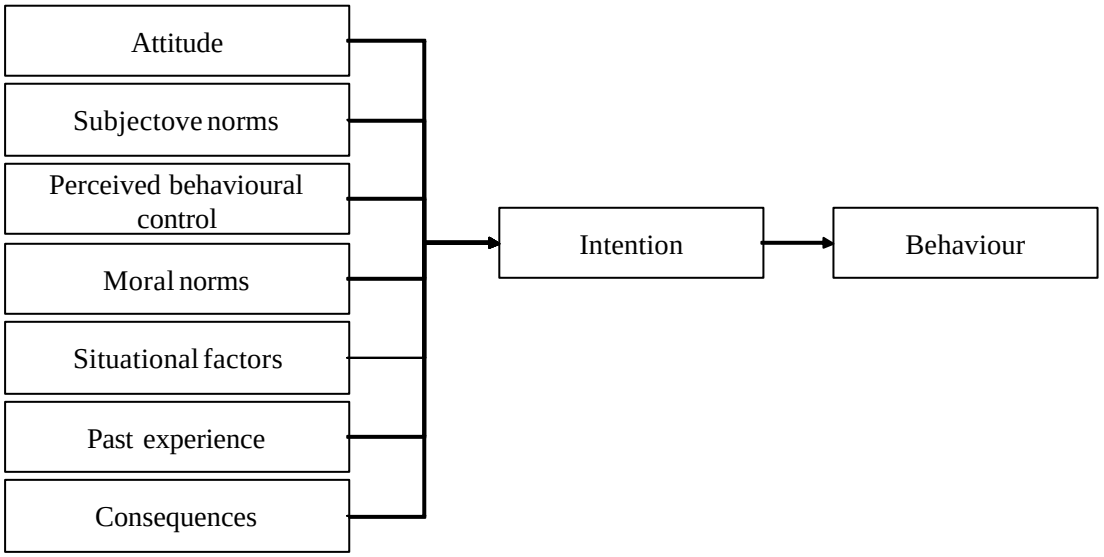


Figure 2. Theories of consumer behaviour.

Because the decision to participate in waste sorting at households is especially complex, additional variables have recently been included to the Theory of Reasoned Action by Barr *et al.* (2003, 2005) (Figure 2C) and to the Theory of Planned Behaviour by Tonglet *et al.* (2004a, 2004b) (Figure 2D). Comparison of the theories is, however, difficult, because the variables are not exactly the same. For example the contextual factors of the situational variables in the theory of Barr *et al.* (2003, 2005) are equal to situational factors in the theory of Tonglet *et al.* (2004a, 2004b). In all theories, consumer behaviour is also influenced by socio-demographic factors that are reference groups, family, roles, status, age, life cycle stage, occupation, economic circumstances, lifestyle, personality, and self-concept (Peter and Olson 1990, 207-230; Kotler *et al*. 1996, 227-272).

At the point of purchasing a packed product, responsible purchasing behaviour reflects the pattern of consumption (for example Lampe and Gazda 1995; Cooper 2000; Coggins 2001). A Danish study revealed (Thøgersen 1999a) that the majority of consumers had developed personal norms about choosing environment-friendly packaging, and the personal norm was a significant predictor of their (self-reported) propensity to choose environment-friendly packaging in the supermarket (whereas perceived costs had a minor influence on the choice). Personal norms concerning recycling and packaging waste prevention were also found to be rooted in the same more general, internalised values (Thøgersen 1999b). The environmental impact of packaging is an important aspect of product perception, but consumers balance environmental aspects against personal benefits such as convenience (van Dam and van Trijp 1994) and the price of the product (Laroche *et al.* 2001).

Responsible purchasing behaviour shows variation in Europe (Anon. 1992). Purist consumers living typically in Great Britain focus on the product and not at all on the packaging, whereas Northern European environmentally concerned consumers are aware of the environmental influence of packaging and prefer packaging manufactured from paper or paperboard. On the other hand, emotional consumers, mostly in the Mediterranean countries appreciate the aesthetics of packaging and technical characteristics are of minor interest. Functional French and Spanish consumers use, consciously or unconsciously, packaging having appealing appearance and special technical characteristics such as protection, preservation, and easiness to use.

The what-to-buy decision is also influenced by what the industry has provided for the market. The major obstacles for responsible purchasing behaviour are the lack of environment-friendly packaging alternatives for most products and consumers' inability to distinguish between more and less environment-friendly packaging alternatives (Thøgersen 1994; Bech-Larsen 1996). Responsible purchasing behaviour has affected the market demand (for example Roberts and Bacon 1997). It has led to improved consumer communication, for example the introduction of eco-labels. Their importance at the point of purchase has, however, been reported to be lower than generally suggested (Leire and Thidell 2005).

At the point of disposing used packaging, the disposal at households depends on the consumer's sorting behaviour (Tonglet *et al.* 2004a) (Figure 3). Sorting has become an integral part of today's waste management practises. Sorting by an individual consumer is, however, a voluntary action, which creates a social dilemma. The personal benefits of the participants always exceed any personal sacrifices they undergo. From the society's viewpoint, society as a whole receives, however, more benefits if all participate than if all do not (Biswas *et al.* 2000).

The most important predictors of sorting intention and behaviour are situational factors (convenience, opportunities, facilities, space, time, and knowledge) that influence on pro-sorting attitudes (Biswas *et al.* 2000; Mannetti *et al.* 2004; Tonglet *et al.* 2004a; Tonglet *et al.* 2004b). Sorting attitudes and attitudes toward environmental issues, rights issues, and political participation also have a predictable relationship (Larsen 1995).

The dominant situational factor is convenience (for example Gamba and Oskamp 1994; Smith *et al.* 1999; Sterner and Bartelings 1999; Mattson *et al.* 2003). The influence of convenience has been reported to be even stronger than financial incentives (Smith *et al.* 1999, Linderhof *et al.* 2001; Caplan *et al.* 2002), even though financial incentives are significant motivators for households (Bagozzi and Dabholkar 1994; Sterner and Bartelings 1999; Perrin and Barton 2001), especially in the case of easy sorting practises (Palatnik *et al.* 2005). The convenience factor includes for example the level of change that is required in existing behaviour (Perrin and Barton 2001). On the other hand, it is directly related to the solutions chosen for waste handling at the source and at waste

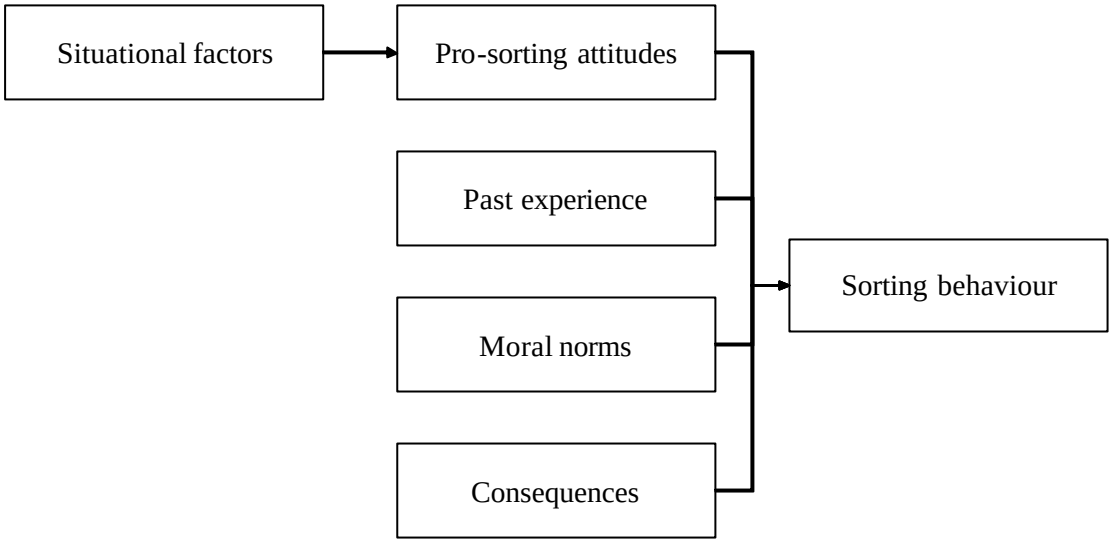


Figure 3. Factors affecting sorting behaviour at households (based on Tonglet *et al.* 2004a). Situational factors are convenience, opportunities, facilities, space, time, and knowledge.

collection, because the less time is needed, the higher the participation rate on sorting (Perrin and Barton 2001; González-Torre *et al*. 2003; Williams and Kelly 2003) (see Section 2.4.2).

Another significant situational factor is knowledge, which can be increased by informative instruments such as education, publicity, and promotion (see Section 2.1.2). Consumers are interested in information and education about sorting that first creates awareness, which leads to sorting behaviour without attitude change, but over time, if the behaviour continues and the knowledge is increased, an attitude change occurs (Shrum *et al.* 1994; Smith *et al.* 1994; Werner *et al.* 1995; Dijkema *et al.* 2000; Williams and Kelly 2003; Davis *et al.* 2006). A good level of knowledge-based understanding guarantees high participation rates and good quality of sorted waste components (Gamba and Oskamp 1994; Matthies and Krömker 2000; Perrin and Barton 2001; Thomas 2001; Mattsson Petersen and Berg 2004; Robinson and Read 2005).

Of other than situational factors, positive past experience (Werner and Mäkelä 1998; Tonglet *et al.* 2004a; Tonglet *et al.* 2004b), especially combined with perceived habit of recycling (Knussen *et al.* 2004), results in permanent sorting at households. Sorting is considered as a moral norm, in other words consumers are concerned for the community and believe that it is morally correct to sort (Bagozzi and Dabholkar 1994; Schultz *et al.* 1995; Werner and Mäkelä 1998; Bone and Corey 2000; Lee and Holden 1999; Price 2001; Barr *et al.* 2003; Thøgersen 2003; Tonglet *et al.* 2004a; Barr *et al.* 2005; Basili *et al.* 2006). In some cases, moral norms can even be stronger than an individual's environmental attitudes (Hormuth 1999). Sorting is also supported by consumers' concern about the consequences of waste (Price 2001; Barr *et al.* 2003; Bovea and Vidal 2003; Tonglet *et al.* 2004a). The weakest predictors of sorting intention at households are subjective norms (Mannetti *et al.* 2004).

The behaviour of European consumers shows variation at the point of disposing a used packaging (Anon. 1992). Environmentally concerned consumers living in Northern Europe sort packaging waste for recovery, whereas British purist consumers are unaware of waste recovery and unmotivated to sort packaging waste. Emotional Mediterranean consumers are aware of sorting, but are unwilling to sort, which is seen as someone else's task. Functional consumers living in Spain and France save packaging for secondary applications at households. After use, the packaging is desired to degrade by itself.

The evolution of waste management requires voluntary participation of all waste producers in the sorting of waste for recovery. As described in this section, consumer behaviour is a complex phenomenon. At commercial and industrial waste producers, the participation in sorting is less complex. Because of a much limited number of waste components, it is straightforward to give sorting instructions to the employees. On the other hand, challenges are generally met at the management level, because the management response to solid waste aspects is small (Kautto and Melanen 2003).

2.4 Solid waste infrastructure

2.4.1 Principles of solid waste infrastructure

The existing solid waste infrastructure has an influence on, how much of the recoverable packaging waste can be recovered. The minimum requirement of the solid waste infrastructure is to offer means to handle the generated solid waste at the source, to remove it from the immediate vicinity of the source, and to treat it. Today's solid waste infrastructure is one of the public resource infrastructures besides the electricity, district heating, natural gas, and water sectors. It is organised under various management arrangements that are country and waste producer dependent. A common feature is centralised operations that collect the generated waste from waste producers and treat it at high volume batches in order to reduce footprints of civilisation to a level where they are not harmful for the nature and future generations. (Tchobanoglous *et al.* 1993, 3-36)

This section focuses on the principles of solid waste infrastructure, whereas the technical factors will be described in the following section. The solid waste infrastructure is an operational part of integrated solid waste management. Integrated solid waste management aims at reducing the amount of generated waste and optimises waste management practices by selecting and applying suitable techniques, technologies, and management schemes in order to achieve the set objectives and goals that are set by international treaties, agreements, and legislation, such as the EU. This way, it combines issues of public health, economics, engineering, conservation, public education, aesthetics, and other environmental considerations. (Simmons 1991, 156-159; Tchobanoglous *et al.* 1993, 3-18)

In the EU the main guidelines for solid waste infrastructure are defined by four Directives. Their common objective is to promote the recovery of waste by preventing and/or reducing its disposal in landfills as far as possible. The Directives follow the Waste Hierarchy Principle. Waste reduction is the first priority of the Waste Hierarchy. It can be achieved for example by reducing the amount of material used per product without

sacrificing the utility of the product, by optimizing manufacturing processes, by extending the useful time of a product, and by eliminating the need of the product. Waste treatment options are prioritised in the declining order of reuse, recycling, and energy recovery. Disposal in a landfill has the lowest (fourth) priority in the Waste Hierarchy, because of the well recognised deterioration of the environment by generating harmful greenhouse gases such as methane, contaminating the ground water, emitting odours, and causing aesthetic deterioration of the environment. (Tchobanoglous *et al.* 1993, 15-17; Stucki and Ludwig 2003, 1-14; Miller 2004, 534-540)

The solid waste infrastructure of municipal waste is based on the Council Directive 75/442/EEC of 15 July 1975 on Waste and the Council Directive 91/156/EEC of 18 March 1991 Amending Directive 75/442/EEC on Waste that define the principles of collection, disposal, recycling, and processing of waste. In the past, the collection of municipal waste was completely organized by municipalities, publicly owned, and financed by taxpayers. The recent legislative changes and the inclusion of the Extended producer responsibility -principle in the legislation have increased the number of waste components, which has gradually changed municipal solid waste collection from an entirely public sector to a public-private sector. Today, the collection of mixed waste from households is generally organized by the municipality. The collection of recoverables from households or from waste collection points is typically contracted out to a private collector, to a producer organisation, or to an environmental organisation (for example Davoudi 2000; Dijkema *et al.* 2000; Eggert 2005).

The operations of landfill sites are based on the Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste. The Directive covers the planning, establishment, construction, use, management, closure, and aftercare of landfills for safe disposal. It restricts the disposal of biodegradable municipal waste, which is responsible for the generation of leachate and landfill gases. The amounts must be gradually reduced to 35 % of the 1995 level by 2016 (or by 2020 in the member states where over 80% of municipal waste is disposed of in landfills). Such wastes as liquid waste, explosive materials, highly flammable wastes, corrosive or oxidizing wastes, infectious wastes, and tires are totally banned from landfills by set dates. The Directive also encourages the member states to increase the costs of landfills so that they reflect the full costs, including environmental costs.

Industrial waste producers are regulated by the Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control. It aims at controlled emissions by permits and by the use of the best available techniques.

The Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the Incineration of Waste covers incineration and co-incineration plants. The Directive focuses on the operating conditions, especially by determining limit values for air emission and water discharges from the cleaning of exhaust gases. The Directive is applied to the existing plants from 28 December 2005.

The Directives have two major drawbacks. The definition of municipal waste is ambiguous. The Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste (the latest amendment on October 31, 2003) defines municipal waste as "waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households". The term "other waste which, because of its nature or composition, is similar to waste from households" refers generally to commercial waste that is generated in non-industrial commercial (such as offices, retailers, restaurants, hotels) and institutional premises (such as schools and hospitals). The status of commercial waste has been complicated by a loophole created by the compromise in legislation (Burnley 2001; Wilson *et al.* 2001) (see Figure 4 for a schematic illustration of the current status of commercial waste). If commercial waste is collected together with municipal waste, it is subject to municipal waste legislation that is based on the Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste, the Council Directive 75/442/EEC of 15 July 1975 on Waste and the Council Directive 91/156/EEC of 18 March 1991 amending Directive 75/442/EEC on waste. If collected by a separate private collector, it is industrial waste and is subject to industrial solid waste legislation that is based on Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control and The Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste. The main consequences of this collector-dependent classification are financial. When subject to municipal waste legislation, the national landfill tax is charged from the waste disposed of in public landfills. The national landfill tax is not charged from industrial waste disposed of in industrial landfills.

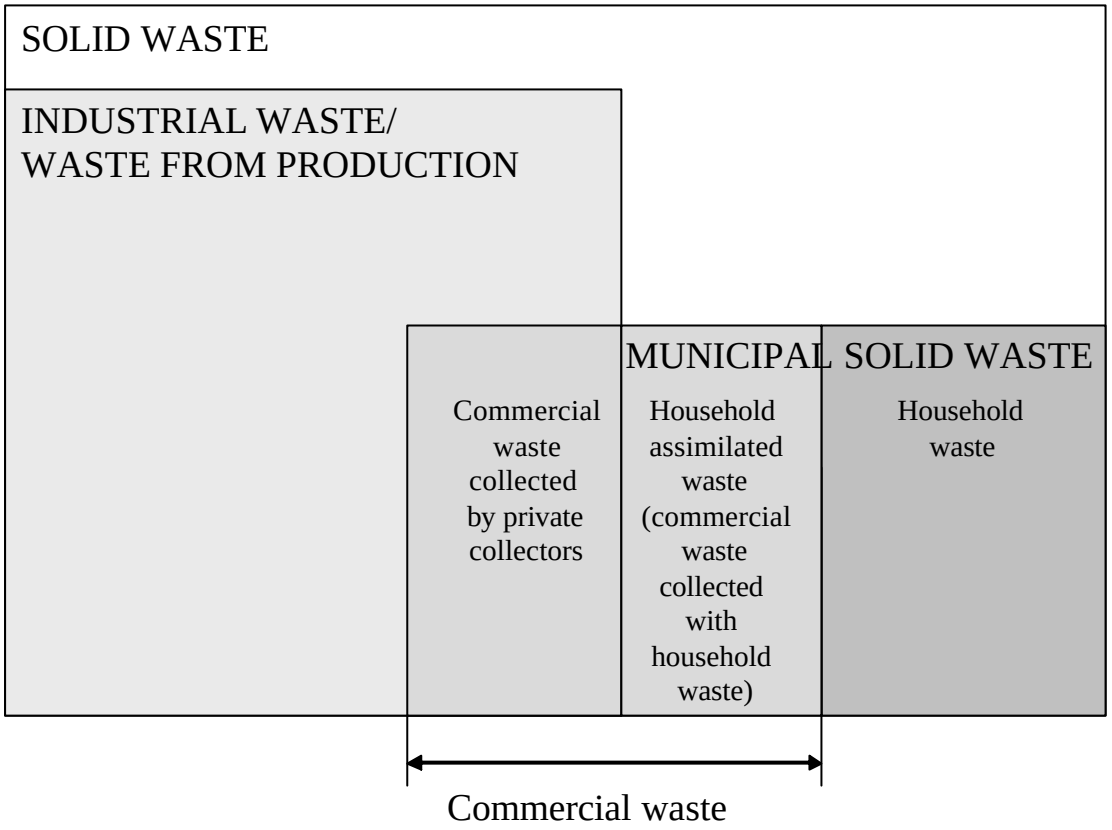


Figure 4. Schematic illustration of the current status of commercial waste.

The ambiguous definition of municipal waste has resulted in different schemes within the EU. As indicated by Figure 5, most municipal waste is generated at households. The share of commercial waste shows, however, a wide variance from 0 % in Austria to 60 % in Finland, which is in clear conflict with the fact that commercial waste is generated in every member state. On the other hand, it has resulted in municipal waste to contain commercial, industrial, construction, and even hazardous waste (Wilson *et al.* 2001). Another drawback is the difficult interpretation of the degradability of municipal waste and composted municipal waste. If composted municipal waste is defined as non-biodegradable, the member states are able to continue with the present solid waste treatment schemes; in other words, keeping disposal in landfills as the dominant waste treatment option. If composted municipal solid waste is defined as biodegradable, the

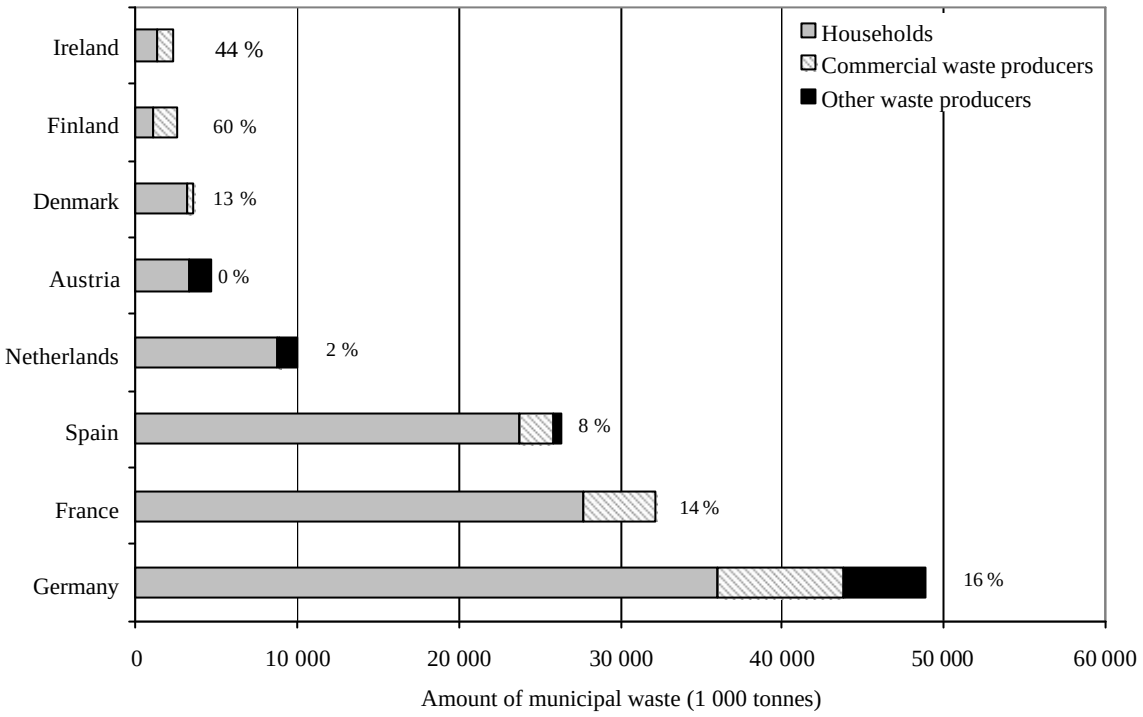


Figure 5. Amount of municipal waste generated at households, commercial, and other waste producers in some member states in 2003 (Eurostat 2005). The percentage values indicate the share of commercial waste.

member states must urgently expand their waste recovery infrastructures by investing on new recycling and combustion facilities. (Burnley 2001)

An optimal solid waste infrastructure involves working conditions, economy, and service to waste producers and is adaptable to local conditions (for example Mattsson *et al.* 2003). It has efficient collection schemes and an optimal number of waste treatment facilities (for example Fiorucci *et al.* 2003; Costi *et al.* 2004). The determination of optimal solid waste infrastructure is, however, difficult when new sorting practises are introduced or waste management practises are planned for fast growing urban areas (Dyson and Chang 2005; Chang *et al.* 2005). The choice of solid waste infrastructure is also dependent on other infrastructures and processes, such as the generation of district heating, electricity, vehicle fuel, plastic, cardboard, and fertilisers (Eriksson *et al.* 2005), and local conditions

that are influenced by regional and socio-economic factors, local politics, and authority type (Davoudi 2000; Parfitt *et al.* 2001).

The recent development of solid waste infrastructure has led to variation at the municipal level. In some municipalities, the development has been directed by market drivers, such as technical features, while in others ideological drivers, such as social or human factors have been more dominant (Burnley 2001). The variance in local conditions has also resulted in municipalities following their own waste charging policies (Karagiannidis *et al.* 2006) and complicated the planning of recovery facilities (Burnley 2001) and co-operation of stakeholders (Davoudi 2000). The variance does not allow the use of a common standard for collection (Mattsson *et al*. 2003), which, on the other hand, may lead to heavy subsidies on recovery in areas where waste management problems are not the most urgent environmental problems (Huhtala and Samakovlis 2002) and result in inefficient local practises, indicating that recovery practices should be concentrated on highly populated and urbanised regions (Berglund 2004).

The development of solid waste infrastructure is also influenced by the Waste Hierarchy Principle. Until today, the Principle has not been questioned. The recent studies of Beigl and Salhofer (2004), Holmgren and Henning (2004), Finnveden *et al.* (2005), Moberg *et al.* (2005), Dahlbo *et al.* (2005a, 85-86), and Bovea and Powell (2006) conclude that the Waste Hierarchy is valid as a rule of thumb, but the preference of recycling and energy recovery is dependent on the existing conditions, such as the existing solid waste infrastructure and the availability of energy sources. It is relevant to prioritise energy recovery to recycling for example at meeting the forthcoming ban on disposing combustible and organic waste in landfills (Ljunggren Söderman 2003a), at replacing recycling of waste paper in countries that have a substantial forest stock but lack their own resources of fossil fuels (Samakovlis 2004), and at reducing the demand for other fuels for district heating and avoiding or postponing the investments in new plants for district heat production (Sahlin *et al.* 2004). These examples indicate that incineration with energy recovery will be an integral part of future waste management as indicated for example by the studies of Finnveden and Ekvall (1998), Anon. (2000a), Sonesson *et al.* (2000), Koufodimos and Samaras (2002), Arena *et al.* (2003), Ljunggren Söderman (2003a, 2003b), Lo Mastro and Mistretta (2004), Malkow (2004), Morselli *et al.* (2005), Dahlbo *et al.* (2005a, 85-86; 2005b, 23), and Porteous (2005).

2.4.2 Technical factors of solid waste infrastructure

The technical factors of the solid waste infrastructure, in other words, technical solutions for waste handling at the source, at waste collection, and at waste treatment are signicicant enablers for the recovery of packaging waste. The main features of each of them are described in this section.

Waste handling at the source

Waste handling at the source involves sorting and storing the sorted waste components and mixed waste before it is collected (Tchobanoglous *et al.* 1993, 159-192; Corbitt 1999, 8.36-8.69). On-site storage of waste needs to be user-friendly for waste producers and must meet the needs of public health concerns and aesthetic considerations. At waste handling at households, the convenience factor (see Section 2.3) has been reported to be directly related to the number of waste components to be sorted (Perrin and Barton 2001) and to appropriate technical solutions such as purposeful kitchen size and furniture (Coggins 2001). The used containers must be applicable to the collection system, collection frequency, and the space available for them. Waste is stored at residential establishments in various types of containers, such as plastic or galvanized metal bins and disposable paper or plastic bin liners. Waste can be transferred from households to the containers for example by gravity chutes, suction systems, pneumatic conveyors, or manually. Large containers are typically used at commercial and industrial waste producers. They can be open top containers, containers used with a stationary compactor, trailer-mounted containers, or deep collection containers that are installed partly under ground and utilize gravity forces for compacting. Especially at industrial waste producers, waste is transferred from the source to the containers by container trains, service elevators, conveyors, and pneumatic conveyors. Waste handling at the source can also include grinding of food waste at households, compaction and shredding of household, commercial, and industrial waste for volume reduction, and backyard composting of food and garden waste at single family houses.

Waste collection

At collection, waste is gathered from the source and transported to the location of a material treatment facility, a transfer station, or a landfill site (Tchobanoglous *et al.* 1993, 193-246; Corbitt 1999, 8.36-8.69). The collection of household and commercial waste is complex, because waste is generated in low quantities scattered to various residential, commercial, and institutional establishments. The increased number of recoverables has further complicated the logistics of collection by dispersing it. It has also affected the disposal costs. The more recoverables are collected, the more separate collections are needed and the higher the volume of waste collected, because the recoverables are not typically compacted in comparison to mixed solid waste that is compacted at source or at collection (Porter 2002, 148-155).

Household waste is generally collected by kerbside collection offered by the municipality. It is influenced by such factors as the choice of collection containers/bins, the number of waste components, the frequency of collection, and the relationship between the collection of recoverables and mixed waste (for example Smith *et al.* 1999; Coggins 2001; Perrin and Barton 2001; Barr *et al.* 2003; Knussen *et al.* 2004; Woodard *et al.* 2005). Because the containers are placed very near to the source of waste generation, kerbside collection is easy to use, which guarantees high participation rates (for example Woodard *et al.* 2001) and high quantities of good quality recoverables, which makes the recoverables marketable (González-Torre *et al.* 2003).

Household waste is generally collected by a stationary container system (Tchobanoglous *et al.* 1993, 193-246; Corbitt 1999, 8.36-8.69). The waste is collected to containers that are emptied mechanically at the collection site using collection vehicles equipped with unloading and compacting mechanisms. Side-, front-, and rear-loading trucks collect one waste component, whereas multichamber trucks can collect more than one waste component at a time (Genter 2003, 18-20).

Waste can also be collected at waste collection points (Tchobanoglous *et al.* 1993, 251-252; Corbitt 1999, 8.36-8.69). They offer centralised collection of those recoverables that are generated at households but are not covered by kerbside or other establishment-related collection schemes. Their operational costs are low especially when they are subsidised by a municipality or run by volunteers. They are attractive for collectors because of easy

physical access and the potential to make the collection more efficient. They can, however, make the scheme effectively inaccessible for waste producers. Their use is voluntary without any financial incentives, which results in low participation rates engaging typically less than 15 % of the population (Anthony 2003, 55). The adequate number of sorted waste components (Smith *et al.* 1999; Barr *et al.* 2003, González-Torre *et al*. 2003; Bach *et al.* 2004), short distance to the waste collection point (Barr *et al.* 2003; Mattson *et al.* 2003; González-Torre and Adenso-Díaz 2005), location of waste collection points close to households (Smith *et al.* 1999; Speirs and Tucker 2001; Barr *et al.* 2003; Mattsson Petersen and Berg 2004), and acceptability of sorted waste components (Smith *et al.* 1999; Barr *et al.* 2003) contribute, however, positively to the use of waste collection points.

Waste collection points are organised by different schemes. Neighbourhood containers consist of a number of containers for different recoverables. They are usually found in public areas or in places that consumers use on a regular basis, such as shopping centres. Despite of the relatively easy access, it may be possible that overfull or overblown containers stop consumers from recycling. They may also attract mixed waste, which reduces the value of the recoverables and causes other problems such as stench. (González-Torre *et al.* 2003; González-Torre and Adenso-Díaz 2005)

Green points are designed for selective waste, such as home appliances, computer equipment, and hazardous waste that are not collected by kerbside collection or neighbourhood containers. Some of them are attended facilities, where consumers can bring recoverables and buy recycled products. (Williams and Taylor 2004; Woodard *et al.* 2004)

Buy-back centres are privately owned enterprises that pay for the recoverables. The range of recoverables purchased is usually small with low purchase prices (Tchobanoglous *et al.* 1993, 253). Because of the economic incentive, they have, however, a moderate participation rate (Anthony 2003, 55).

The hauled container system is generally used at waste collection points and commercial waste producers. The loaded containers are hauled to an off-site location such as the transfer station of a recovery facility or a landfill site for unloading. The container is

returned back to its original location or to some other location. (Tchobanoglous *et al.* 1993, 193-246; Corbitt 1999, 8.36-8.69)

One significant factor in waste collection are the disposal costs (for example Porter 2002, 148-155). The collection must be appropriately priced for a waste producer to motivate it to reduce and to recover the generated waste. Too low disposal costs of mixed waste do not encourage waste producers to separate recoverables. On the other hand, too high disposal costs may induce a waste producer to illegal dumping. Especially kerbside collection is highly sensitive to price (for example Blaine *et al.* 2005).

The pricing of kerbside collection is typically based on unit-pricing (for example Porter 2002, 148-155). The principle of unit pricing is widely favoured by collectors because of its many advantages. The term 'unit' refers typically to a bin liner, a bin, or a container with a certain volume. It is simple to specify the number of units for different waste components and their collection frequencies per week in a contract with the residential waste producer; a fact that simplifies the invoicing significantly. From the waste producer's viewpoint, unit pricing provides an incentive for example for sorting, for composting in the backyard (Porter 2002, 148-155) and for asking for less packed products from the manufacturers (Choe and Fraser 1999; Kinnaman and Fullerton 2000). Drawbacks of unit pricing are for example the eventual illegal disposal (Fullerton and Kinnaman 1995), and customers' unawareness of their own influence over collection costs caused by inadequate consumer education (Palmer and Wells 1997).

The pricing principle is ruined by stomped and too light units, because volume and weight are not one-to-one related. The pricing of household waste is based on the average specific weight of a unit. Specific weight refers to the average weight of a fixed volume unit; the value being typically based on thorough empirical analysis. Pricing by volume is efficient only if there is a fixed and immutable proportionality between weight and volume. If not, waste producers of lighter units are overcharged and waste producers of stomped units are undercharged, which weakens the incentive role of disposal costs. (Porter 2002, 148-155)

Recently, some communities have introduced weight-based pricing for households. After the weight-based pricing has been introduced, the annual amounts of total waste and mixed waste have decreased, while sorting of recoverables and backyard composting has increased (Sterner and Bartelings 1999; Linderhof *et al.* 2001; Thøgersen 2003).

Dysfunction, such as illegal dumping, has been minimal because of an efficient control system. The cost of waste collection and treatment has not increased. The weight-based pricing has increased collection, control, and administration costs, because the collection vehicles are equipped with scales and billing is based on the waste weights of each individual waste producer. Treatment costs are simultaneously reduced as a result of lower waste amounts. Weight-based pricing of household waste has, however, some drawbacks. It slows the collection by about 10 % (Porter 2002, 149), household-related weight-based pricing is difficult to organize especially in high rising apartments (Bai and Sutano 2002) and the success is dependent on the socio-demographic factors of the municipality (Sterner and Bartelings 1999; Linderhof *et al.* 2001). These Dutch and Swedish studies were carried out in municipalities with a certain degree of social control and a strong dominance of single family houses. The collectors may also be reluctant to change from unit-based to weight-based pricing (Porter 2002, 148-155). Even though many collectors have experience on weight-based pricing of commercial and/or industrial waste, they may have no experience on a new pricing scheme for household waste; a fact that may cause large losses in the early stages, because the winning bids would be too low.

The pricing of household waste collection can also be based on household type, property value, apartment size, number of residents, and number of rooms applied alone or in combination with unit pricing and/or weight-based pricing (Wilson *et al.* 2001). The disposal costs of commercial and industrial waste are generally based on weight-based pricing, because waste is generated in high amounts at a limited number of locations (Porter 2002, 148-155).

Waste treatment

The collected waste components are treated by three options: by recovering as material or as energy, or by disposing in landfills. Prior to waste treatment, the collected waste components can be pretreated for the treatment processes. Packaging waste is typically pretreated, because it is bulky and the recoverables may be heterogeneous.

Component separation is used for example to sort recoverables that have been collected together and/or to remove contaminants and bulky items from sorted waste components. Component separation can be manual and/or mechanical, using gravity, density, magnets,

screening, optical sorting, and bounce adherence. In the newest applications, electrostatic techniques are used for the identification and sorting of plastic packaging waste from municipal waste (Gente *et al.* 2003; Hearn and Ballard 2005). The volume of the sorted waste components can be reduced mechanically by compacting. Mechanical size reduction, such as shredding, grinding or milling, alters the form and reduces the size of solid waste. Size reduction does not necessarily imply volume reduction. (Tchobanoglous *et al.* 1993, 544-578; Corbitt 1999, 8.70-8.83)

Waste components can be recovered as material (recycling) or as energy (energy recovery). Treatment by recovery reduces the demand for natural resources and energy consumption and the amount of waste disposed of in landfills. At recycling, waste is treated as a resource in its own right (for example Tchobanoglous *et al.* 1993, 828-844). Waste can be recycled to produce new products of the same type, such as aluminium cans into aluminium cans (primary or closed loop recycling) or a range of lower quality conversion products, such as biodegradable waste into compost (secondary or open loop recycling). In addition to sorted and collected waste components, the waste generated during manufacturing processes can be utilised in the recycling process. As described in Section 2.2, the recyclability of packaging is high or moderate, except for the packaging manufactured from composites.

Recycling has many advantages (Tchobanoglous *et al.* 1993, 828-844; Corbitt 1999, 8.86-8.108; Porter 2002, 121-187). Sorted and collected waste components offer a stable domestic source of raw materials with uniform and known composition. Recycling decreases the need for disposal of by-products at production and saves raw materials resulting in resource conservation by extending the lifetime of materials. The savings in raw materials and production costs can be referred to the price of the final product. Recycled products are also well accepted by consumers, the positive effect being, however, limited to established brands (Mobley *et al.* 2005).

Recycling of all materials is not economically feasible, because recycling is highly material-dependent and it is closely related to the equivalent manufacturing processes (Tchobanoglous *et al.* 1993, 718-720; Corbitt 1999, 8.86-8.108). Secondary recycling in particular may produce recycled products inferior in quality having lower grade applications and limited markets (Porter 2002, 54-85, 133-148).

Special forms of recycling are biological treatment processes that are applicable to the biodegradable part of waste. They have, however, a risk of odour, rodents, and pests (Porter 2002, 54-85, 133-148). Examples of biological treatment processes are aerobic composting, anaerobic digestion (also called biomethanisation or anaerobic fermentation), and mechanical and biological treatment. In aerobic composting, the organic part of waste is biologically converted in the presence of oxygen and nutrients to carbon dioxide, water, ammonia, sulphate, and compost. Compost is humus-like material that is used in a multitude of applications, for example as soil conditioner, landfill cover, and landscape constructor (Tchobanoglous *et al.* 1993, 684-697; Corbitt 1999, 8.135-8.141).

In anaerobic digestion, the biodegradable portion of the organic part of solid waste is converted to a mixture of carbon dioxide, methane, and small amounts of other gases and resistant organic matter in the absence of oxygen. The gases are used for energy recovery and the digested sludge is treated before it is disposed of by landspreading or landfilling (Tchobanoglous *et al.* 1993, 697-710; Corbitt 1999, 8.135-8.141). A recent study of Fricke *et al.* (2005) revealed that anaerobic digestion shows a great potential for treating municipal waste.

The special application of a biological treatment process is a two-step mechanical and biological treatment. In mechanical treatment, metal and refuse-derived fuel (RDF) are separated from organic-rich waste that produces gases and a compost/a digested sludge in the biological treatment phase (Slater and Frederickson 2001; Soyez and Plickert 2003). Mechanical and biological treatment is efficient for example in stabilising municipal waste (Adani *et al.* 2004), in decreasing the polluting potential of leachates that are produced from mechanically sorted organic wastes in landfill sites (Robinson *et al.* 2005), and in decreasing the reactivity and gas emissions by reducing the amounts of nitrogen (Mostbauer and Heiss-Ziegler 2005; Komilis 2006), and carbon dioxide (Bockreis and Steinberg 2005; Komilis and Ham 2006).

At energy recovery, the latent heat that is released from the waste is utilised as heating or generating electricity. In the EU, 70 % of the recovered energy was used for heat generation and 30 % for electricity generation in 2000 (Sipilä 2003, 167). As described in Section 2.2, the incinerability of packaging manufactured from wood-based or plastic

packaging materials is high, except for packaging manufactured from PVC or PVdC. Packaging waste manufactured from glass or metal cannot be used for energy recovery.

Despite of the high initial capital and operational costs of energy recovery plants, energy recovery is widely favoured, especially because it reduces the volume and weight of waste efficiently (Tchobanoglous *et al.* 1993, 618-627; Corbitt 1999, 8.142-8.166). The energy recovery plants, however, emit pollutants, contribute to global warming, and are more stringent in operation and control (Porter 2002, 54-85, 133-148).

Energy recovery is typically based on chemical transformation processes. Energy can be derived from waste directly by burning as a fuel and indirectly through the conversion of wastes to gas or fuel pellets (RDF) (Tchobanoglous *et al.* 1993, 618-627¸ Corbitt 1999, 8.142-8.166). Mixed mass-burning in mass-burn incinerators is the dominating technology to derive energy directly from waste. It typically uses unsorted mixed waste as fuel. The energy content of mass-burn waste is variable depending on the climate, season, and the source of waste. The main drawbacks of mass-burning are hazardous emissions and harmful process residues that can, however, be decreased by efficient control systems (Leskens *et al.* 2005).

The indirect derivation of energy from waste is generally based on combustion. In combustion, excess oxygen reacts with the organic part of waste and produces heat in the form of hot combustion gases composed primarily of nitrogen, carbon dioxide, water, and oxygen. Energy is recovered from the hot combustion gases by generating hot water or steam. Hot water is typically used for heating applications, such as district heating. Steam is used for heating and generating electricity. The noncombustible residue forms ash that is used in road construction or disposed of in landfills. (Tchobanoglous *et al.* 1993, 618-627¸ Corbitt 1999, 8.142-8.166)

Gasification is a relatively new, energy efficient technique using RDF as fuel. The RDF is partially combusted to generate a combustible gas that is rich in carbon monoxide, hydrogen, methane, and small amounts of other gases. The combustible gas is combusted in an internal combustion engine, gas turbine, or boiler under excess-air conditions to produce electricity. The most commonly used gasifier types are a vertical fixed bed, horizontal fixed bed, and fluidized bed (Tchobanoglous *et al.* 1993, 630-636; Corbitt

1999, 8.167-8.180). Because the energy output of gasification is better than in mass-burning, the use of gasification has recently increased (Malkow 2004).

Safe and reliable long-term disposal in landfills is the ultimate fate of all waste that is not recovered, that remains after treatment at a material recovery facility, and that remains after the recovery of conversion products and/or energy. Landfills are widely used because of their many advantages, such as low operative costs, quick build-up, and easy operation (Tchobanoglous *et al.* 1993, 361-371; Corbitt 1999, 8.110-8.133). They have, however, high need for land that has become scarce (Porter 2002, 133-148). The recent development of landfills from dumping sites to waste treatment units has also increased - and will increase in the future - the operative costs of disposal in landfills.

Despite of the recent development indicating gradually decreasing numbers of landfill sites and simultaneously increasing numbers of recovery facilities in the member states (Wilson *et al.* 2001), most municipal waste, including packaging waste, is still disposed of in landfills in the EU (Table 1A and Figure 6). Disposal of municipal waste in landfills was the primary waste treatment option in the United Kingdom, Spain, Portugal, Italy, Ireland, Greece, and Finland in 2002/2001. The absolute number of landfill sites was the highest in Germany, but the amount of waste disposed per a landfill site was the highest in Spain (Table 1B). A majority of the municipal solid waste was recycled in the Netherlands, Germany, Belgium, and Austria (Table 1A and Figure 6). Incineration and recycling were equally used in Sweden, France, and Luxembourg. Denmark was the only member state to recover most of the generated municipal waste as energy, resulting in less than 10 % of municipal waste being disposed of in landfills. The absolute number of incineration plants was, however, the highest in France, but the amount of waste incinerated per an incineration plant was the highest in Finland (Table 1B).

Table 1. Amount of municipal waste and its recovery (A) and the number of landfill sites and incinerators (B) in the member states.

A.

Member state	Amount of municipal waste						
	Recycled	Composted	Incinerated with energy recovery	Incinerated without energy recovery	Disposed of in landfills	Total (calculated)[1]	Total (reference)[2]
	1 000 tonnes	1 000 tonnes	1 000 tonnes	1 000 tonnes	1 000 tonnes	1 000 tonnes	1 000 tonnes
Germany	13 025	7 325	31	10 796	12 174	43 351	48 836
France	3 769	4 145	8 905	1 465	13 890	32 174	32 174
Italy	2 595	2 209	2 554	107	19 705	27 170	29 788
Spain	2 956	2 746	1 488	0	15 707	22 897	26 340
Netherlands	2 113	2 386	3 227	0	830	8 556	9 953
Portugal	347	275	930	0	3 410	4 962	4 696
Greece	375	32	0	0	4 233	4 640	4 640
Austria	1 129	1 818	481	0	1 478	4 906	4 634
Sweden	1 130	390	1 500	0	880	3 900	3 930
Denmark	680	560	2 090	0	297	3 627	3 587
Finland	0	0	280	0	1 540	1 820	2 500
United Kingdom	4 294	0	2 555	0	27 846	34 695	na
Ireland	271	17	0	0	2 071	2 359	na
Luxembourg	1	41	123	0	60	225	na
Belgium	na	na	na	na	na	na	na
Total	32 685	21 944	24 164	12 368	104 121	195 282	171 078
in %	17	11	12	6	53		

[1] Calculated as a sum of columns Recycled, Composted, Incinerated with and without energy recovery, and disposed of in landfills.
Data from Table 'Treatment of municipal solid waste: latest available year' (Eurostat 2005)
na refers to not available data
2 From Table 'Amount of municipal waste in 2002/2001' (Eurostat 2005).

B.

Member state	Number of landfill sites[1]	Number of incineration plants[1]	Amount of waste per landfill site[2]	Amount of waste per incineration plant[3]
			1 000 tonnes/site	1 000 tonnes/plant
Germany	2 926	154	4	70
France	452	305	31	34
Italy	789	164	25	16
Spain	195	13	81	114
Netherlands	38	14	22	231
Portugal	120	4	28	233
Austria	0	9	0	53
Sweden	274	22	3	68
Denmark	146	68	2	31
Finland	359	1	4	280
Ireland	126	6	16	0
Luxembourg	1	0	60	0

[1] From Table 'Waste treatment facilities; latest available year' (Eurostat 2005).
[2] Calculated by dividing 'Disposed on in landfills' from A by the number of landfill sites
[3] Calculated by dividing the sum of 'incinerated with energy recovery' and
Incinerated without energy recovery' from A by the number of incineration plants

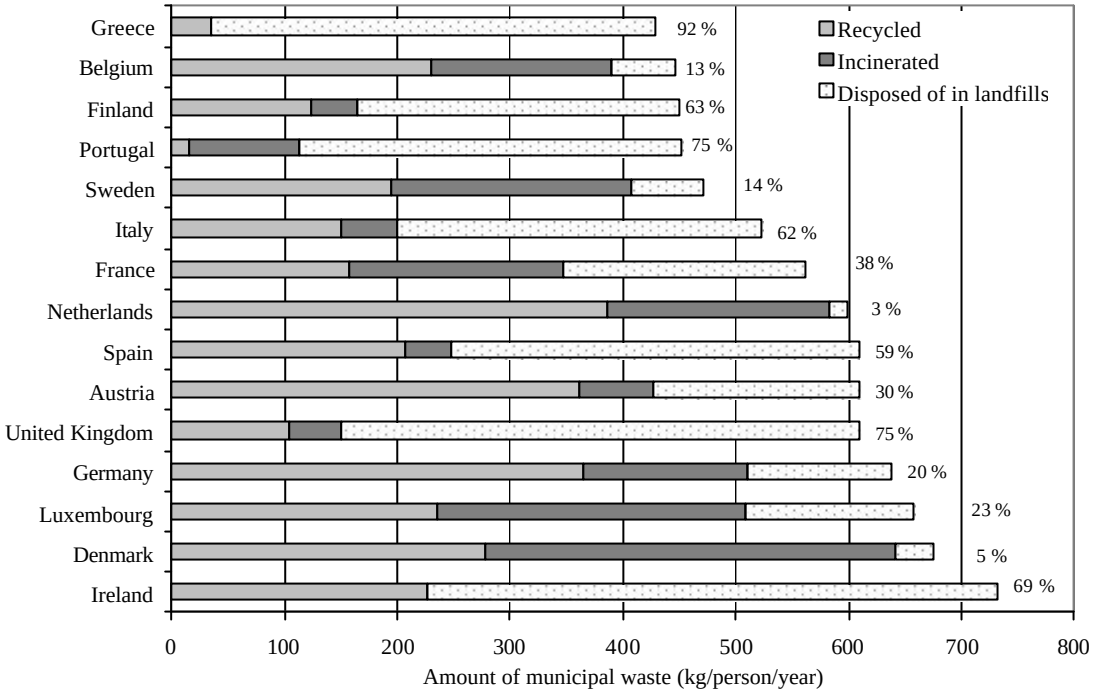


Figure 6. Amount of municipal waste generated annually per person and its treatment in the member states in 2003 (Eurostat 2005). The percentage values indicate the share of municipal waste being disposed of in landfills.

3. Fast food industry

3.1 Features

The modern lifestyle has changed eating habits in many ways (for example Love 1995, 12-19; Michaelis 2003). It has created a habit of taking care of every day routines as fast and as conveniently as possible. Meals with family members are being replaced with snacks that are more often eaten outside the home, and self-prepared meals have been replaced by convenience and prepared food and home-delivered products, a trend that is promoted by a faster paced life style and increased amenities at households. The needs of modern eating habits are partly met by the fast food industry that is described in this section.

The fast food industry offers consumers a limited menu of food products that are easily and time-efficiently attainable because of efficient production technologies. A part of products is sold as take-away, which means ready-to-eat food products that are purchased at an outlet but consumed outside at work or at home. The fast food industry is specialised in food products such as hamburgers, pizzas, chicken, or sandwiches (Bender and Bender 2001, 157). They are generally franchised chains operating nationally or internationally, each chain having the same food products on the menu, manufactured by identical food production techniques. The fast food industry is positioned in the restaurant sector, because it resembles restaurant and retail sector from the selling and consumption point of view. The production techniques resemble, however, food industry by offering a limited number of menu items that are produced from a limited number of food raw materials with assembly line techniques and packaged in highly standardised single use sales packaging.

The very first fast food companies were founded in the 1920s and 1930s in the United States, where the fast food concept led to a great success in the 1950s, generating chains such as Burger Chef, Burger King, McDonald's, Taco Bell, Wendy's, and Kentucky Fried

Chicken. The globalisation of the Amercian fast food industry started in the 1970, when the first European outlet of McDonald's was opened in the Netherlands. Today, nationally and internationally operating fast food industry has gained a permanent position in meeting the needs of modern eating habits all over the world. (Love 1995, 10-19, 41, 187-201)

The fast food industry has, however, confronted negative publicity especially in the 1990s and 2000s. In the 1990s, the rapid growth of the fast food industry led to charges for globalisation (for example Vignali 2001; Schlosser 2002, 303-342), child-targeted marketing (Schlosser 2002, 65-74), neglecting employee rights (Schlosser 2002, 98-120), and factory farming (Schlosser 2002, 185-204).

In the 2000s, public perception of fast food has been associated with messages of nutritional negativity (for example Ng *et al.* 2001; Harnack and French 2003; Carroll and Schade 2003; Astrup 2005; Harrington 2005; Pereira *et al.* 2005) especially on the adolescent diet (Story *et al.* 2002). Large portion sizes (Rozin *et al.* 2003) and poor nutritional values (Stewart and Yen, 2004; Spencer *et al.* 2005) are seen to increase the overeating, overweight, and obesity of the population, which has even led to lawsuits in the United States (Mello *et al.* 2003; Bagaric and Erbacher 2005) and which indicates a correlation between the number of fast food outlets and neighbourhood deprivation in the United States (Block *et al.* 2004) and in Scotland and England (Cummins *et al.* 2005).

Because of the publicity, some fast food chains have added products with better nutritional value (for example salads) on the menu, decreased the portion sizes and given nutritional information to customers (Anon. 2004; Anon. 2005d; Yamamoto *et al.* 2005), whereas some chains keep on introducing large portion sizes in the market (Anon. 2005d). According to the studies of Davies and Smith (2004), Stewart and Yen (2004), and Spencer *et al.* (2005), it is possible to enjoy a health diet in the fast food outlet. A short meal duration at a fast food outlet (Bell and Pliner 2003) connected to a faster paced life style, can, however, be a risk for gastrointestinal disturbances (Davies and Smith 2004).

3.2 Packaging waste management

The fast food industry uses one-way sales packaging to pack its products. The sales packaging is manufactured from the basic packaging materials described in Section 2.2., and are dominated by wood-based packaging materials. The use of one-way sales packaging was not questioned in publicity until the intense public scrutiny that was experienced from the mid-1980s to the mid-1990s (see Section 2.1.3). The publicity influenced the packaging waste management of the fast food industry, which is the topic of this Section.

Before the intense scrutiny on packaging waste, the packaging waste generated in the fast food industry was disposed of by the available means, in other words, they were generally disposed of in landfills. Because one-way sales packaging is an integral part of the fast food concept, the industry reacted intensively to the negative publicity in the 1990s by focusing on the used packaging materials and introducing the sorting of packaging waste. In several countries, the sales packaging manufactured from PS was replaced with a paperboard alternative to replace crude oil with renewable wood as a raw material and for better recycling potential (Anon. 1990; Anon. 1991a; Anon. 1991c; Anon. 1996). New packaging solutions such as biodegradable plastic (Anon. 2000b; Anon. 2001a; Dravet 2001) have been innovated, resulting in a decreased amount of packaging waste in some cases (Hunt 1994b; Roberts and Denison 1994). Because of the fading public interest in packaging in the 2000s, the environmental benefits of packaging have been replaced by cost savings in prime costs (Anon. 2005c) and greater graphic opportunities (Anon. 2003a; Anon. 2003b).

The sorting of packaging waste was tested in the dining area at the outlets in Switzerland (Anon. 1991b), the Netherlands (Pidgeon 1992), and the United Kingdom (Hunt 1994a) in the 1990s, but tests were reported to have failed (Pringe 1995). The collection of secondary packaging waste manufactured from cardboard and generated at small waste producers also proved to be impractical for hygiene and cost reasons in particular (Fernie and Hart 2001). The successful sorting trials have gradually shifted the focus from

packaging waste management to managing all waste generated at the outlets (for example Cramer and van Leenders 2000; Mason *et al.* 2003; Mason *et al.* 2004).

The development of the sorting of packaging waste faces challenges, because the supply chain in the fast food industry is complex (Georgiadis *et al.* 2005). The life cycle of packaging is long, being initiated at the manufacturers of packaging materials and ending at the waste management (Figure 7). The packaging industry, in other words the manufacturers of packaging materials, sales, primary, and secondary packaging, supplies the fast food industry directly or indirectly through the manufacturers of food raw materials and other goods needed at the production. Packaging waste is generated at outlets and outside the outlets in the case of take-away food products. Because of releasing sales packaging on the market and producing packaging waste, the fast food industry has the responsibility of packaging waste disposal on the basis of Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste (see Section 2.1.3).

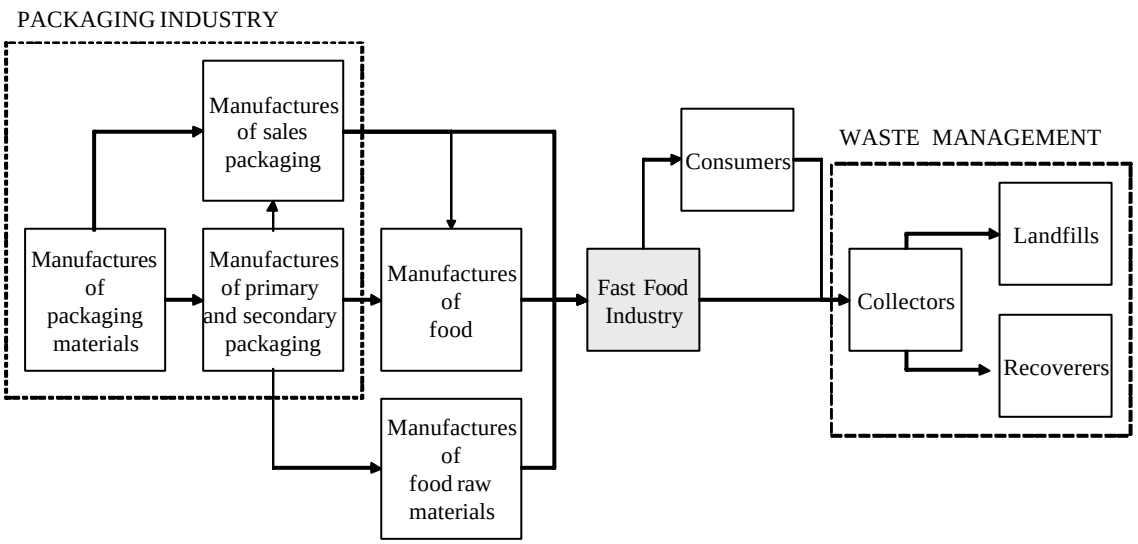


Figure 7. Life cycle of packaging in the fast food industry (modified from Olsmats 2002, 43).

A closer look at operational and packaging waste generation patterns reveals that a fast food outlet is simultaneously a production plant and a place of consumption, which results in different waste generation patterns than for example in the retail/wholesale and restaurant sectors (Figure 8). Producing and selling food products generate three main packaging waste streams in the retail/wholesale sector. The streams are generated at the food industry (the stream of the primary and secondary packaging of sales packaging), at the retailer/wholesaler (the stream of the primary and secondary packaging of food products), and at households (the stream of the sales packaging of food products). The primary and secondary packaging waste is treated as industrial or commercial waste, and sales packaging generated at households as household waste. As described in Section 2.4.1, the industrial and household wastes have a clear status in the solid waste infrastructure. Especially larger retailers and wholesalers have even introduced own tailor-made waste management practises that treat packaging waste as industrial waste (for example Fernie and Hart 2001).

In the restaurant sector, only one packaging waste stream of the primary and secondary packaging of food raw materials is generated (Figure 8). The stream is treated as commercial waste.

The operation in the fast food industry generates four packaging waste streams, one of which (the stream of the sales packaging of food products) is generated at households and three (the stream of the sales packaging of food products, the stream of the primary and secondary packaging of food products and food raw materials, and the stream of the primary and secondary packaging of sales packaging) at the outlets (Figure 8). In principle, the primary and secondary packaging of sales packaging should be treated as industrial waste, the primary and secondary packaging of food products and food raw materials as commercial or industrial waste, and the sales packaging of food products as household waste (see Section 2.4.1). The amounts of each packaging waste at individual outlets are, however, too low for three separate waste management practises. As a consequence, the three waste streams generated at outlets are typically treated together as commercial waste.

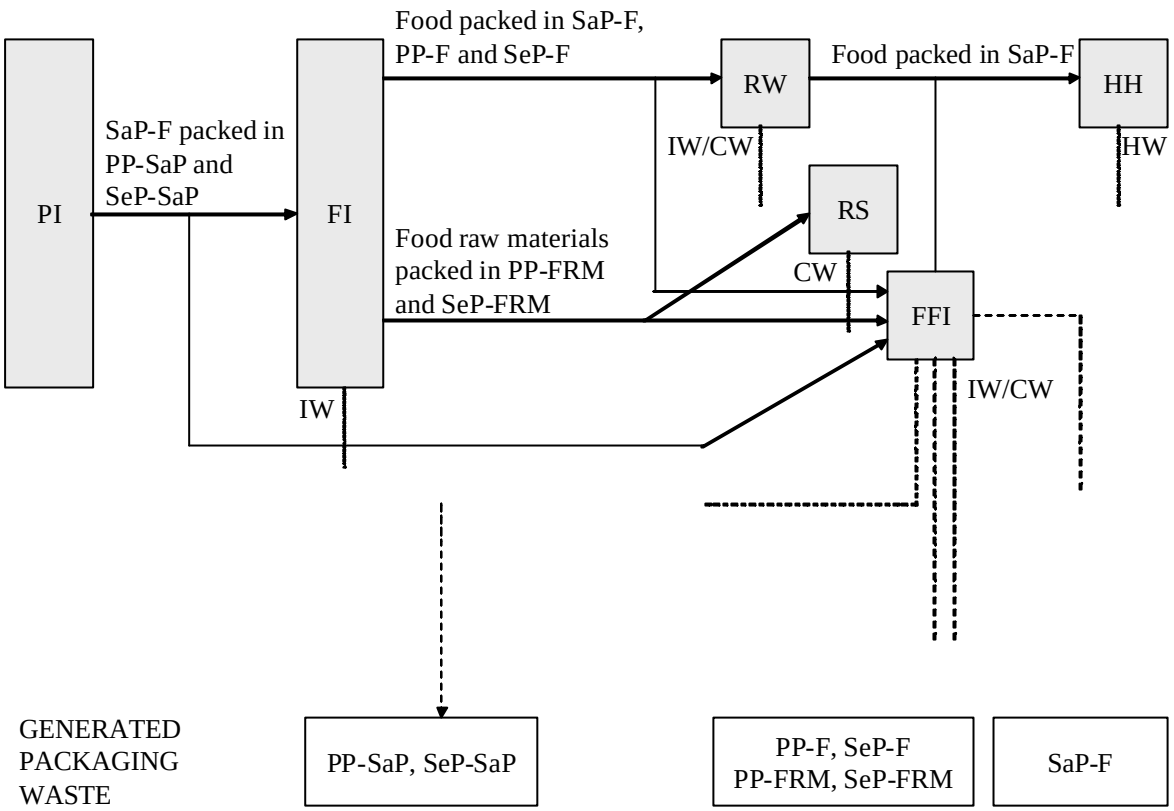


Figure 8. Management of packaging waste in the retail/wholesale sector (RW), restaurant sector (RS), and the fast food industry (FFI). Used abbreviations:

CW	commercial waste
FI	food industry (the manufacturers of food raw materials and food products)
HH	households
HW	household waste
IW	industrial waste
PI	packaging industry
PP	primary packaging
PP-F	primary packaging of a food product
PP-FRM	primary packaging of food raw material
PP-SaP	primary packaging of sales packaging
SaP-F	sales packaging of a food product
SeP	secondary packaging
SeP-F	secondary packaging of a food product
SeP-FRM	secondary packaging of food raw material
SeP-SaP	secondary packaging of sales packaging

4. Research framework

4.1 Case study

In the EU, the amount of packaging waste is restricted by the Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste (see Section 2.1.3). The Directive covers all packaging and packaging waste that a packager has placed on the market in the EU. The Directive binds the fast food industry (see Section 3.1), because it is a packager, packing products to one-way sales packaging and releasing them on the market. The fast food industry also produces packaging waste at production. The packaging waste generated in the fast food industry is split to four streams. Three of the streams are generated at the outlets and treated as commercial waste (see Section 3.2). Because of the legislative loophole (see Section 2.4.1), the waste can also be treated as industrial waste. The recoverability of the packaging is especially dependent on the materials the packaging is manufactured from (see Section 2.2), the behaviour of the waste producer, especially at the point of disposing used packaging (see Section 2.3), and the existing solid waste infrastructure (see Section 2.4).

The main research problem of this study is to find out the means of promoting the recovery of the packaging waste generated in the fast food industry. Practical experiences show that this waste is mostly disposed of in landfills despite of the high recoverability. The general factors influencing packaging waste management (see Chapter 2) are applied to the fast food industry (see Chapter 3) by a case study that combines the data collected from different sources and reveals relationships between the different factors (Yin 1994, 1-253). The case company is McDonald's Oy operating in Finland. The case company (see Section 4.3) is located in Finland, which is an EU member state. The packaging waste management in Finland is described in Section 4.2.

The main research problem is approached by defining the theoretical and actual recovery rate, and the recovery potential of packaging waste generated in the case company

presently, which the subproblems of the research. The recovery of packaging waste in the case company is studied by the methods presented in Figure 9.

The recoverability of packaging waste is significantly influenced by the used packaging materials. Despite of composites, the recoverability of basic packaging materials is high (see Section 2.2). The theoretical recovery rate illustrates how much of the packaging waste can be recovered as material or as energy. The theoretical recovery rate is 100 % if all packaging waste can be recovered.

The participation of waste producers in waste sorting (see Section 2.3) and a working solid waste infrastructure (see Section 2.1 and 2.4) are significant enablers for packaging waste recovery. The actual recovery rate of packaging waste illustrates how much of the packaging waste is actually recovered by the existing solid waste infrastructure. In theory, the actual recovery rate equals theoretical recovery rate, if all packaging waste is recoverable, sorted by the waste producers, and treated by the existing solid waste infrastructure.

The total recovery potential illustrates how much of the packaging waste could be recovered, in other words, it is a difference between the theoretical and actual recovery rate. In theory, the total recovery potential is 0 %, if all recoverable packaging waste is sorted by the waste producers and treated by the existing solid waste infrastructure. The total recovery rate is a sum of the achievable and theoretical recovery potentials. The achievable recovery potential illustrates how much of the packaging waste could be recovered by the existing solid waste infrastructure, but that is not currently recovered. The theoretical recovery potential illustrates how much of the recoverable packaging waste is non-recoverable by the existing solid waste infrastructure.

STEPS	METHODS (SECTION)	RESULTS (SECTION)
Theoretical recovery rate	Calculation of theoretical recovery rate (4.4.2)	5.1
Actual recovery rate	Calculation of actual recovery rate (4.4.2)	5.2
Recovery potential	Calculation of recovery potential (4.4.2)	5.3.1
Means to promote recovery	Experiments to study the means of reaching the achievable recovery potential	5.3.2
	1. Development of sorting instructions Analysis of the terminology and colour coding of waste components in the case municipalities	
	2. Development of a sorting station at outlet 1 Phase 1: - Calculation of the purity index of the sorted waste components (4.4.2) - Indicative qualitative customer survey (4.4.3) Phase 2: - Calculation of the purity index of the sorted waste components (4.4.2) - Indicative customer observation (4.4.3) Phase 3: - Calculation of the purity index of the sorted waste components (4.4.2) - Indicative qualitative customer survey (4.4.3)	
	3. Development of waste management practises at outlets 1 and 2 Calculation of disposal parameters at outlets 1 and 2 (4.4.2)	5.3.3
	Analysis to study the means of reaching the theoretical recovery potential	
	1. Evaluation of the existing solid waste infrastructure Calculation of solid waste infrastructure -related parameters in the case municipalities (4.4.2)	5.4
	Analysis to evaluate the influence of packaging materials on the theoretical recovery rate	
	1. Estimate of packaging material harmonisation (4.4.2)	

Figure 9. Methodology of the case study.

The means of promoting the recovery of packaging waste, in other words to increase the actual recovery rate, are studied by a variety of methods. The means to reach the achievable recovery potential are studied by the experimental and analytical approach. The development of sorting instructions is based on an analysis of the terminology and colour coding of waste components in the municipalities where the outlets of the case company are located. A sorting station for customers' use has been developed in three successive phases at one outlet. Calculation of purity indexes of the sorted waste components and indicative customer surveys and observation are used to manage the development. The disposal parameters are defined to support the development of waste management practises for the sorted waste components at outlets 1 and 2.

The means to reach the theoretical recovery potential are studied by calculating the solid waste infrastructure -related parameters in the case municipalities. The influence of packaging material choices on the theoretical recovery rate is estimated by packaging material harmonisation. Finally, the findings of the literature review and the case sudy are combined to find the general means of promoting the recovery of packaging waste generated in the fast food industry.

4.2 Packaging waste management in the case member state

4.2.1 Packaging waste management

The case member state of this study is Finland, where the case company is located. The packaging waste of the case company is controlled by the national packaging waste management that is discussed in this section.

The share of packaging waste from total waste was 0.35 % in Finland in 2000 (Table 2). The packaging waste originated from domestic production and imports. The packaging waste management in Finland is based on the Council Directive 94/62/EC of 20

Table 2. Annual amounts of solid waste and the share of waste recycled, recovered as energy, treated by other means, and disposed of in landfills in Finland in 2000 (Statistical Yearbook of Finland 2004, 67).

	Amount	Share of			
		Recycling	Energy recovery	Other treatment	Disposal in landfills
	1000 tonnes	%	%	%	%
Waste from production	124 340				
Agriculture	25 500	78	-	22	-
Forestry	20 000	-	3	-	-
Mining and quarrying	26 400	-	-	-	-
Manufacturing	16 800	31	36	4	29
Energy and water supply	775	58	-	3	39
Construction					
House building	1 400	38	-	25	37
Civil engineering	33 500	5	-	-	-
Municipal waste	2 760				
Municipal solid waste	2 600	29	10	-	61
Municipal sewage sludge	160	91	1	2	6
Total generation	127 100				
Hazardous waste	1 203	5	6	22	67
Packaging waste	443	50	10	-	40

December 1994 on Packaging and Packaging Waste (see Section 2.1.3) that has been integrated in Finnish legislation as the Government Decision on Packaging and Packaging Waste 962/1997 (the latest amendment 817/2005). According to the Decision, a packager has the responsibility to take care of the recovery of packaging waste it has placed on the domestic market and to release the monitoring data once a year. The obligation is limited to packagers with a turnover exceeding 841 000 euros. A packager is defined as a company that uses packaging materials to protect its products. In most cases, the packager is the manufacturer of the product. The packager can also be a wholesaler or a distributor

adding packaging to its product, a retailer using in-store packing, or an importer. (PYR 2004)

The obligations are fulfilled through a centralized scheme for packagers. The Environmental Register of Packaging PYR Ltd (PYR) is a non-profit organisation working in conjunction with producers. By making a contract with PYR, a packager transfers its recovery obligation to the producer organisations. PYR collects the monitoring data from the member packagers to report them to the EU. In practise, every packager must join the scheme. Only in few exceptional cases, a packager or an importer can have a system of their own. These companies report packaging waste amounts to the Finnish Environment Institute. (PYR 2004)

A pooled take-back scheme by packaging material-specific, non-profit producer organisations has been implemented. The producer organisations cover the entire packaging chain (in other words, the packaging industry, importers, the retail sector, the manufacturers of packaging raw materials, and packaging waste recovery companies) and are owned by them in most cases. There are eight producer organisations, for cardboard, industrial fibres, consumer fibres (paperboard), liquid board, plastic, glass, metal, and return packaging. (PYR 2004)

The producer organisations are funded by annual material-specific recovery fees that are defined annually by individual producer organisations (PYR 2004). They are charged on the basis of the packaging material and the amount of the packaging waste a packager has placed on the domestic market. The recovery fee of those packaging materials whose recovery is challenging is higher than of those materials that can be recovered easily (Table 3). Besides recovery fees, a registration fee is charged once at registration to PYR and a membership fee annually on the turnover basis. All fees are charged by PYR. The Government Decision on Packaging and Packaging Waste 962/1997 also includes recovery targets that are based on the EU legislation. The present minimum targets of recovery rate until 2008 are 75 % recovery and the 60 % recycling of fibre based packaging, the 60 % recycling of glass packaging, the 50 % recycling of metal packaging, the 22.5 % recycling of plastic packaging and the 15 % recycling of wooden packaging.

Table 3. Annual packaging material-specific recovery fees in 2002 (vat excluded) (Anon. 2001b).

Packaging material/Packaging	Annual recovery fee euros/tonne
Cardboard	3.30
Industrial wrapping/sacks	8.40
Cores	8.40
Paperboard (Fibre-based consumer packaging/wrapping)	4.50
Liquid board	20.00
Plastic	13.00
Aluminium	20.00
Tinplate	20.00
Steel	2.00
Deposit beverage cans (metal)[1]	0
Glass (non-deposit glass)	10.00
Wood	0
Other	0

[1] The producer organisation charges the recovery fee.

In 2002, the recovery rate of packaging waste was 61 % (Table 4). Because cardboard is the most common distribution container material (see Section 2.2), packaging waste was dominated by fibre-based packaging materials, whose share was 57 %. 191 000 tonnes out of 255 000 tonnes of fibre-based packaging materials were recovered, mainly by recycling: paper in paper manufacturing, paper and liquid board in core manufacturing, and cardboard in cardboard manufacturing (Myllymaa *et al.* 2005, 46). With a share of 19 %, plastics formed the second largest packaging waste (Table 4). Most plastic packaging waste was disposed of in landfills. The share of packaging waste manufactured from glass was 15 % (Table 4). About half of it was recycled as recycled glass or glass wool (Myllymaa *et al.* 2005, 46). The share of packaging waste manufactured from metal was the lowest, 9.1 % (Table 4). One half of it was recycled and the other half was

Table 4. Total annual amount, the share, the amounts of treated packaging waste, and the recovery rate of packaging waste in Finland in 2002. (PYR 2004)

	Unit	Packaging waste manufactured from				Total
		Fibre based	Plastic	Metal	Glass	
Amount	1 000 tonnes	255	87	41	68	451
Share	%	57	19	9.1	15	100
Amount of recovered waste	1 000 tonnes	191	33	19	33	276
of which recycling	1 000 tonnes	156	13	19	33	221
of which energy recovery	1 000 tonnes	35	20	0	0	55
Recovery rate	%	75	38	46	49	61
Amount of waste disposed of in landfills	1 000 tonnes	64	54	22	35	175

disposed of in landfills. Especially reaching the recovery target of plastic packaging will be challenging because of the decreasing incineration capacity in future years (Ministry of the Environment 2005c).

Meeting the recovery targets is challenging, especially because of the difficulties the implementation of the Decision has encountered at the municipal level. The responsibilities for collection and financing have been unclear, for example the collection of waste glass and plastic has stayed on the municipality's responsibility and expense. In some cases, a customer has been invoiced twice (for both recovery and disposal in landfills). The collection coverage has been insufficient, because packaging waste has not been collected in small municipalities and in scattered settlement areas. Long intervals incollection frequency, impurities, and the lack of collection centres have weakened the collection routines. The deficient control has also caused some fly tipping. (Suomen Kuntaliitto 2003, 10)

The drawbacks in implementation are covered by the latest amendment 987/2004 of the Decision. The recovery responsibility of a packager is targeted to cover 61 % of the packaging it has placed on the market. The recovery of packaging waste is the

responsibility of the property holder, the municipality, or other waste producers. The change in legislation does not, however, give a final answer to how far the producer responsibility reaches concerning the waste generated by consumers and what obligations a municipality has to fulfil in organizing collection sites and collection.

These factors have recently been clarified by a working group on waste management and a working group on packaging. In its final report (Ministry of the Environment 2005a), the working group on waste management proposed changes in the Waste Act and the Waste Decree. The responsibility of organising the waste collection should be given to a municipality in the case of household and commercial waste, to a waste producer in the case of trade (for example retailers, restaurants, and hotels) and to those producers whose products are bound by the Extended producer responsibility -principle. The proposal reduced the amount of waste that was under municipalities' responsibility by restricting commercial waste to waste that is generated at institutional waste producers and at commercial waste producers located in residential establishments. The waste that municipalities are responsible for was proposed to be treated by the municipalities in order to guarantee constant supply to municipal waste treatment facilities. The working group also proposed clarified rules for competitive bidding and disposal charges. The three schemes to organise collection (by a property, by a municipality, or by their combination) was proposed to be maintained.

A working group on packaging proposed the recovery targets to become binding (Ministry of the Environment 2005c). According to the proposal, each packager should have the responsibility of the packaging it has placed on domestic market by meeting the minimum recycling targets of fibre-based packaging (53 %), glass packaging (48 %), metal packaging (25 %) and plastic packaging (15 %).

4.2.2 Solid waste infrastructure

The packaging waste generated in Finland is managed by the solid waste infrastructure that is the focus of this section. The solid waste infrastructure is based on EU legislation, especially four Directives (see Section 2.4.1) that are implemented to national legislation. Council Directive 75/442/EEC of 15 July 1975 on Waste and Council Directive 91/156/EEC of 18 March 1991 Amending Directive 75/442/EEC on Waste are covered in Waste Act 1072/1993 (the latest amendment 815/2005) and Waste Decree 1390/1993 (the latest amendment 988/2004). The Waste Act defines prevention of waste generation, promotion of waste recovery, and organisation of integrated solid waste management and provision on littering, while the Waste Decree completes and specifies the provisions of the Waste Act.

The content of Council Directive 99/31/EC of 26 April 1999 on Landfill of Waste is implemented in Government Decision on Landfills 861/1997 (the latest amendment 202/2006). It defines the operation of landfills. The measures restricting the disposal of biodegradable waste in landfills are defined in the National Biodegradable Waste Strategy (Ministry of the Environment 2003). The targets for reducing biodegradable municipal waste disposal in landfills to 75 % of the 1995 level by 2006, to 50 % by 2009, and to 35 % by 2016.

Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control is covered by Environment Protection Act 86/2000 (the latest amendment 137/2006). The Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the Incineration of Waste has been implemented by Incineration Decree 362/2003. According to the Decree, all waste incineration and co-incineration plants have to comply with the set requirements from 29 December 2005. Especially the existing co-incineration plants have been reluctant to invest on technology to measure and control emissions required by the Decree, and as a consequence, co-incineration of waste and peat or pellets has been closed down at several plants (for example Anon. 2006).

The Extended producer responsibility -principle concerns tyres, packaging, paper, cars, and electronics and electrical equipment (Ministry of the Environment 2005d), and has a great potential for waste reduction in the future (Melanen *et al.* 2002).

The solid waste infrastructure is defined in the National Waste Plan that is laid by the Ministry of the Environment on the basis of national legislation (Ministry of the Environment 2002). The Plan presents the current state of solid waste management and the quantitative and qualitative objectives defining that the amount of municipal waste is to be reduced so that in the year 2005 it is at least 15% below the level of the year 1994 (in relation to economic growth), and more than 70% of the municipal waste is to be recovered in the year 2005. The Plan defines the waste policy instruments and other means to achieve these objectives by 2005. The objectives presented in the plan are, however, not legally binding.

According to Waste Act 1072/1993 and Waste Decree 1390/1993, municipalities are obliged to organise waste collection in settlement areas by their own or private collectors and to treat and dispose waste generated within their boundaries. They have the right to collect a disposal fee from all participants. Municipal solid waste is defined in the legislation as household waste and waste whose quality, composition, and quantity is household waste assimilated but which is generated at industrial, service, or other waste producers. Municipal waste contains household waste whose share is 40 %, and commercial waste whose share is 60 % (Eurostat 2005). The composition of household and commercial waste in the Helsinki Metropolitan Area is presented in Table 5. The local municipal waste management practises such as recoverables, the sizes, colour coding and cleaning frequency of bins, the pick-up frequency, used vehicles, and disposal costs are defined in local waste regulations.

Waste management practises are based on on-site sorting by residential, commercial, and industrial waste producers. Mixed municipal waste is collected from households by kerbside collection. Recoverables such as glass, cardboard, liquid board, paperboard, and metal, are collected by kerbside collection or by waste collection points that are mainly neighbourhood containers and that are organised by producer organisations.

Table 5. Share of waste components in mixed waste generated at residential, commercial, and institutional establishments in the Helsinki Metropolitan Area.

Waste component	Share of waste components in mixed waste generated at					
	house-holds[1]	offices[2]	schools[2]	restaurants and hotels[2]	hospitals[2]	retailers[2]
	%	%	%	%	%	%
Food waste	25	27	25	39	7	52
Garden and other biodegradable waste	13	0	13	0	0	0
Tissues	3	12	14	10	22	4
Biodegradable waste	41	39	52	49	29	56
Waste paper, cardboard, liquid and paperboard	20	30	17	11	9	13
Other paper, cardboard, liquid and paperboard	1	1	1	9	6	2
Recyclable (fibre) waste	21	31	18	20	15	15
Plastics	13	11	11	12	21	13
Others	25	19	19	19	35	16
Mixed waste	38	30	30	31	56	29

[1] From YTV 2004, 47-55

[2] From YTV 2005, 26-30

Each recoverable has its own container that is emptied separately. Mixed waste and recoverables from households are generally stored in 0.1…0.6 m^3 large-wheeled plastic containers that are located in a dedicated waste room or shelter, because of the rough weather conditions. In contrast to the majority of the member states, the collector picks the containers from the waste room or shelter and returns them back after emptying. (Ihalainen 2000, 65-67)

New innovations, such as suction chutes (for example Puzer Oy 2005) and deep collection containers (for example Molok Oy 2005) are being installed in new residential and commercial establishments. Green points are available for selective waste such as

hazardous waste. Backyard composting is encouraged especially in single family houses. Grinding and draining of food wastes is forbidden at households.

Mixed household waste is collected in the stationary system mainly by front- and rear-loading trucks equipped with compactors. One- or multichamber trucks are used to collect recoverables or mixed waste and one recoverable. 4…12 m^3 hauler containers are generally used for the collection of large waste amounts from waste collection points and commercial establishments. The recoverables are collected to transfer stations, to sorting facilities, or directly to recovery facilities. The recoverables are transported from transfer stations to recovery facilities typically by vehicles or rail cars. (Ihalainen 2000, 65-67)

Waste collection is organised by three schemes. When a municipality organises the collection, it makes a contract with a collector that is chosen on the basis of competitive bidding. All the properties must use the collection services offered by the chosen collector. The average term of a contract is 5 years. Municipalities had organised collection for about 22 % of the total population in 2002. When organised by a property, the property chooses the collector and a property-related contract is written between the property and the collector. Property-based collection covered about 40 % of the population in 2002. In the third scheme, municipality and property -based contracts are used in parallel. The collection of mixed waste is arranged by the municipality and the collection of recoverables by a property-related contract. The combination scheme is especially used in larger cities and covered about 38 % of population in 2002. In all the three schemes, a collector may cooperate with one or more subcontractors from the transport sector. Commercial and institutional waste producers can join the municipal waste collection scheme or they can make a contract with a private collector. (Suomen Kuntaliitto 2003, 7, 19)

The collection of municipal waste is no longer completely publicly owned. Regional waste management companies are privately owned. A federation of municipalities is an independent public corporation consisting of two or more municipalities that do constant cooperation on the collection of municipal waste. Public utilities are companies, cooperatives, or foundations that run public utility-related operations such as waste collection. The introduction of private stakeholders has made it possible to combine private and public capital to realize different plans. In 2002, federations of municipalities

and public utilities operated at one to 23 municipalities regionally close to each other. (Suomen Kuntaliitto 2003, 48-50)

The disposal costs of residential and commercial waste producers are typically charged from the property by the collector. The invoicing is mainly based on unit pricing, which is a sum of transport and treatment charge. The transport charge covers the logistics costs and typically exceeds the treatment charge, because of long collection distances, which are caused by a high surface area with low population density and by the decreasing number of landfill sites for mixed waste. Treatment charges are generally charged only from mixed waste. They cover the actual operative costs of the landfill site and include the national landfill tax. (Suomen Kuntaliitto 2003, 48-50)

The national landfill tax is defined in Waste Tax Act 495/1996 (the latest amendment 1066/2002). Its main objective is to encourage waste producers to minimize the waste amounts to be disposed of in landfills and to maximize the amount of waste to be recovered. The national landfill tax is levied on all mixed waste that is disposed of in public landfills, with some exceptions, such as de-inking waste and waste that can be utilised in landfill structures. The value of the national landfill tax was 23 euros per tonne of waste disposed of in public landfills in the years 2003-2004. After the year 2005, its value will be 30 euros per tonne. The national landfill tax has succeeded in steering the waste management practises of the companies producing significant amount of recoverable waste (Hiltunen 2003, 27-28; Ministry of the Environment 2005b). The steering effect has been minimal at households, because of the low value. The introduction of the national landfill tax has improved the operations of landfill sites. On the other hand, there has been no increase in littering.

The ultimate target of disposal costs, the national landfill tax in particular, is weakened by the non-transparency of unit pricing, in other words a different cash basis. The landfill operator charges the national landfill tax from the collector on the weight basis of delivered waste and pays it further to the government, whereas the collector charges the landfill tax from the waste producer, not on exact weight basis but rather on an estimate of the average weight of a unit. (Suomen Kuntaliitto 2003, 8-9, 20-40)

Some municipalities have defined green taxes in their local waste regulations. Green taxes typically cover the costs of waste recovery and hazardous waste treatment, and the

operative costs of guidance services especially in those municipalities that do not have landfill sites of their own. Green taxes are charged from residential and commercial waste producers by the municipality or by a collector on behalf of the municipality. In 2002, 32 % of municipalities charged green taxes, whose average value was 33 euros/household or property. About half of the municipalities charged green tax also from collectors. The average value was 10 euros/load. (Suomen Kuntaliitto 2003, 8)

The economic instruments, the national landfill tax and green taxes in particular, have primarily increased tax revenues with hardly any benefits at the environmental sector. Because of their low value, they have not succeeded in steering the waste producers' behaviour. The national landfill tax has distorted the competition of commercial and industrial waste producers, because it is not levied on waste disposed of in private industry-owned landfills. In case an industrial company disposes of its waste in public landfills, the waste is subject to the national landfill tax. It has also been impossible to implement covering fiscal regulation, which is a long term objective. (Huhtala 1999; Ilomäki and Melanen 2001; Hollo 2004, 488-492)

The collected waste is treated at recovery facilities or disposed of in landfills. Recovery is based on the needs and facilities of the local industry. Recycling has long history in Finland. The collecting and recycling of waste paper started already after the Second World War (Paperinkeräys-yhtiöt Oy 2005) and the deposit on returnable beverage bottles and cans has led to world record shares of returning (Suomen keräyslasiyhdistys 2005). The collection of recoverables is municipality-dependent. In 2002, about 50 % of the municipalities demanded the sorting of waste paper, about 40 % the sorting of cardboard waste, waste glass, and waste metal, and about 30 % the sorting of biodegradable waste. Biodegradable waste was treated in 43 composting facilities in 2002 (Suomen Kuntaliitto 2003, 7, 18). Energy recovery is less frequently used. Combustible waste was sorted in about 10 % of the municipalities in 2002. Less than 30 facilities produced RDF or incinerated waste in 2002 (Suomen Kuntaliitto 2003, 7, 18). Only one facility utilized a mass-burn combustor. Combustible waste was generally used as a side fuel at gasification technology based facilities (Sipilä 2003). The recovered energy was generally utilized in district heating or in producing electricity.

Disposal in landfills has been a dominant waste treatment option in Finland (Kettunen and Vuorisalo 2005). Public landfills are operated by a municipality or a body appointed by the municipality. The number of municipal landfill sites has constantly decreased during the recent years. In 1993, the number of municipal landfill sites was 585 (Ministry of the Environment 1994, 118), whereas nine years later, in 2002, the number was about 100, of which about 70 % were used by two or more municipalities (Suomen Kuntaliitto 2003, 7).

Finnish consumers as residential waste producers are an integral part of the solid waste infrastructure (see Section 2.3). They are environmentally concerned, asking for more product-related and general environmental information (Timonen *et al.* 1998, 72-74). They have a general positive attitude towards the recovery of waste (Wahlström *et al.* 1996, 126; Huhtala 1999), and packaging waste in particular (Heiskanen 1992, 40-45). Recycling is preferred to incineration in the recovery of packaging and other household waste (Huhtala 1999). Sorting is considered as an environmentally friendly disposal method that represents 'a viable alternative for a throw-away society's wasteful lifestyle'. High-income households consider, however, sorting as time-consuming and unattractive. Some find the sorting of waste even a job that falls outside the scope of their voluntary effort. The motivation in lower-income households is based on more concrete reasons, such as 'saving and not wasting'.

4.3 Case company

The fast food industry has operated in Finland since the 1970s. Today, the market of hamburger selling companies is dominated by Hesburger Oy and McDonald's Oy. Hesburger Oy has about 200 outlets, its turnover was about 125 million euros in 2003 and it has published an environmental policy (Hesburger Oy 2005).

McDonald's Oy is the case company of this study. It is a daughter company of McDonald's Corporation that had over 30 000 outlets in over 100 countries in all continents in 2005 (McDonald's Oy 2005). McDonald's was founded by brothers Richard and Maurice McDonald in California, the USA in 1937 (Love 1995, 12-19; Schlosser

2002, 35-37). In 1948, the brothers contributed to the birth of the fast food industry by defining a totally new food service concept with self-service, paper service, and quick service. For example timeworn food preparation techniques were replaced with assembly line procedures drawn from industrial manufacturing practises, paper bags, wraps, and cups replaced the china and flatware, eliminating the need for a dishwasher, and the menu had only nine products.

The first Finnish McDonald's was opened in 1984 in Tampere. In 2002, the number of outlets was 87, and they were located in 37 municipalities. The number of outlets located in shopping malls and other premises was 37. Fifty outlets had an own building. 54 outlets were owned and operated by 32 franchisees, and 33 outlets were owned by the company. The taxable sales were 116 million euros. Each outlet has 30…40 employees summing up to about 3 500 employees in 2002. The main goal of the company is 100 % customer satisfaction that is surveyed annually. (McDonald's Oy 2003)

Each outlet sells the same food products that are packed in standardised one-way sales packaging. In 2002, the products were hamburgers, nuggets, French fries, salads, ice cream, soft drinks, warm drinks, milk shakes, and pastry. The standard products such as Big Mac and cheeseburger were accompanied by campaign products such as BigExtra and McPork which were on menu for a limited period of time. Each outlet uses the same sales packaging and food raw materials. A large part of these are supplied by internationally operating manufacturers. In 2002, the company used 91 different sales packaging items and 106 food raw materials (Appendix 1). All goods are distributed to outlets from a distribution centre by trucks. The distribution centre is an independent company working only for McDonald's Oy.

The company has an annually revised environmental program to promote environmentally sound operations (McDonald's Oy 2005). In the years 1997-2002, the company had a certified ISO 14001 environmental system. In 2002, all outlets recycled the used deep frying oil and cardboard waste (McDonald's Oy 2003). In the beginning of the 2000s, the environmental image of McDonald's Oy was positive. Over 70 % of the customers appreciated the environmental work the company had done (Nuutila 2001, 128). The preliminary study indicated that there is a potential for packaging waste recovery (Niemi 2003, 47-49). In 2002, McDonald's Corporation included the environment in its Social

Responsibility Report (Anon. 2002), which was followed in Finland in 2003. Being defined as a packager by the legislation, McDonald's Oy has been a member of PYR since 1997.

4.4 Methods

4.4.1 Primary and secondary data collection

The primary and secondary data is from the year of 2002 and is annual, if not otherwise mentioned. Units are presented in parentheses. The data has been gathered from different sources (Table 6). Because of confidentiality, the names of the outlets, the case municipalities, the sales packaging, food, and food raw materials are not published.

4.4.2 Mathematical calculations

Calculation of the theoretical and the actual recovery rates, and the total, the achievable, and the theoretical recovery potentials

The calculation the theoretical and the actual recovery rates, and the total, the achievable, and the theoretical recovery potentials is based on the following assumptions:

Table 6. Primary and secondary data and their sources.

Primary data	Source
Unit weights of packaging materials of sales packaging, and primary and secondary packaging of sales packaging, food, and food raw materials[1]	Manufacturers of sales packaging, food, and food raw materials
Packaging materials and the weight of each packaging[1]	Manufacturers of sales packaging, food, and food raw materials
Number of distributed units[1]	Distribution centre
Prime cost estimate of sales packaging, food, and food raw materials[1]	Distribution centre
Outlet-related sales[1]	McDonald's Oy
Disposal invoices[1]	McDonald's Oy
Disposal contracts[1]	McDonald's Oy
Primary data of an indicative qualitative customer survey on sorting	McDonald's Oy
Primary data of an indicative customer observation	McDonald's Oy
Primary data for the purity index[2]	Appendix 5
Secondary data	
Local waste regulations in the 37 case municipalities	Municipalities' homepages or printed versions in October 2002
Solid waste infrastructures	Suomen Kuntaliitto 2003
Share of take-away sales from total sales	McDonald's Oy 2002
Sorting of waste components at the outlets	McDonald's Oy 2002
Product-related customer surveys[3]	Tuunanen 2002a, 2002b, 2002c, 2002d

[1] Unpublished

[2] The content of 3…8 bin liners for 'Paperboard and plastic waste' and 'Biowaste and paper' has been analysed by sorting the content of a bin liner correctly into waste components and by measuring their weights with a top loading scale with an accuracy of ± 10 g.

[3] Condifential company reports

1. Each packaging is 100 % sorted.
2. Each packaging is disposed of in the municipality where the outlet is located.
3. ‘Sales packaging disposed of outside the outlets’ is disposed of as household waste.
4. ‘Sales packaging disposed of in the dining area’ and ‘Primary and secondary packaging disposed of in the kitchen area’ are disposed of as commercial waste.
5. There is no loss during the collection and recovery.

The calculations (in tonnes) are presented in Figure 10. The total amount of packaging waste (m_{TOT}) has been calculated as a sum of the unit weight of each packaging (in g/unit) multiplied by the number of distributed units (in units). Information on packaging materials and disposal locations have been used to calculate the amount of recoverable packaging waste (m_1). The disposal location has been determined on the basis of the point of disposal. The share of take-away sales from total sales has been used to divide the amount of sales packaging to waste categories ‘Sales packaging disposed of in the dining area’ and ‘Sales packaging disposed of outside the outlets’ presenting the sales packaging of take-away food products.

The theoretical recovery rate (in %) has been calculated as a share of the amount of recoverable packaging waste (m_1) in the total annual amount of packaging waste (m_{TOT}).

For determining the actual recovery rate, the existing solid waste infrastructure in the 37 case municipalities and the sorting practises in the outlets have been analysed. The analysis has been simplified by defining the collection of waste components mandatory regardless of the limitations in the number of households per property or weekly waste amounts that the local waste regulations have typically defined. The information on the infrastructure aimed at the voluntary collection of waste components, offered by the producer organisation of liquid board (Suomen NP-kierrätys Oy 2005), has been integrated to the analysis. This producer organisation was the only one relevant for this study. The sorting at the outlets has been defined by dividing the total amount of packaging waste to individual outlets in relation to the outlet’s sales. The information on the sorting of waste components at the outlets and outside the outlets has been received from the case company.

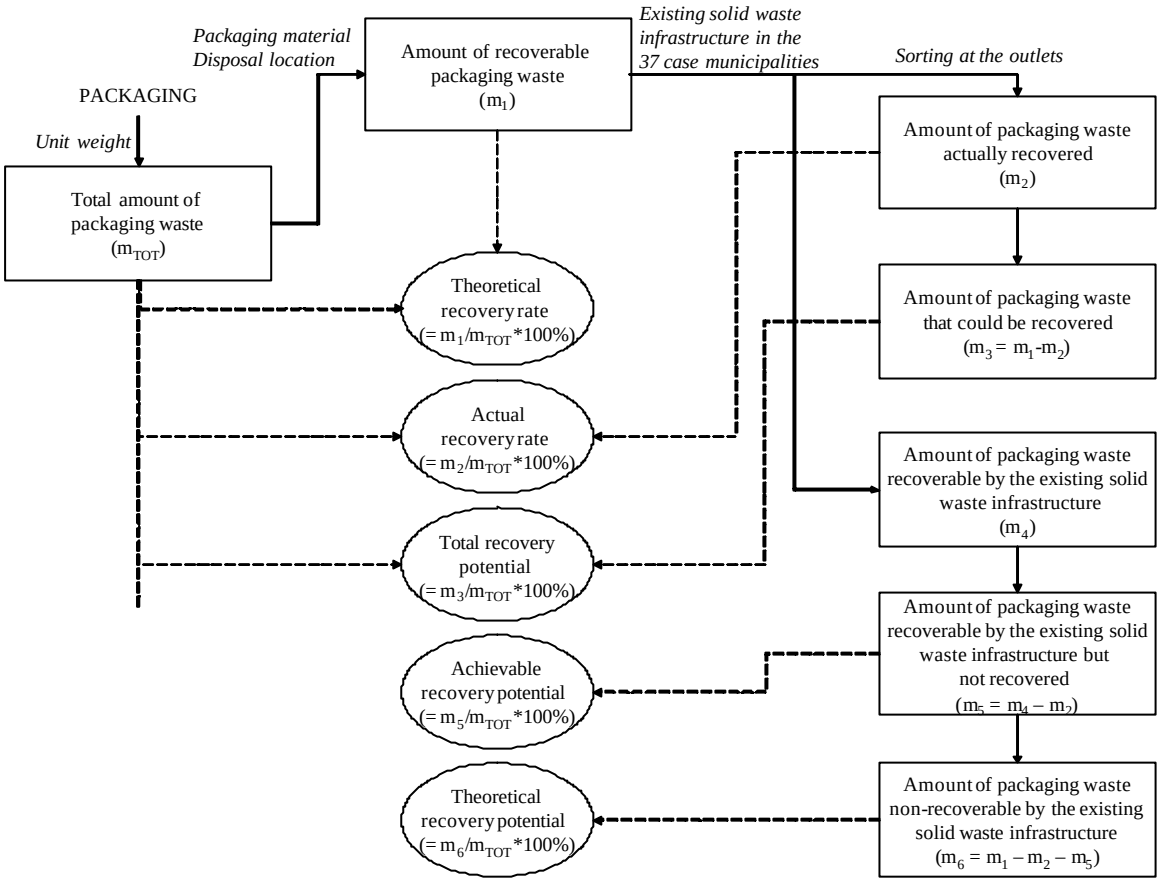


Figure 10. Mathematical calculations to determine the theoretical and the actual recovery rates, and the total, the achievable, and the theoretical recovery potentials. Primary data is presented in italics.

The actual recovery rate (in %) has been calculated as a share of the total amount of actually recovered packaging waste (m_2) in the total annual amount of packaging waste (m_{TOT}).

The total recovery potential of packaging waste has been calculted as a share of the amount of packaging waste that could be recovered (m_3) in the total annual amount of packaging waste (m_{TOT}). The amount of packaging waste that could be recovered (m_3) has been calculated by subtracting the amount of packaging waste actually recovered (m_2) from the amount of recoverable packaging waste (m_1).

The analysis on the existing solid waste infrastructure in the 37 case municipalities has been used to calculate the amount of packaging waste recoverable by the existing solid waste infrastructure (m_4). The amount of packaging waste recoverable by the existing solid waste infrastructure but that was not recovered (m_5) has been calculated by subtracting the amount of packaging waste actually recovered (m_2) from the amount of packaging waste recoverable by the existing solid waste infrastructure (m_4).

The achievable recovery potential (in %) has been calculated as a share of the amount of packaging waste recoverable by the existing solid waste infrastructure but that was not recovered (m_5) in the total annual amount of packaging waste (m_{TOT}).

The theoretical recovery potential (in %) has been calculated as a share of the amount of packaging waste non-recoverable by the existing solid waste infrastructure (m_6) in the total annual amount of packaging waste (m_{TOT}). The amount of packaging waste non-recoverable by the existing solid waste infrastructure (m_6) has been calculated by subtracting the amount of packaging waste actually recovered (m_2) and the amount of packaging waste recoverable by the existing solid waste infrastructure but that was not recovered (m_5) from the amount of recoverable packaging waste (m_1).

In addition to the total amount of packaging waste, the theoretical and the actual recovery rates, and the total, the achievable, and the theoretical recovery potentials have been calculated for each waste category and component.

The determination of the theoretical recovery rate is credible, because the calculations are based on data given by all manufacturers of sales packaging, food, and food raw materials and the distrubution centre and because all used sales packaging, food, and food raw materials are included.

The made assumptions and the indicativeness of the customer feedback on the sorting of waste components outside the outlets collected by the company decrease the credibility of the actual recovery rate. It is, however, increased by the high credibility of the information on the sorting of waste components at the outlets. The credibility of the analysis of the local waste regulations is moderate, because it is based on written regulations. In some cases, the solid waste practises varied from the written regulations. For example one municipality has defined the collection of biodegradable waste in the local waste regulations. Biodegradable waste was not collected because of problems at the

composting facility. The credibility is also decreased by the simplification that the collection was defined mandatory regardless of the limitations in the number of households per property or weekly waste amounts the local waste regulations had typically defined and by the assumption that packaging waste generated at outlets was treated as commercial waste. Part of packaging is treated as industrial waste, for example the waste generated at outlets located in shopping centers . As a consequence, the credibility of the actual recovery rate is moderate.

The moderate credibility of the actual recovery rate leads to a moderate credibility of the total, the achievable, and the theoretical recovery potential.

The calculation principle of the theoretical and the actual recovery rate, and the total, the achievable, and the theoretical recovery potential is general and independent on a country. It is applicable to all waste producers operating in different solid waste infrastructures. The actual values are, however, valid only for fast food companies whose operations, products, and packaging resemble those of the case company. The actual values are also country-dependent, because of national differences in solid waste infrastructures and waste producer behaviour (see Chapter 2).

Calculation of the purity indexes of the sorted waste components

The calculation of purity indexes has been used to verify the sorting results at outlet 1 during three developmental phases of a sorting station for customers' use in the dining area. The purity index has been calculated by dividing the amount (in g) of correctly sorted packaging waste by the total amount (in g) of packaging waste. The results are based on the average values (Fink 1995, 17-18) of bin liners analysed during each developmental phase.

The credibility of the results is moderate, because the standard deviations (Fink 1995, 23-25) are relatively high and the variance between the days of the week has not been defined exactly. All waste producers with a similar need to define the purity index of sorted waste can use the calculation principle. The actual values are, however, valid only for fast food companies whose operations, products, and packaging resemble those of the case company.

Calculation of the disposal parameters of outlets 1 and 2

Waste management practises have been analysed at two test outlets. The achievable recovery potentials (in kg) have been calculated for each waste category and component from the total annual amount of packaging waste (in kg) in relation to the sales of outlet 1 and 2 to the total sales.

Weekly capacities (in m^3/week) have been calculated as unit size (in m^3) times the number of units (in unit/pick up) times pick up frequency (in pick up/week). Weekly disposal costs (in euros/week) have been calculated as the number of units (in unit/pick up) times pick up frequency (in pick up/week) times unit price (in euros/unit). The specific costs of each waste component (in euros/m^3) have been calculated as unit price (in euros/unit) divided by unit size (in m^3/unit). The specific unit weights (in kg/m^3) have been calculated by dividing the average weight of a bin liner (in kg) by the volume of the bin liner (in m^3).

The credibility of the analysis of the waste management practises at outlets 1 and 2 is moderate. It is influenced especially by the variance in compacting the waste and the differences between the data in contracts and invoices. Because of the length of the development of the sorting station, the figures from waste management invoices in 2001 at outlet 1 have been sales and price corrected to correlate with the costs and sales in 2003, which may have a slight influence on the credibility of the results.

The used data covers the disposal of all generated waste, excluding the used deep frying oil that is collected and charged for separately. On the basis of practial experiences, it was assumed that the share of non-packaging waste would be significantly lower than the share of packaging waste and the share of non-packaging waste would remain constant with equal sales, which decreases the credibility of the results.

All waste producers with a similar need to define the disposal parameters can use the calculation principle. The actual values are, however, valid only for fast food companies whose operations, products, and packaging resemble those of the case company.

Calculation of the existing solid waste infrastructure -related parameters

Variance in the treatment charges, the unit prices and experimental specific unit weights in the case municipalities have been analysed by calculating the average (Fink 1995,

17-18) and standard deviation (Fink 1995, 23-25) and defining the minimum and maximum values. Experimental specific unit weights (in kg/m^3) have been recalculated by dividing the value (in kg/unit) by the unit volume (in m^3/unit). The specific cost (in euros/ m^3) has been calculated by dividing the unit price (in euros/unit) by the specific unit weight (in kg/unit) and multiplying the result with the specific unit weight (in kg/ m^3).

The credibility in analysing the solid waste infrastructure in the case municipalities is relatively high, because it is based on data reported by Suomen Kuntaliitto (2003). The results are transferable to all stakeholders that are interested in variance in local solid waste infrastructures. The results are, however, limited to the 37 case municipalities that represent 8.6 % of the total number of Finnish municipalities, but almost 60 % of the Finnish population (Statistical Yearbook of Finland 2004, 71). The transferability can be improved by including all municipalities in the analysis.

Estimate on packaging material harmonisation

The calculation principle of the theoretical recovery rate presented above has been used to estimate the influence of packaging material harmonisation on the theoretical recovery rate. The harmonisation has not been tested empirically. The harmonisation has not affected product quality, operational procedures, equipment, or labour hours of the outlet or the manufacturers. It has required no new innovations; it has been rather a question of selecting alternatives already available at the market. When exact data for new sales packaging alternatives has not been available, it has been estimated by combining purchasing data from different sources, such as manufacturers, previously used packaging, or similar type of packaging.

The credibility of harmonising the packaging waste is extremely low, because the analysis is based on calculations with a range of assumptions that have not been tested in practice. Because of the company-related contracts of purchase, the results are company-specific and cannot be transferred to other companies.

4.4.3 Indicative customer observation and survey

One indicative customer observation at phase 2 and two indicative qualitative customer surveys on sorting at phases 1 and 3 (Blaxter *et al.* 1997, 156-159) were carried out during the development of a sorting station at outlet 1. Their respondents were randomly chosen during the lunch hours of a working day without a quota on gender, age, visiting frequence, and time of the visit.

The indicative qualitative customer survey consisted of a questionnaire with three questions ("How to ease sorting?", "How to speed sorting?", and "How to improve the sorting instructions?"). The repondents wrote their answers on the questionnaire. The means to support the sorting by customers have been based on the individual answers and have been summarised under "Means to improve sorting station ergonomics", "Means to improve sorting instructions", "Other means", and "No means", which shoes the number of respondents that were satisfied with the present sorting practises.

The credibility of the observation and the surveys is extremely low, because they were carried out only at outlet 1, had a low customer sample size (about 100), and the results were not analysed statistically. Because of the extremely low credibility, the results have been used in connection with the purity indexes of the sorted waste components (see Section 4.4.2) that have been the main developmental tool for the sorting station.

5. Results of the case study

5.1 Theoretical recovery rate

The analysis of sales packaging, food raw materials, and their primary and secondary packaging is presented in Appendix 1. The total annual amount of packaging waste was 1 937 tonnes in 2002. Based on the figures in Table 2 it was estimated to be about 0.44 % of the total annual amount of packaging waste, 0.0745 % of the total annual amount of municipal waste, and 0.00152 % of the total annual amount of solid waste in Finland in 2000, with the assumption that all generated packaging waste was treated as household or commercial waste.

The total amount of packaging waste was divided to waste categories on the basis of disposal location. Sales packaging were disposed of in the dining area ('Sales packaging disposed of in the dining area') and outside the outlets ('Sales packaging disposed of outside the outlets') presenting the sales packaging of take-away food products. Primary and secondary packaging were disposed of in the kitchen area at the outlets ('Primary and secondary packaging disposed of in the kitchen area').

One quarter of the packaging waste was generated outside the outlets and three quarters at the outlets (Figure 11). At the outlets, the share of 'Sales packaging disposed of in the dining area' was 39 %. Packaging waste originating from primary and secondary packaging had a share of 36 %.

Packaging was manufactured from wood-based materials (paperboard, liquid board, cardboard, paper, and wood), plastics, and composites (Table 7). The waste treatment options for each packaging material were determined in the declining order of the Waste Hierarchy, with special focus on recycling. Plastics made an exception. The energy recovery of plastics was preferred to recycling, because three types of plastic with differing applicability for recycling were analysed. The composites were not suitable for

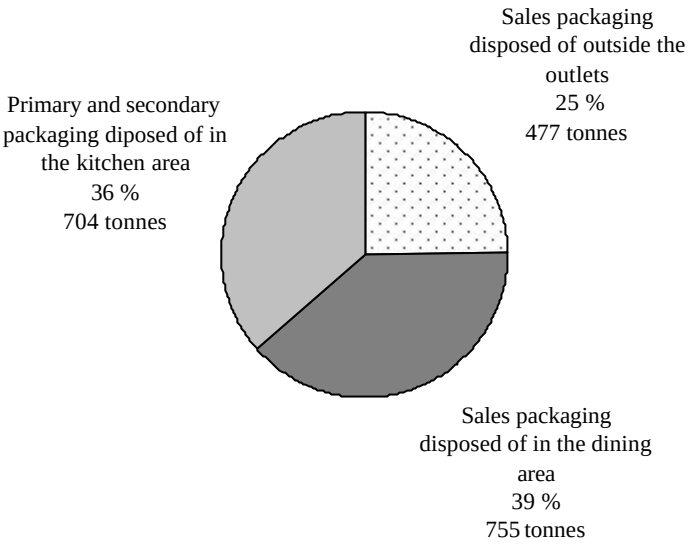


Figure 11. Share and amount of each waste category from the total annual amount of packaging waste.

recovery, because each of them was manufactured from several packaging materials (see Section 2.2) and was contaminated with food residuals. The applicability of some waste treatment options was dependent on the contamination level, as indicated in Table 7. It was, however, assumed that the contamination level was recovery process qualified.

The sales packaging was manufactured from six different packaging materials (Table 8). Most of the sales packaging was manufactured from paper by number, and from paperboard by weight, because the average weight of paper sales packaging was 2 grams/item compared to the average weight of paperboard sales packaging weighing 10 grams/item.

The primary and secondary packaging disposed of in the kitchen area was dominated by cardboard on the weight basis and on the basis of the number of packaging items. The fact that sales packaging and food raw materials were transported to outlets in cardboard boxes with a few exceptions of bakery and dairy products resulted in the dominance. Cardboard

Table 7. Analysed packaging materials and their waste treatment options in declining order of the Waste Hierarchy.

Packaging material	Preferred waste treatment option	Other waste treatment options
Wood-based packaging materials		
- Paperboard	Recycling (fibre)	Composting – Energy recovery[1] – Disposal in landfills
- Liquid board	Recycling (fibre)	Energy recovery[1] – Disposal in landfills
- Cardboard	Recycling (fibre)	Composting – Energy recovery[1] - Disposal in landfills
- Paper[2]	Composting	Energy recovery[1] – Disposal in landfills
- Wood	Composting	Energy recovery[1] – Disposal in landfills
Plastic[3]	Energy recovery[1]	Recycling[1] – Disposal in landfills
Composites	Disposal in landfills	Energy recovery[1]

[1] Applicability is dependent on the contamination level.

[2] Ordinary and wax-coated paper

[3] PS, PP, and PE

Table 8. Number of packaging items and annual amounts of packaging materials of packaging disposed of outside the outlets (A) and at the outlets (B).

	Packaging materials							Total
	Paperboard	Liquid board	Cardboard	Paper	Wood	Plastic[1]	Composites	
A. Sales packaging disposed of outside the outlets								
Number of packaging items	16	11	-	29	2	15	16	89
Total amount (tonnes)	158	97	-	155	0.33	55	12	477
Share (%)	33	20	-	32	0	12	3	100
B. Packaging disposed of at the outlets								
Number of packaging items	13	15	177	26	2	61	115	409
of which disposed of in the dining area	13	11	-	26	2	14	15	
of which disposed of in the kitchen area	0	4	177	0	0	47	100	
Total amount (tonnes)	202	234	564	193	0.77	137	130	1 460
of which disposed of in the dining area	202	227	-	193	0.77	127	6	
of which disposed of in the kitchen area	0	6.8	564	0	0	9.9	124	
Share (%)	14	16	39	13	0	9	9	100

[1] PS, PP, and PE

was followed by composites that originated from the primary packaging of food raw materials. Plastic packaging in the kitchen area originated from the primary packaging of sales packaging.

Table 7 shows that seven packaging materials formed four waste components. The recyclable (fibre) waste was suitable for fibre recycling and originated from packaging manufactured from paperboard, liquid board, and cardboard. The biodegradable waste was compostable and originated from packaging manufactured from paper and wood. The combustible waste originated from plastic packaging and was suitable for recovery as energy. Packaging manufactured from composites formed mixed waste that was disposed of in landfills.

The total annual amount of recoverable packaging waste was 1 795 tonnes resulting in a theoretical recovery rate of 93 % (Table 9). The recoverable packaging waste was dominated by recyclables (fibre), whose share was the highest, 70 %. The share of biodegradable and combustible packaging waste was 19 % and 11 %, respectively. None of the primary and secondary packaging disposed of in the kitchen area was biodegradable.

Table 9. Amount of packaging by waste category and component, the total amount and the theoretical recovery rate.

Waste category and component	Amount tonnes	
Sales packaging disposed of outside the outlets of which	477	
Recyclable (fibre) waste		255
Biodegradable waste		155
Combustible waste		55
Mixed waste		12
Sales packaging disposed of in the dining area of which	755	
Recyclable (fibre) waste		429
Biodegradable waste		194
Combustible waste		127
Mixed waste		6
Primary and secondary packaging disposed of in the kitchen area of which	704	
Recyclable (fibre) waste		570
Biodegradable waste		0
Combustible waste		10
Mixed waste		124
Total amount of packaging waste of which	1 937	
Recoverable packaging waste of which	1 795	
Recyclable (fibre) waste[1]	1 255 (70 %)	
Biodegradable waste[1]	348 (19 %)	
Combustible waste[1]	191 (11 %)	
Mixed waste[2]	142 (7 %)	
Theoretical recovery rate	93 %	

[1] Share (in %) from the amount of recoverable packaging waste in parentheses.

[2] Share (in %) from the total amount of packaging waste in parentheses.

5.2 Actual recovery rate

The analysis of mandatory and voluntary collection of waste components generated as household and commercial waste in the 37 case municipalities is presented in Appendix 2A. All the municipalities had given local waste regulations. The collection of liquid board packaging waste generated as household waste was mandatory in eight municipalities (Figure 12). The producer organisation of liquid board offered waste collection points for voluntary collection of liquid board waste generated at households in all the case municipalities except for one. The collection of biodegradable household waste was mandatory in 34 municipalities. Combustible waste was collected from households in 13 of the case municipalities, showing, however, variation in the composition of waste components. Combustible waste was determined to consist of sole plastic packaging, of combustible and mixed waste, or of biodegradable and packaging waste. The collection of mixed waste from residential waste producers was mandatory in all the municipalities. It was the only waste treatment option of household waste in three case municipalities.

The collection of cardboard waste generated at commercial waste producers was mandatory in all the municipalities (Figure 12). Only three municipalities had given orders to collect liquid board packaging waste from commercial waste producers. There were no waste collection points for liquid board packaging waste generated as commercial waste. The collection of biodegradable commercial waste was mandatory in 35 municipalities. Equal to household waste, combustible waste was collected in 13 of the case municipalities. The collection of mixed waste from commercial waste producers was mandatory in all the municipalities. It was the only waste treatment option of commercial waste in two case municipalities.

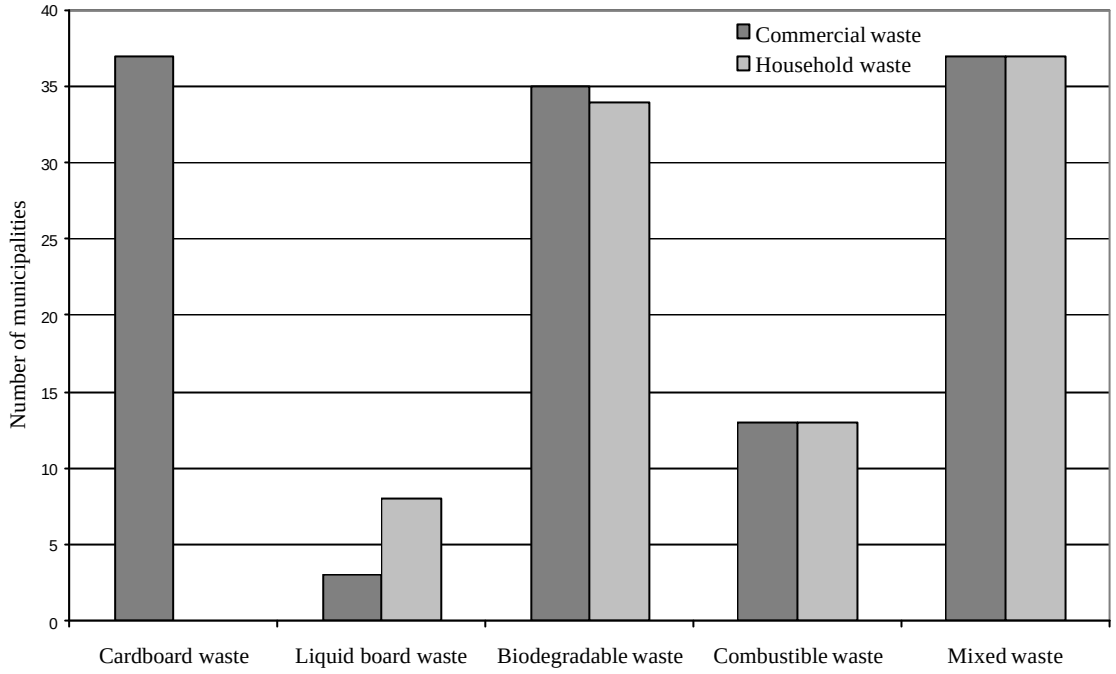


Figure 12. Number of municipalities having defined the mandatory collection of waste components in their local waste regulations.

The secondary packaging disposed of in the kitchen area was, however, the entire packaging waste collected for recovery, and the customer feedback collected by the company gave evidence that the sales packaging was disposed of in landfills outside the outlets. As a consequence, 564 tonnes out of 1 937 tonnes of annual packaging waste was recovered, resulting in an actual recovery rate as low as 29 % (Table 10). It originated from secondary packaging manufactured from cardboard and was disposed of as recyclable (fibre) waste.

Table 10. Actual recovery rate of each waste category and the total amount of packaging waste.

Packaging waste	Unit	Waste categories			Total
		Sales packaging disposed of outside the outlets	Sales packaging disposed of in the dining area	Primary and secondary packaging disposed of in the kitchen area	
Total amount	tonnes	477	755	704	1 937
Amount of recoverable packaging waste	tonnes	465	749	580	1 795
Amount of packaging waste actually recovered	tonnes	0	0	564	564
Actual recovery rate	%	0	0	80	29

5.3 Recovery potential

5.3.1 Total recovery potential

The annual amount of packaging waste that could be recovered was 1 230 tonnes, resulting in a total recovery potential of 64 % (Table 11). By the waste category, 'Sales packaging disposed of in the dining area' and 'Sales packaging disposed of outside the outlets' had the highest total recovery potential, nearly 100 %. 'Primary and secondary packaging disposed of in the kitchen area' had the lowest potential, only 2.3 %, because the secondary packaging that was manufactured from cardboard and dominated the waste category was actually recovered.

Table 11. Total recovery potential of each waste category and the total amount of packaging waste.

Packaging waste	Unit	Waste categories			Total
		Sales packaging disposed of outside the outlets	Sales packaging disposed of in the dining area	Primary and secondary packaging disposed of in the kitchen area	
Total amount	tonnes	477	755	704	1 937
Amount of recoverable packaging waste	tonnes	465	749	580	1 795
Amount of packaging waste actually recovered	tonnes	0	0	564	564
Amount of packaging waste that could be recovered	tonnes	465	749	16	1 230
Total recovery potential	%	97	99	2.3	64

5.3.2 Achievable recovery potential

The amounts of packaging waste recoverable by the existing solid waste infrastructure are presented in Appendix 3. The annual amount of packaging waste recoverable by the existing solid waste infrastructure but not recovered was 647 tonnes, resulting in an achievable recovery potential of 33 % (Table 12). The achievable recovery potential of ‘Sales packaging disposed of outside the outlets’ was the highest, 86 %, which originated

mainly from the unexploited recovery potential of liquid and paperboard packaging waste generated at households (Table 9). The achievable recovery potential of 'Sales packaging disposed of in the dining area' was 31 %. The achievable recovery potential of 'Primary and secondary packaging disposed of in the kitchen area' was only 0.3 %, because the cardboard packaging waste dominating this category was actually recovered.

Especially the analysis of mandatory and voluntary collection of waste components generated as household and commercial waste in the 37 case municipalities (see Section 5.2) indicates that the actual recovery rate of packaging waste could be increased by promoting sorting by consumers outside the outlets and in the dining area and by finding waste management practises for collecting the sorted waste components from the outlets. Development of sorting instructions, a sorting station for customers' use in the dining area at outlet 1, and waste management practises at outlets 1 and 2 are presented in the following paragraphs.

Development of sorting instructions

The achievable recovery potential of 'Sales packaging disposed of outside the outlets' was the highest, 410 tonnes (Table 12). The potential can be reached by motivating consumers to use the existing solid waste infrastructure when disposing of sales packaging outside the outlets. One significant situational factor to influence sorting behaviour is knowledge (see Section 2.3), which can be increased by informative instruments such as education, publicity, and promotion (see Section 2.1.2). The instruments create first the awareness of consumers, which leads to sorting behaviour without attitude change, but over time, if the behaviour continues and their knowledge is increased, attitude change occurs.

For increasing the knowledge of consumers by giving sorting instructions, the terminology and colour coding of waste components in the local waste regulations of the 37 case municipalities were analysed. The analysis is presented in Appendixes 2B and 2C,

Table 12. Achievable recovery potential of each waste category and the total amount of packaging waste.

Packaging waste	Unit	Waste categories			Total
		Sales packaging disposed of outside the outlets	Sales packaging disposed of in the dining area	Primary and secondary packaging disposed of in the kitchen area	
Total amount	tonnes	477	755	704	1 937
Amount of recoverable packaging waste	tonnes	465	749	580	1 795
Amount of packaging waste recoverable by the existing solid waste infrastructure	tonnes	410	235	566	1 210
Amount of packaging waste actually recovered	tonnes	0	0	564	564
Amount of packaging waste recoverable by the existing solid waste infrastructure but not recovered	tonnes	410	235	2	647
Achievable recovery potential	%	86	31	0.3	33

respectively. The terminology of waste components varied within the case municipalities (Table 13). Biodegradable, mixed, and combustible waste had the widest variance in terminology. Waste, municipal waste, and paperboard waste had only one term, but were defined in few local waste regulations. Such terms as ‘Coarse waste’ and ‘Wet waste’ were obscure and likely to be difficult for non-residents to understand. In addition, the term ‘Dry waste’ had double meaning referring to combustible waste or to mixed waste depending on the case municipality.

The colour coding of waste components showed similar variance (Table 14). Grey, brown, and blue referred to nearly 10 different waste components. White was the only colour to refer to one waste component, waste glass.

Based on these findings, the variation in local waste regulations was too wide for giving nationally consistent sorting instructions for sales packaging waste generated outside the outlets. The case company made a decision to provide consumers information about the packaging materials the sales packaging were manufactured from on the company’s home pages. This way, it was the consumers’ task to find out the relevant local sorting practise.

Table 13. Terminology of waste components defined in the local waste regulations of the 37 case municipalities.

Waste component	Number of municipalities	Number of terms
Combustible waste	25	9
Mixed waste	34	8
Biodegradable waste	36	6
Liquid board waste	4	4
Cardboard waste	20	3
Plastic waste	5	2
Paperboard and paper packaging waste	8	2
Recoverables	27	2
Waste	6	1
Municipal waste	34	1
Paperboard waste	2	1

Table 14. Colour coding of waste components defined in the local waste regulations of the 37 case municipalities.

Colour coding	Number of municipalities	Number of waste components referred to
Grey	25	8
Brown	25	8
Blue	19	7
Yellow	12	6
Green	25	5
Orange	10	3
Red	22	2
Black	11	2
White	11	1

Development of a sorting station for customers' use at outlet 1

The achievable recovery potential of 'Sales packaging disposed of in the dining area' was the second highest, 235 tonnes (Table 12). Reaching the potential can be supported by sorting the packaging waste by the customers in the dining area. For that purpose, a set of dustbins at the outlet was developed to a sorting station for customers' use. The set of dustbins consisted of two adjacent 70 litre dustbins equipped with swing lids for mixed waste and one 7 litre dustbin for drink left-overs and ice cubes. The data of the development of the sorting station are presented in Appendix 4 for the results of the indicative customer observation and the qualitative customer surveys and in Appendix 5 for the purity indexes of the waste components.

The sorting station was developed in three successive phases that took 18 months. At each phase, the contamination levels of the waste components were analysed by calculating the purity index of the sorted waste components (Appendix 5). The higher the purity index was, the lower the contamination level, and the better the waste component was recovery qualified. Prior to the developmental phases, the waste components to be sorted by customers and the sorting order were defined.

The waste components to be sorted by customers were defined on the basis of the results presented in Section 5.1. The two main waste components to be sorted by customers at the sorting station were recyclable (fibre) waste, in other words paperboard and liquid board packaging materials, and biodegradable waste, in other words paper and wood packaging materials. Each of these was collected to a 70 litre dustbin. Because the fibre recycling process was able to exploit small amounts of plastic as energy source, plastic packaging materials presenting a share of 17 % of sales packaging disposed of in the dining area (Table 9) were collected together with recyclable (fibre) waste. The small share of composites (0.8 % from Table 9[4]) was collected to a 7 litre dustbin together with drink left-overs and ice cubes. When the dustbin was emptied, the liquids were drained and the composites strained and disposed of as mixed waste.

The waste components were colour coded with three colours. Recyclable (fibre) waste was given the colour yellow, because yellow containers were used in the waste collection points organised by the producer organisation for liquid board (Suomen NP-kierrätys Oy 2005) and because yellow referred to a variety of recyclable waste components in the case municipalities (Appendix 2C). Brown was chosen to indicate biodegradable waste, because it was used for biodegradable waste in 25 case municipalities (Appendix 2C). Grey colour for mixed waste made the appearance of the sorting station mournful and was changed to red, even though red indicated hazardous and biological waste in 22 case municipalities (Appendix 2C). Red was used as the background colour in the instruction boards at the top of the sorting station.

First, the waste components were named as 'Landfill waste', 'Hard packaging' and 'Soft packaging' the terms describing the physical state of the packaging waste. At phase 2 (see below), the terms were changed to 'Paperboard and plastic waste' referring to recyclable (fibre) and plastic waste, 'Biowaste and paper' referring to biodegradable waste, and 'Liquids and mixed waste' referring to drink left-overs, ice cubes, and composites. The chosen terms were frequently used in local waste regulations in the 37 case municipalities (Appendix 2B).

The sorting order was defined empirically prior to the developmental phases. Because a majority of customers are right handed, the sorting ran from right to left (the tray was held

[4] The amount of mixed waste (6 tonnes) divided by the total amount of sales packaging disposed of in the dining area (755 tonnes).

in the left hand and packaging waste sorted with the right): first drink left-overs, ice cubes and composites (such as portion packs) to the 7 litre dustbin, followed by recyclable (fibre) waste (such as liquid board cups, paperboard boxes, and plastic lids) to the right side 70 litre dustbin; and all remaining biodegradable waste, such as food left-overs and paper wraps, to the left side 70 litre dustbin.

At phase 1, the set of dustbins was equipped with self made verbal sorting instructions to guide the customers. Each dustbin was labelled with a colour coded sticker with the name of the waste component 'Landfill waste', 'Hard packaging' or 'Soft packaging' in it. The sorting was supported by personal guiding of customers in the dining area by voluntary guides. Hardly any customers stated that it was the employees' task to separate the generated packaging waste (Appendix 4A). They, however, asked for improvements in sorting practises (Appendix 4A).

Sorting could be eased and speeded up by improving the sorting station ergonomics and by improving the sorting instructions (Appendix 4A). Swing lids allowed customers to behave as previously, in other words to dispose of all packaging waste in one dustbin (Wälläri 2003, 18). The low purity index of 'Paperboard and plastic waste', on average 0.61, (Appendix 5A) also encouraged further development.

At phase 2, the dustbin lids were fastened and equipped with a round opening for recyclable (fibre) and plastic waste and a rectangular one for biodegradable waste. A worktop for a tray was added to the sorting station. The sorting instructions were clarified. The colour coding was not changed. The used terminology was misleading, because it differed from the ones used in publicity. As a consequence, the waste components were renamed as 'Paperboard and plastic waste', 'Biowaste and paper', and 'Liquids and mixed waste'. The pictures of packaging waste were added to the self-made verbal instructions at the sorting station, because they were asked for and because consumers with high task motivation filter pictorial information better than textual one (Pieters and Warlop 1999). Colour or symbol coding of packaging waste was impossible to introduce, even though asked for by customers (Appendix 4A).

The influence of the changes was analysed by customer observation. 80 % of customers sorted the packaging waste (Appendix 4B). Most of the unsorted packaging waste, 14 %, was disposed of in 'Biowaste and Paper'. Sorting was encouraged by the fastened lids of

the 70 litre dustbins (Wälläri 2003, 18-19). The most frequent mistake was sorting carton boxes to ‘Biowaste and paper’ instead of the ‘Paperboard and plastic waste’ (Appendix 5). The missorting did not, however, affect the contamination level of the waste components, because the paperboard boxes were applicable for fibre recycling and composting. Average purity indexes of 0.71 and 0.95 were calculated for ‘Paperboard and plastic waste’ and ‘Biowaste and paper’, respectively (Appendix 5). Customers paid more attention to pictures than to text at the short moment of sorting (Appendix 4B). The worktop for the tray was hardly used.

At phase 3, the worktop for the tray was removed and the fastened lids were colour coded. The verbal instructions with the pictures of packaging waste were professionalized by large instruction boards designed at a marketing agency and printed in a printing house. Customer communication was improved by tray liners and stands at the dining tables. They gave customers information on how to sort the packaging waste at the sorting station and how the waste components were recovered. The tray liners were used as a temporary communication tool for two weeks, but the stands were used to guide sorting permanently. The front door was labelled with a sticker telling customers that the outlet had sorting stations in the dining area.

The results of the indicative customer survey at phase 3 are presented in Appendix 4C. The two main improvements customers asked for were wider openings for the 70 litre dustbins and clearer sorting instructions. The customer communication tools worked well except for the stands, which were broken very easily and were therefore removed (Wälläri 2003, 25). The average purity index of the ‘Paperboard and plastic waste’ was slightly increased to 0.72 (Appendix 5A). The variation between the analysed bin liners was, however, decreased, indicated by declining standard deviation (in %). ‘Paperboard and plastic waste’ was recovered as fibre and energy, even though the reached purity index did not exactly meet the qualification limit of 0.8 given by the recoverer of ‘Paperboard and plastic waste’.

Even though the average purity index of ‘Biowaste and paper’ remained at the high level of 0.95 (Appendix 5B), observation result B in Appendix 4B indicates that customers used ‘Biowaste and paper’ more often than ‘Paperboard and plastic waste’ as a general dustbin for unsorted packaging waste. The reason was the largest opening in the lid and the

lightness of ‘Paperboard and plastic waste’ when compared to ‘Biowaste and paper’. At each phase, the analysed bin liners contained hardly any food left-overs and waste originating from outside the outlet, indicating that customers ate all the food they purchased and did not throw their own trash in the dustbins in the dining area.

After phase 3, the sorting station was introduced to three additional outlets, supported by tray liners used for a two week period at the introduction of the sorting station and a sticker in the front doors. The sorting station was not used during late opening hours (after 10 pm) in order to avoid irritating the customers (Wälläri 2003, 23-24). Packaging waste sorting was limited to the inside areas of the outlets. The contents of dustbins outside the outlets were disposed of as mixed waste, because their content was less controlled, having open access to passer-bys.

Development of waste management practises at outlets 1 and 2

The development of a sorting station for customers’ use made it possible to sort the packaging waste in the dining area. Operationally and economically efficient waste management practises of the sorted waste components were, however, needed to actually reach the achievable recovery potential of ‘Sales packaging disposed of in the dining area’. These practises also contributed to reaching the achievable recovery potential of ‘Primary and secondary packaging disposed of in the kitchen area’.

The waste management practises were studied at two outlets that had introduced packaging waste sorting in the dining and kitchen area. The outlets had organised the collection of waste components, in other words they had made contracts directly with the collectors. The achievable recovery potentials were 7.8 tonnes at outlet 1 and 14.9 tonnes at outlet 2 (Table 15).

Table 15. Achievable recovery potentials by waste category and component at outlets 1 and 2.

Waste category and component	Achievable recovery potential kg	
	Outlet 1	Outlet 2
Sales packaging disposed of in the dining area	7 643	14 613
Recyclable (fibre) waste	4 375	8 365
Biodegradable waste	1 974	3 774
Combustible waste	1 294	2 474
Primary and secondary packaging disposed of in the kitchen area	169	325
Recyclable (fibre) waste	69	133
Biodegradable waste	-	-
Combustible waste	100	192
Total	7 812	14 938
Recyclable (fibre) waste	4 444	8 498
Biodegradable waste	1 974	3 774
Combustible waste	1 394	2 666

The analysis of the waste management practises before and after the introduction of packaging waste sorting at outlets 1 and 2 is presented in Appendix 6. The figures have been calculated from the data in waste management contracts the outlets had made with the collectors. Before the introduction of packaging waste sorting, three waste components were collected. Cardboard waste was mechanically compacted and collected to racks. Biodegradable waste consisted of food raw material waste generated at production in the kitchen area. It was collected to containers whose volume was 0.24 m^3. Mixed waste was the main waste component and was collected to 0.6 m^3 (outlet 1) and 0.34 m^3 (outlet 2) containers after it had been mechanically compacted.

The introduction of packaging waste sorting generated a need for the collection of a fourth waste component, ‘Paperboard and plastic waste’ sorted in the dining area. It also

generated a need for more biodegradable waste containers, and a need of less mixed waste containers in the outlet's waste room. At outlet 1, biodegradable and mixed wastes were collected as earlier, but with the updated number of containers and pick-up frequencies. Cardboard waste and 'Paperboard and plastic waste' were collected together to a 4.0 m^3 container that was placed in a parking lot outside the outlet. 'Paperboard and plastic waste' was mechanically compacted before it was discarded into the container. Because of the unexceptionally small waste room at outlet 2, four deep collection containers were installed in the backyard outside the outlet for the collection of biodegradable waste (two containers), 'Paperboard and plastic waste' (one container), and mixed waste (one container). Cardboard waste was collected to a rack as earlier. Because of operational difficulties, 'Paperboard and plastic waste' and mixed waste were disposed of in the deep collection containers without mechanical compaction. (Appendix 6)

The introduction of packaging waste sorting increased the total weekly capacity by 20 % but did not affect the total weekly disposal cost at outlet 1 (Table 16). There was, however, dramatic increase in total weekly capacity and disposal costs at outlet 2. The total weekly capacity was increased by 229 %, which more than doubled the weekly total disposal costs. The reason was in compacting the packaging waste. The gravity forces were far too weak to replace the former mechanical compaction of packaging waste.

Table 16. Weekly capacities and disposal costs at outlets 1 and 2 before and after the introduction of packaging waste sorting, calculated from the waste management contracts.

	Unit	Before	After	Change	
Outlet 1					
Weekly capacity	m^3/week	7.35	8.80	+ 1.45	+20 %
Weekly disposal costs	euros/week	131.65	130.44	- 1.21	- 1 %
Outlet 2					
Weekly capacity	m^3/week	7.90	26.00	+ 18.10	+ 229 %
Weekly disposal costs	euros/week	91.56	239.38	+ 147.82	+ 161 %

The actual total monthly disposal costs at outlets 1 and 2 before and after the introduction of packaging waste separation are presented Table 17. The actual total monthly disposal cost at outlet 1 decreased slightly after the introduction of packaging waste sorting, the actual decrease being more (- 9 %) than calculated from the contract (- 1 %) (Table 16). The increase in monthly disposal costs at outlet 2 was verified by the actual figures (Table 17). The increase was, however, lower (+ 139 %) than calculated from the contract (+ 161 %) (Table 16). The cost comparison was complicated by the different number of pick-ups per month, the additional pick-ups, and constantly changing unit prices.

Table 17. Comparison of actual total monthly disposal costs before and after the introduction of packaging waste sorting at outlets 1 and 2.

	Actual monthly disposal costs euros/month					
	Fibre and plastic sales packaging waste	Cardboard waste	Biodegradable waste	Mixed waste	Total	
Outlet 1						
Before[1]	0	45.80	165.60	315.21	526.61	
After[2]	80.00	0	259.20	138.38	477.58	
Change	+ 80.00	- 45.80	+ 93.60	- 176.83	- 49.03	- 9%
Outlet 2						
Before[3]	0	138.40	107.80	168.48	414.68	
After[4]	160.00	60.00	435.67	337.26	992.93	
Change	+ 160.00	- 78.40	+ 327.87	+ 168.78	+578.25	+ 139 %

[1] November 2001; sales and price corrected to correlate with costs and sales in May 2003; 1 euro = 5.95 FIM

[2] May 2003

[3] January 2003

[4] August 2003

The specific cost of a waste component illustrates the cost of one m^3 of waste. The average specific cost of each collected waste component has been calculated on the basis of the data in Appendix 6. The specific cost was collector dependent with the highest variation in the specific cost of mixed waste (Table 18).

Variation in specific costs indicated variation in unit pricing, being collector dependent. In the waste management contracts, the unit price was defined as a sum of transport and treatment charge (Appendix 6). Treatment charge included obligatory fees, such as the national landfill tax. Treatment charge was not paid for 'Paperboard and plastic waste' and cardboard waste, because they were recovered. The unit price was fixed for the outlets, but the collectors were charged on the weight basis at the waste treatment facility for biodegradable waste and at entering the landfill site (see Section 4.2.2). As described in Section 2.4.1, the dilemma has been solved by the collectors by defining a specific unit weight (kg/m^3) for each container size of each waste component. The specific unit weight is an average weight of a container and each collector has its own methodology to define the specific weights.

Table 18. Average specific costs of collected waste components.

Waste component	Collectors	Average specific cost euros /m^3	Std %
'Paperboard and plastic waste'	C3, C4	4.50	16
Cardboard waste	C1, C2, C3	10.48	15
Biodegradable waste	C1, C2, C3	28.83	15
Mixed waste	C1, C2, C3	12.36	36

Specific unit weights from different sources are presented in Table 19. The specific unit weights defined in this study were significantly below the reported values. Especially bulky sales packaging decreased the specific unit weights of ‘Paperboard and plastic packaging’ and mixed waste disposed of in the dining area before the introduction of packaging waste sorting. The specific unit weight of biodegradable waste disposed of in the dining area was 10…20 % of the reported values, indicating that biodegradable sales packaging was significantly lighter than traditional biodegradable waste, such as food raw material production waste. As presented earlier in this section, ‘Biowaste and paper’ disposed of in the dining area contained entirely biodegradable sales packaging. The comparison of specific unit weights gave, however, only indicative results, because compaction data on the waste components was not available.

The introduction of packaging waste sorting caused additional investment costs in the dining area, when a set of dustbins was modified to the sorting station. The average cost of modifying one set of dustbins was about 1 500 euros. The target was to cover the modification investments by savings in the national landfill taxes that were not charged from waste components recovered after the introduction of packaging waste sorting. The investment costs of modifying two sets of dustbins at each outlet could not be covered by the national landfill tax or by the empirical savings in disposal costs (Table 20). The introduction of packaging waste sorting generated additional disposal costs (6 939 euros) at outlet 2.

Table 19. Specific unit weights of waste components.

Waste component	Specific unit weight kg/m^3
'Paperboard and plastic waste'	
Fibre and plastic sales packaging waste in the dining area after the introduction of a sorting station[1]	23
Paper packaging[2]	28
Plastic packaging[2]	28
Biodegradable waste	
'Food and paper waste'[3]	31
Biodegradable waste[4]	378
Biodegradable waste[5]	200
Mixed waste	
Packaging waste disposed of in the dining area before the introduction of packaging waste separation[6]	36
Mixed waste[4]	78
Mixed waste[5]	95

[1] From Appendix 5A

[2] From Mattsson Petersen and Berg (2004)

[3] From Appendix 5B

[4] From Appendix 2G

[5] From Tanskanen (1996, 35).

[6] Collected as mixed waste. The average weight of a bin liner (n=14) was 2.5 kg resulting in the specific unit weight of 36 kg/m^3 when divided by the volume of the bin liner (0.07 m^3) (unpublished primary data).

Table 20. Savings generated in introducing the packaging waste sorting at outlets 1 and 2.

	Unit	Outlet 1	Outlet 2
Achievable recovery potential[1]	kg/year	7 812	14 938
Savings in the value of the national landfill tax[2]	euros/year	179.68	343.57
Empirical savings in disposal costs[3]	euros/year	588.36	-6 939.00

[1] From Table 15.

[2] Achievable recovery potential multiplied by the value of the national landfill tax, 23 euros per tonne (see Section 4.2.2)

[3] Monthly savings from Table 17 multiplied by 12.

5.3.3 Theoretical recovery potential

The annual amount of packaging waste non-recoverable by the existing solid waste infrastructure was 583 tonnes, resulting in a theoretical recovery potential of 31 % (Table 21 and Appendix 3). The theoretical recovery potential of 'Sales packaging disposed of in the dining area' was the highest, 68 %, originating mainly from liquid board packaging waste (Table 11). The theoretical recovery potential of packaging waste generated outside the outlets was significantly lower, 12 % and that of 'Primary and secondary packaging disposed of in the kitchen area' only 2.0 % (Table 21).

The theoretical recovery potential could not be reached in the existing solid waste infrastructure, mainly because of the variance in the solid waste infrastructure based on local waste regulations, mandatory collection orders in particular, and because of the absence of a take-back scheme for liquid board packaging waste generated as commercial waste offered by a producer organisation (see Section 5.2).

Table 21. Theoretical recovery potential of each waste category and the total amount of packaging waste.

Packaging waste	Unit	Waste categories			Total
		Sales packaging disposed of outside the outlets	Sales packaging disposed of in the dining area	Primary and secondary packaging disposed of in the kitchen area	
Total amount	tonnes	477	755	704	1 937
Amount of recoverable packaging waste	tonnes	465	749	580	1 795
Amount of packaging waste actually recovered	tonnes	0	0	564	564
Amount of packaging waste recoverable by the existing solid waste infrastructure but not recovered	tonnes	410	235	2	647
Amount of packaging waste non-recoverable by the existing solid waste infrastructure	tonnes	55	514	14	583
Theoretical recovery potential	%	12	68	2.0	31

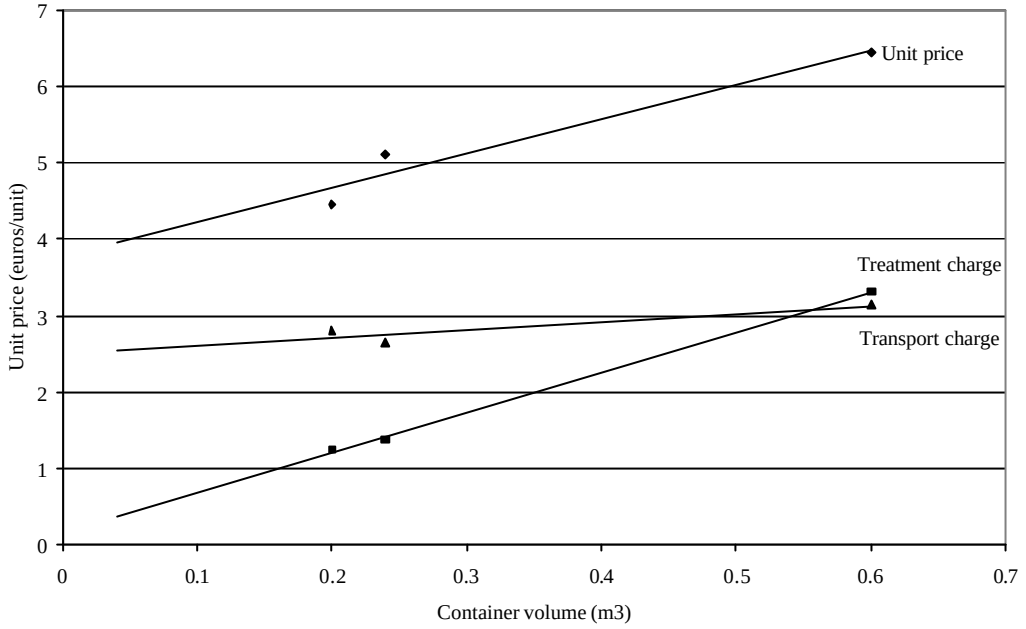
An analysis of some factors of the solid waste infrastructure in the 37 case municipalities is presented in Appendixes 2D…2G to illustrate the variance in local solid waste infrastructures. The collection of mixed waste was organised by the municipality in most of the case municipalities (Appendix 2D). The average validity of a contract was 4.4 years. The most common company form for the collectors was a regional waste management company, which operated in 26 municipalities.

The actual average treatment charge of mixed waste was 56.79 euros/tonne with the variation of 29 %. The maximum treatment charge (127.10 euros/tonne) was over three times the minimum one (39.36 euros/tonne). The actual treatment charges of biodegradable waste showed even higher variation (56 %). The average charge was 36.11 euros/tonne, the maximum charge (88.80 euros/tonne) being almost nine times the minimum one (10.09 euros/tonne). (Appendix 2E)

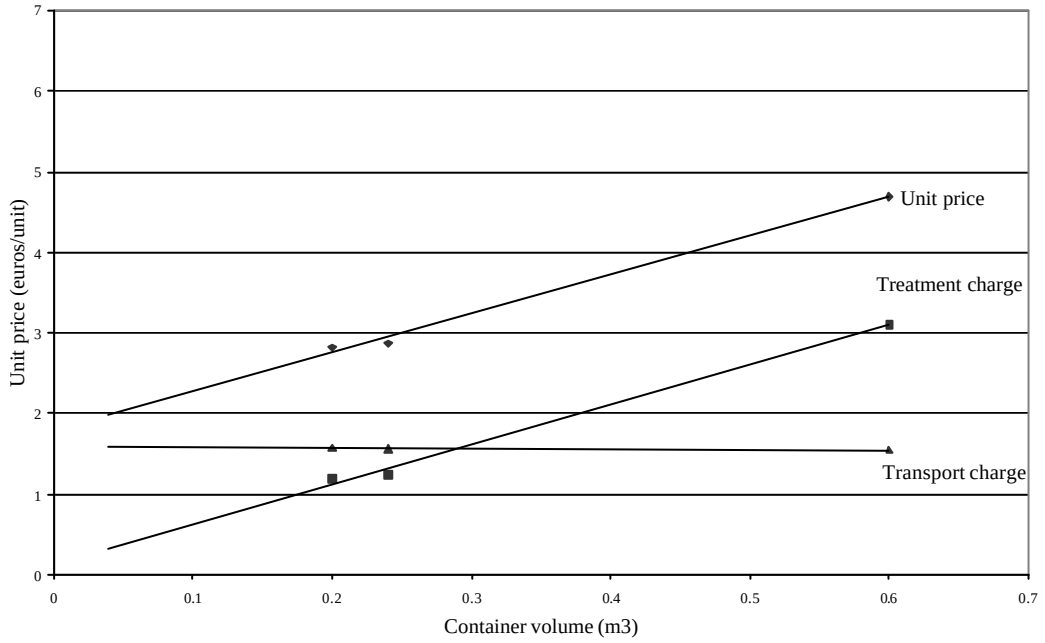
The variance in the actual unit prices of mixed waste was dependent on the container volume and contract type (Appendix 2F). The average unit prices of the collection organised by a municipality were 27…44 % lower than the collection organised by a property. When the collection was organised by a municipality, the average transport charges were independent on the container volume (Figure 13). The actual specific unit weights of mixed and biodegradable waste showed also variance (Appendix 2G). The correlation between the average specific unit weights of mixed waste and the container volume was linear (Figure 14). The linear correlation in the unit of kg/m^3 was, however, contradictory to the fact that the density of a substance is constant, in other words, independent of the container volume.

The specific cost was calculated for mixed waste with different container volumes (Table 22). The collection of mixed waste was organised by a property or by a municipality. The specific cost decreased when the volume of the container increased. It was lower when the collection was organised by a municipality than when the collection was organised by a property.

A.


Unit price
Treatment charge
Transport charge
Unit price (euros/unit)
Container volume (m3)
0
1
2
3
4
5
6
7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

B.


Unit price
Treatment charge
Transport charge
Unit price (euros/unit)
Container volume (m3)
0
1
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0.1
0.2
0.3
0.4
0.5
0.6
0.7

C.

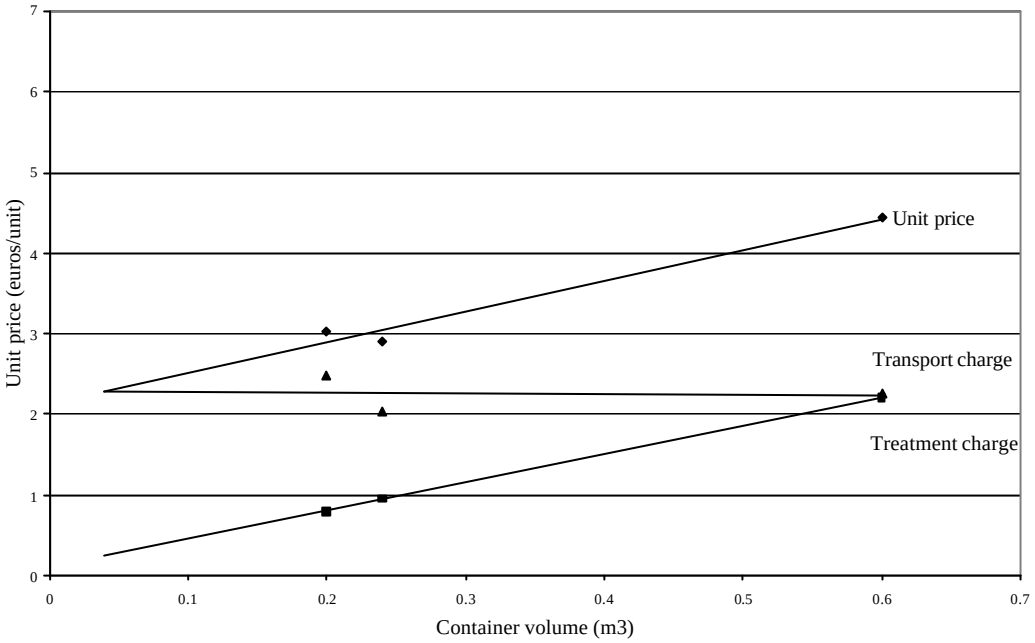

Figure 13. Average unit prices, transport charges, and treatment charges of mixed waste as a function of container volume. Collection organised by a property (A), by a municipality (B) or by a municipality in the case of a combined scheme C).

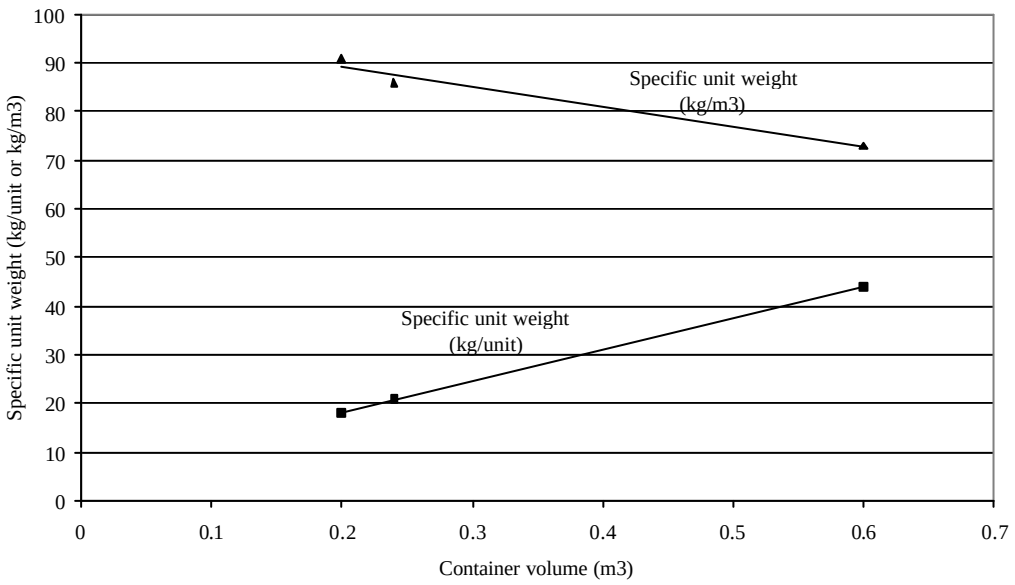

Figure 14. Specific unit weights of mixed waste as a function of container volume.

Table 22. Specific costs of mixed waste for different container volumes. Collection organised by a property or by the municipality.

.	Unit	Container volume		
		0.2 m^3	0.24 m^3	0.6 m^3
Average unit price[1]				
contract P		4.45	5.10	6.45
contract M		2.82	2.87	4.69
contract CM		3.02	2.91	4.44
Average specific weight[2]	kg/unit	16.60	19.82	42.50
Average specific weight[3]	kg/m^3	83.00	82.58	70.83
Specific cost[4]				
contract P	euros/m^3	22.25	21.25	10.75
contract M	euros/m^3	14.10	11.96	7.82
contract CM	euros/m^3	15.10	12.13	7.40

[1] From Appendix 2F. The collection of mixed waste was organised by a property (Contract P) or by the municipality (Contract M). When a combination was used, the collection was organised by a municipality (Contract CM)

[2] From Appendix 2G. Table i

[3] From Appendix 2G. Table ii

[4] The specific cost (in euros/ m^3) was calculated by dividing the unit price (in euros/unit) by the specific unit weight (in kg/unit) and multiplying the result with the specific unit weight (in kg/ m^3).

5.4 Influence of packaging materials on the theoretical recovery rate

The influence of packaging materials on the theoretical recovery rate was analysed by harmonising the packaging materials. The harmonisation was relevant for this study, because the limited variation of packaging materials simplifies the sorting of packaging waste by customers and employees. It also decreases the total amount of packaging waste.

An analysis of packaging material harmonisation is presented in Appendix 7. About half of the sales packaging was affected by the packaging material harmonisation mainly by replacement (Table 23). The total number of packaging material items was reduced by 17 items from 91 items to 74 items. Sales packaging manufactured from paperboard was mainly replaced with paper alternatives in order to decrease the amount of bulky sales packaging waste. The number of sales packaging manufactured from liquid board remained unchanged. There was only one change in the amount of one single packaging. Most paper packaging items remained unaffected. The number of items, however, increased, because some sales packaging manufactured from paper board, such as hamburger and French fries boxes were replaced by paper alternatives. Two new types of wooden sales packaging were added, when plastic forks and knives were replaced by wooden alternatives. The number of plastic packaging decreased from 15 to 10 items by replacement and by limiting their use. For example plastic lids in soft drink cups were used only in drinks sold as take-away or for children's use. The share of composites in the sales packaging was the smallest on the weight basis (1,5 % from data in Table 8[5]), but complicated the sorting in the dining area (Appendix 5). By the packaging material harmonisation, the number of composites decreased from 16 to 5 items by removing items with low sales volumes and replacing them with larger unit sizes making dosing by customers or employees possible.

The packaging material harmonisation decreased the annual amount of packaging waste by 16 % from 1 937 tonnes to 1 620 tonnes (Table 24). The amount of recoverable packaging material decreased by 17 % from 1 795 tonnes to 1 485 tonnes. The theoretical recovery rate was slightly decreased from 93 % to 92 %. The decrease was significant in combustible waste (a decrease of 72 %) and moderate in biodegradable (a decrease of 33 %) and recyclable (fibre) waste (a decrease of 23 %). The amount of mixed waste remained practically unchanged (a decrease of 4.9%).

[5] The share of the amount of mixed waste disposed of outside the outlets (12 tonnes) and in the dining area (6 tonnes) in the amount of sales packaging disposed of outside the outlets (477 tonnes) and in the dining area (755 tonnes).

Table 23. Number of packaging material items before and after the packaging material harmonisation and changes in packaging material items.

A.

Packaging material	Number of items		Number of items		New items
	before	after	affected	unaffected	
Paperboard	17	6	13	4	1
Liquid board	11	11	1	10	0
Paper	30	38	8	22	10
Wood	2	4	0	2	2
Plastic	15	10	11	4	0
Composites	16	5	12	4	1
Total	91	74	45	46	14
Share from the number of items before the harmonisation		81 %	49 %	51 %	

B.

Packaging material	Number of items affected by				Total
	replacement	removal	limited use	change in amount	
Paperboard	12	0	0	1	13
Liquid board	0	0	0	1	1
Paper	2	0	3	3	8
Wood	0	0	0	0	0
Plastic	4	1	6	0	11
Composites	7	5	0	0	12
Total	25	6	9	5	45
Share from the number of items affected	56 %	13 %	20 %	11 %	

Table 24. Amount of packaging by waste category and component and the total amount and their changes before (from Table 8) and after the packaging material harmonisation (from Appendix 7).

Waste category and component	Amount tonnes		Change %
	Before	After	
Sales packaging disposed of outside the outlets of which	477	380	- 20
Recyclable (fibre) waste	255	167	- 35
Biodegradable waste	155	190	+ 23
Combustible waste	55	14	- 75
Mixed waste	12	10	- 17
Sales packaging disposed of in the dining area of which	755	552	- 27
Recyclable (fibre) waste	429	246	- 43
Biodegradable waste	194	274	+ 41
Combustible waste	127	32	- 25
Mixed waste	6	0.9	- 85
Primary and secondary packaging disposed of in the kitchen area of which	704	688	- 2.3
Recyclable (fibre) waste	570	555	- 2.6
Biodegradable waste	0	0	-
Combustible waste	10	8	- 20
Mixed waste	124	125	+ 0.8
Total amount of packaging waste of which	1937	1620	- 16
Recoverable packaging waste[1] of which	1 795 (93 %)	1 485 (92 %)	- 17
Recyclable (fibre) waste	1 255	967	- 23
Biodegradable waste	348	464	- 33
Combustible waste	191	53	- 72
Mixed waste	142	135	- 4.9

[1] The theoretical recovery rate (in other words, the share (in %) of recoverable packaging waste in the amount of packaging waste) in parentheses.

The amount of sales packaging manufactured from paper and liquidboard (waste component recyclable (fibre) waste) was decreased by 35 % in the category 'Sales packaging disposed of outside the outlets' and by 43 % in the category 'Sales packaging disposed of in the dining area'. They were mainly replaced by paper alternatives being lighter by unit weight and compostable, which increased the amount of biodegradable waste by 23 % in the category 'Sales packaging disposed of outside the outlets' and by 41 % in the category 'Sales packaging disposed of in the dining area'. It was possible to decrease the amount of mixed waste in the category 'Sales packaging disposed of in the dining area' by 85 % by replacing portion packed food products with dosable alternatives. However, the portion packs of take-away food could not be replaced, which resulted in a slight decrease of 17 % of mixed waste in the category 'Sales packaging disposed of outside the outlets'.

The change in 'Primary and secondary packaging disposed in the kitchen area' showed an insignificant decrease potential of 2.3 %, mainly because of the dominance of secondary packaging manufactured from cardboard and because of the limited number of available alternatives for primary and secondary packaging.

The comparison of prime costs before and after the packaging material harmonisation indicates that harmonisation has a significant influence on the prime costs of the food raw materials and sales packaging. The annual saving was estimated to be about 48 % of the total prime costs that summed up to over 1 million euros.

The influence of changing the sales packaging of hamburgers and French fries was tested by a customer survey (Tuunanen 2002a; 2002b). Functionality and environmental benefits of sales packaging were preferred by customers (Table 25). When a hamburger was packed in a paperboard box, a napkin was used by the customer to wrap the hamburger for eating. Packed in a paper wrap, the hamburger could be eaten just by opening the wrap. The paperboard box of French fries was preferred to a paper alternative because of greater heat retention. Marketing values, such as appearance, showed low importance in sales packaging in the case company.

The preference for functionality and environmental benefits was supported by two other surveys. In the first one (sample size 288 customers), the customers' preference for ice cream packaging was tested. Two thirds of the customers preferred a liquid board cup

instead of a plastic one (Tuunanen 2002c, 3-4). The main criteria were ‘Less waste, more environmental friendly, more ecologic’ and ‘Functional design’. The second survey (sample size 401 customers) revealed that 45 % of customers could accept the replacement of portion-packed salad dressings with portioning by the customer himself/herself or by an employee (Tuunanen 2002d, 4).

Table 25. Customer preference on paperboard and paper alternatives of sales packaging for hamburgers and French fries.

	Hamburger[1]		French Fries[2]	
Sample size	288		149	
Preference for				
paperboard packaging (%)	44		60	
paper packaging (%)	56		40	
Top three preferences	paperboard	paper	paperboard	paper
‘Easier, more practical, faster’	1	1	1	2
‘Cleaner, more hygienic’	2	2	-	-
‘Less waste, more environmental friendly, more ecologic’	-	3	-	1
‘More rigid, firmer, stays together’	3	-	-	-
‘Functional design’	-	-	3	3
‘Easy to take away’	-	-	2	-
‘Good appearance’	-	-	-	-

[1] From Tuunanen (2002a, 5-6)

[2] From Tuunanen (2002b, 4-5)

6. Discussion and conclusions

6.1 Theoretical and actual recovery rates

The theoretical recovery rate of packaging waste illustrates how much of the packaging waste can be recovered (see Section 4.1). The recoverability is directly dependent on the material the packaging is manufactured from, because every recovery process has tight raw material specifications, in this case concerning packaging waste (see Section 2.2). The actual recovery rate illustrates how much of the packaging waste is actually recovered (see Section 4.1). The actual recovery rate is significantly influenced by the behaviour of the waste producer (see Section 2.3) and the existing solid waste infrastructure (see Section 2.4). The findings on the theoretical and actual recovery rates and the influence of packaging material harmonisation on the theoretical recovery rate in the case company are discussed in this section.

The theoretical recovery rate of packaging waste generated in the case company is extremely high, 93 % (see Section 5.1), but the actual recovery rate is as low as 29 %, originating entirely from secondary packaging manufactured from cardboard that is recovered as material (fibre) at all outlets (see Section 5.2). The result verifies the practical observation of high recoverability and low recovery rate of packaging waste (see Section 1.2).

Recovery rates of packaging waste generated in the fast food industry have not been published earlier. The study of Mason *et al.* (2004) focuses on a 5-week period of waste generation in one cafeteria located on an Australian university campus selling fast food type products, such as wrapped sandwiches. The study reports a recycling rate of 88 % for the kitchen and dining area, which is in line with the results of this study.

The packaging material harmonisation has insignificant influence on the theoretical recovery rate, but decreases the annual amount of packaging waste by 16 % (see Section 5.4), which correlates with the value of 12 % reported for food and drink industry by

Hyde *et al.* (2001). Evident significant influence on the prime costs of sales packaging and food raw materials has been reported earlier for example by Henningsson *et al.* (2001).

A packager can influence the recoverability of the packaging waste it places on the market through a number of different packaging materials. Given the wide range of substitutable packaging materials, the choice of packaging materials depends on many factors that can be partly contradictory (Paine and Paine 1992, 53-58). For example, when sales packaging decisions were made locally by the marketing department of the case company, the company decisions were promoted more by a retail market-oriented marketing agency than by the results of customer surveys. As a consequence, the paperboard box of hamburgers was not replaced with a paper wrap because the need to differentiate from the competitor expressed by the marketing department was stronger than the results of the consumers' preference for a paper wrap (see Section 5.4). As the sales packaging decisions were made internationally, there was no possibility to influence the packaging materials locally. The sales packaging of salad manufactured from liquid board was replaced with an internationally designed plastic packaging. The replacement ruined the sorting in the dining area. The plastic packaging should have been sorted to 'Liquids and mixed waste'. Because the dimensions of the dustbin and its opening were too small, the plastic salad bowl did not fit in and customers started to sort it to 'Biowaste and paper' having the widest opening. Missorting increased the contamination level of 'Biowaste and paper' significantly.

Co-operation with the sales packaging industry also influence the choice of packaging materials. The prime costs of the new innovated packaging materials may be too high (Anon. 2000b; Anon. 2001a; Dravet 2001) and the sales principles inefficient, as experienced in the case company. A sales packaging manufacturer offered sales packaging to the case company with the traditional 'take it or leave it' principle.

The possibility to influence the choice of the primary and secondary packaging of food, food raw materials, and sales packaging is especially difficult in internationally operating companies, because the mother company has often made international contratcs of purchase with high volume manufacturers. For example the primary packaging of dried onion was manufactured from PVC coated paper. The share of McDonald's Oy was

among of lowest ones in Europe, which made it impossible to replace PVC with an alternative packaging material better applicable for sorting.

There is, however, significant potential by weight (311 tonnes) and by value (estimated saving potential over 1 million euros in prime costs) for packaging material harmonisation in the case company (see Section 5.4). The exploitation of this potential can be promoted not only by the fast food industry, but also by the packaging industry. Instead of selling a packaging, the packaging industry could sell a packaging and a service, in other words decision supporting tools such as customer surveys or pilot marketing of present and alternative packaging. They can be used to support the purchase decisions of fast food and other companies that have limited internal resources in support functions. By knowing the needs of customers, the packaging industry can proactively sell solutions that are not necessarily asked by the customer. Proactive sales methods also offer the packaging industry tools to steer packaging consumption towards the direction it desires and to diminish the influence of retail market-oriented marketing agencies on the fast food industry.

6.2 Means to reach the achievable recovery potential

The recovery potential illustrates how much of the packaging waste could be recovered (see Section 4.1). It is the difference between the theoretical and the actual recovery rate and is influenced by the packaging waste legislation (see Section 2.1), the waste producers' behaviour (see Section 2.3), and the existing solid waste infrastructure (see Section 2.4). The total recovery potential of packaging waste is 64 % (see Section 5.3.1). It is a sum of the achievable and theoretical recovery potentials.

The achievable recovery potential illustrates how much of the packaging waste could be recovered by the existing solid waste infrastructure, but is not currently recovered. The achievable recovery potential is 33 % (647 tonnes) (see Section 5.3.2), being 53 % of the total recovery potential. The means to reach the achievable recovery potential are discussed in this section.

The sorting experiment in test outlet 1 indicates that it is possible to reach the achievable recovery potential in the existing solid waste infrastructure (see Section 5.3.2). The achievement is complicated by the non-working waste management practices offered by the collectors and the equipment suppliers, as experienced especially in test outlet 2. For example the collectors were not able to offer solutions to meet the outlets' needs that differed from the ones in common use. They had a limited variety of containers available and the only factors to choose from were the unit (container) volume and pick-up frequency. They proposed sorting mixed waste to biodegradable waste whenever possible, because of the lower unit price of biodegradable waste. A closer analysis, however, revealed that the solution would have generated additional costs for the outlet. For example at outlet 1, the unit price of mixed waste was 9.61 euros and that of biodegradable waste 7.20 euros (Appendix 6). The unit sizes were, however, different. The cost of mixed waste was per a 0.6 m^3 container, that of biodegradable waste for a 0.24 m^3container. As a consequence, the disposal cost of 0.6 m^3 biodegradable waste was 9.61 euros when collected as mixed waste and 18.00 euros when collected as biodegradable waste.

Neither the collectors nor the equipment suppliers had hardly any solutions to treating light but bulky packaging waste. The waste compactors had been developed for heavy use (for example Europress Oy 2005), and they were able to compact hard waste in high volume batches. The prime cost of the only compactor for light use was far too expensive for use at the the fast food industry. The applicability of the compactors was also limited. They were generally designed for a one-size container; in other words, each container size would have needed a compactor of its own. On the other hand, the compaction was limited by ergonomic considerations, because local waste regulations had typically set a limit for the weight of a container.

At outlet 2, the containers were replaced with deep collection containers. The manufacturer claimed that the specific weight of waste would increase, because gravitation forces would pack the waste tighter to the container. The gravity forces were, however, far too weak to replace the former mechanical compaction of packaging waste. The waste was generated so fast that a container of 5 m^3 was filled in a few days and there was no time for gravitation forces to compact the bulky cups and boxes that were in worst cases sealed to closed plastic bags. The manufacturer was reluctant to develop a

compaction system, even though a supplier for a grinder to be installed on the lid of the deep collection container was found.

The non-working waste management practises include the non-transparency of unit pricing. The commercial waste producer cannot affect the unit price even though the specific weights differ significantly from the common ones. For example the unit prices remained unchanged at outlets 1 and 2 even though the specific weight of biodegradable waste generated in the dining area, being nearly entirely composed of light biodegradable packaging waste, was only one tenth of the average specific weight of biodegradable waste (see Section 5.3.2). Also, the composition of waste generated at the outlets was different from other commercial waste producers. Comparison of the commercial waste generated at commercial and institutional establishments in Finland (Table 5 in Section 4.2.2) with the composition of waste generated in the case company (calculated from weekly capacities at outlet 1 after the introduction of the packaging waste sorting presented in Appendix 6) indicates that the difference is the most significant in the share of fibre-based waste. Its share is high (46 %) in the case company when compared to the shares ranging from 15 % to 31 % at other commercial waste producers. The share of biodegradable waste in the case company is 27 %, which is slightly lower than the share at hospitals (29 %) but significantly lower than at other commercial waste producers (39 % … 56 %). On the other hand, the share of mixed waste is about on the same level as at other commercial waste producers, excluding hospitals.

The disposal must be properly priced (see Section 2.4.2). An integral part of pricing are the economic waste policy instruments (such as the national landfill tax) that work as concrete tools to decrease the amount of waste disposed of in landfills (see Section 2.1.2). The case study indicates that the steering effect of the national landfill tax is insignificant, resulting in a marginal, zero, or even negative effect on disposal costs that do not motivate waste producers to sort but rather stay with disposal in landfills as long as legally possible.

In theory, the sorting of packaging waste causes savings in disposal costs, because the landfill tax is not charged from the waste components that are sorted for recovery. Because of the common unit-pricing principle (see Section 2.4.2), sorting does not necessarily decrease the disposal costs after introducing the sorting of packaging waste. For example, when sorting was introduced at four outlets of the case company, only one

outlet (outlet 1) was able to gain the indicated theoretical savings (see Section 5.3.2). At outlets 3 and 4, the efforts in sorting brought no financial benefit because the outlets were located in a shopping mall and their disposal cost was integrated in the rent. Outlet 2 confronted a drastic increase, because of non-working collection practises.

The value of the national landfill tax is also too low. For example in the case company level, the theoretical annual saving potential in the national landfill taxes was about 28 000 euros[6] in 2002, which is significantly lower than the estimated over 1 million euro saving potential by packaging material harmonisation (see Section 5.4). At the outlet level, the saving potentials were about 20 euros/month for an average outlet. The value of the national landfill tax has increased from 23 euros per tonne to 30 euros per tonne after 2002, but the increase of 7 euros per tonne has brought an insignificant annual increase of 8 600 euros to the case company. The present value of the national landfill tax has not caused illegal dumping nor led to intensive changes in waste management practises (see Section 4.2.2), which indicates that there is potential to intensify the steering effect by increasing the value of the national landfill tax. The higher savings potential in the national landfill tax would encourage waste producers to change their waste management practises.

The recovery of packaging waste can be promoted by waste producer -oriented waste management practises offered by the collectors. Because of the diverse needs of commercial waste producers in particular, the operative focus should be transferred from logistically easy operation to innovative solutions at waste handling at the source. For example the final solution was found at outlet 1, when a newcomer (collector C4) accepted combining cardboard waste with 'Paperboard and plastic waste' sorted in the dining area. It offered a container with zero rent for collecting this waste component. The container was placed outside the outlet at a parking place, which released space for other collection purposes in the waste room. The correct pick-up frequency with an acceptable filling degree was defined empirically. The outlet's employees also found the new practise easy to operate. As a consequence, outlet 1 uses the final solution three years after the introduction, whereas outlet 2 stopped sorting less than a year after the introduction.

[6] Total recovery potential (1 230 tonnes) multiplied by the national landfill tax (23 euros per tonne)

The collector sector should offer a total service to the waste producers, including the best available handling and collection technologies, fair and transparent pricing based on the waste characteristics of the waste producer, transparent waste treatment of separated waste components, and consultation in finding out the most suitable disposal practises. Examples are waste-producer-related specific weights especially in the case the specific weight of the generated waste differs from the common waste or to charge waste producers by weight (see Section 2.4.2), which improve the transparency of pricing. Weight-based pricing should be available especially for individual waste producers in commercial complexes, such as shopping malls, in order to motivate such waste producers as the case company to sort the packaging waste for recovery.

The image of the collector sector also needs to be improved. A single lorry transporting recoverables to a landfill site, deliberately or not, is enough to nullify the recovery willingness of waste producers. For example at outlet 2, a collector had agreed in the contract to transport mixed waste to a landfill, biodegradable waste to a composting facility, and recyclable (fibre) waste to a transport station. After a three-month operation period and invoicing, it was coincidentally found out that the recyclable (fibre) waste had been disposed of in a landfill. Several persons, including the managing director of the collector claimed, however, that the waste was transported as agreed. Finally a check-up at the transport station revealed the reality.

6.3 Means to reach the theoretical recovery potential

The theoretical recovery potential illustrates how much of the recoverable packaging waste is non-recoverable by the existing solid waste infrastructure (see Section 4.1). Recoverable packaging waste is left non-recovered, because of differences in the existing solid waste infrastructure, especially at the municipal level (see Section 2.4.1 and Section 4.2.2).

The theoretical recovery potential is 31 % (583 tonnes) (see Section 5.3.3), being 47 % of the total recovery potential. The theoretical recovery potential could be reached,

if the packaging waste was recovered similarly in all municipalities. The experiments at test outlets 1 and 2 indicate that it is not possible to reach the theoretical recovery potential. Reaching the theoretical recovery potential can be promoted by increasing the consistency of the solid waste infrastructure, which is discussed in this section.

The present national legislation gives Finnish municipalities the right to organise waste collection in settlement areas by their own or private collectors and to treat and dispose waste generated within their boundaries (see Section 4.2.2). This right has given the local authorities a strong autonomy that has resulted in dispersed municipal/regional solid waste infrastructures with high variation (see Section 5.3.3 and Appendix 2) and decreased the overall system efficiency (Gidarakos *et al.* 2006). An illustrative example is the terminology and the colour coding of waste components that are defined in local waste regulations. Despite of the EU List of Wastes[7] that is implemented in national legislation (Ministry Decree on the List of Wastes 1129/2001), the terminology showed variance that was too wide for giving nationally consistent instructions for sorting the sales packaging in the case company (see Section 5.3.2). The sorting instructions should have been in the form of "If you live in area x and your collector is y, separate to kitchen waste. If you live in area z and your collector is w, separate to dry waste, and so on" in order to promote sorting.

The national recovery targets of packaging waste have even increased the variance of local waste management practises, because the more recoverables are sorted, the more varied the solid waste infrastructures are. Local/regional practises are developed to meet the local/regional numeric targets optimally but they pay little or no attention to national coherency. At its extreme, the same waste component is disposed of in landfills, recovered as energy, or recycled, depending on the municipality where the waste is disposed of. On the other hand, the municipalities target at the lowest possible disposal costs for many reasons, such as fear of illegal dumping due to too high disposal costs (see Section 2.1.2, Section 2.4.2, and Section 4.2.2). When they have put mixed waste to bid, private collectors have not been asked what price they would like to charge but rather at what cost

[7] Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establing a list of hazardous waste pursuant to Article a(4) of Council Directive 91/689/EEC on hazardous waste (notified under document number ((2000)1147) (amended by Commission Decisions 118/2001, 119/2002, and 573/2001)

they will do the collection. This course of action has led to long, low profit contracts, which has kept the unit prices low (see Section 5.3.3), but - more importantly - has hindered the development of collection practises (see Section 6.2).

The consistency of the solid waste infrastructure can be increased by decreasing the municipal autonomy to allow local variance only in some special factors, such as the treatment of collected waste components and the collection practises. The nationally consisted factors should be decided and controlled centrally by the Ministry of the Environment. For example, a common standard for terminology and the colour coding of waste components would ease the sorting significantly by promoting waste producer-oriented practises (see Section 6.2). A common standard for terminology already exists and covers the terms for packaging waste (in category 15 01) and municipal waste (in category 20). After the introduction of a common standard, it is not any more the waste producer's task to figure out how to sort, but rather to follow the given instructions. Once sorted, the waste components can be collected and recovered depending on the local conditions. For example liquid board waste can be collected individually or together with cardboard for recycling, or as a part of combustible waste for incineration.

Introducing a common standard accelerates learning (see Section 2.3). For example, if all the outlets of the case company had the same sorting instructions in use in the dining areas, consumers would get used to sorting not only in the dining area but also at households when disposing of the sales packaging outside the outlets (see Section 5.3.2). Nationally standardised sorting education is more cost effective than hundreds of municipal level education campaigns (see Section 2.1.2) and can be financed by municipalities for example in relation to their population. A common standard allows manufactures to promote sorting for example by printing small coloured dots in sales, primary and secondary packaging to indicate the correct collection container to the waste producer. In the long run, companies are able to harmonise sales packaging materials to apply optimally to existing standards. At hundreds of nationally operating companies standards make it possible to give equal sorting instructions to all local operators. It is especially important in the fast food industry, because the sales packaging contains no sorting instructions and it is rarely integrated into public education materials. Equally colour-coded containers have also a positive effect on the prime cost of collectors and other container-owners due to increased manufacturing volumes. Once the common

standard is introduced, savings and improved recovery rates are achieved for example by overall system flexibility and continuous national educative programs.

Also, the collection responsibilities and the capacities in the waste treatment facilities should be determined centrally in order to guarantee national consistency. One option for clarifying the collection responsibilities is to leave the collection of waste generated in high quantities and/or in heterogeneous compositions (in other words, mixed, biodegradable, and combustible waste) on the municipality's responsibility and to transfer the collection of recyclables to the responsibility of producer organisations or private collectors. The collection of household waste can be left to municipalities' responsibility, while commercial and industrial waste producers can have the responsibility of their own waste, a proposal that is already given by a Finnish working group on waste management (see Section 4.2.1).

The redefinition of collection responsibilities causes a breakdown of the monopoly municipalities have had in the collection of municipal waste. The redefinition, combined with the decreasing waste amounts to be disposed of in public landfills affects municipalities' economy by diminished income (Porter 2002, 133-148). On the other hand, it offers possibilities. For example less operation in public landfills causes savings to municipalities, more homogeneous waste streams eases local planning, and resources are released for example to developing more waste producer-friendly practises as indicated by the introduction of weight-based pricing to households (see Section 2.4.2).

6.4 Packaging waste management and the fast food industry

The packaging waste management in the fast food industry can be promoted by redefining the status of commercial waste (see Section 2.4.1), improving the take-back schemes for packaging waste generated at commercial waste producers (see Section 2.1.1), and clarifying the status of the fast food industry (see Section 3.1). These factors are discussed in this section.

Packaging waste is treated as household, commercial, and industrial waste, depending on the disposal location. The management of household waste and industrial waste form harmonic unities, whereas commercial waste management shows unharmony (Table 26). Commercial waste originates from various waste producers, and waste components and their amounts are waste producer -dependent. It is generated at moderate volumes at a moderate number of locations. The possibilities of waste producers to influence the solid waste infrastructure are minor, or moderate in the case of a high volume commercial waste producer.

The requirements of commercial waste on the solid waste infrastructure are moderate, because the waste is handled at the source and collected by a limited number of schemes. Commercial waste producers prefer the collection of mixed waste by private collectors, because of cost reasons, in other words, because the national landfill tax is not charged (see Section 2.4.1). Recoverables are generally collected by private collectors or producer organisations. The commercial waste producers can seldom influence the choice of the collection scheme, especially when the waste is collected as municipal waste. Waste treatment is waste component -dependent. Especially small and medium volume commercial waste producers have minor influence on the choice of the waste treatment options.

The commercial waste producers are mainly bound by local waste regulations, but on the other hand, national legislation binds them, when waste is subject to for example the Extended producer responsibility -principle. Their influence on national planning is minor, but may be high on local planning. Their operations need no operative permits.

The development of packaging waste management is complicated by the inaccurate and/or missing statistics. The obscure status of commercial waste complicates the development further, because a part of packaging waste is treated as commercial waste. For example Section 2.4.1 reveals that Austria produces no commercial waste collected with household waste, while in Finland 60 % of municipal waste originate from commercial waste producers. Except for Finland and Ireland, the share of commercial waste collected with household waste is below 20 %. On the other hand, the EU statistics reveal contradictory data (see Section 2.4.2). The total amount of municipal waste calculated from ‘Treatment

Table 26. Comparison of factors affecting household, commercial, and industrial waste (from Section 2.1.2, Section 2.4.1, and Section 2.4.2).

Factors	Household waste	Commercial waste	Industrial waste
Waste producers			
Number of waste producers	Numerous	Moderate	Limited
Volume per waste producer	Low	Moderate	High/Massive
Waste components per waste producer	Numerous	Limited	Dedicated
Waste producer's possibility to influence	Minor	Minor/moderate	High
Solid waste infrastructure			
Number of handling schemes at the source	Numerous	Limited	Dedicated
Number of collection schemes	Numerous	Limited	Dedicated
Organiser of mixed waste collection	Municipality	Municipality/ private	Own/private/ municipality
Organiser of the collection of recoverables	Municipality/ private/producer organisations	Municipality/ private/producer organisations	Own/private
Influence on the choice of collection scheme	Minor	Minor/moderate	High
Number of waste treatment options	Numerous	Numerous/ Limited	Dedicated
Influence on the choice of waste treatment options	Minor	Minor	High
Location of waste treatment facilities	Scattered	Scattered/ centralised	Centralised
Legislation			
National legislation directly binding	No	No/yes	Yes
Local waste regulations directly binding	Yes	Yes	No
Influence of national planning	Minor	Minor	High
Influence of local planning	High	High	Minor
Need for operative permits	No	No	Yes

of municipal solid waste: latest available year' equals the figures reported in 'Amount of municipal waste in 2002/2001' only in the case of France, Portugal, Greece, Denmark, and Sweden. The calculated figures are 6…14 % lower or higher except for Finnish calculated figure that is 27 % lower than the reported figure. According to the EU statistics of Finland, municipal waste is not recycled, even though an actual share of 29 % is recycled (see Section 4.2.1). Recycling is, however, included in the data on the amount of municipal waste generated by a resident (see Section 2.4.2). Also, the statistics of 'Waste treatment facilities' reveal that there are no landfill sites in Austria, even though a share of 30 % is disposed of in landfills, and that the number of Finnish landfill sites is 359 instead of the actual circa 100 sites (see Section 4.2.2). Data on the packaging waste in the member states was not available on Eurostat.

The inexactness in defining commercial waste is also reflected in the Finnish statistics (see Section 4.2.1). It is impossible to determine the share of commercial waste from the total annual amount of waste. On the other hand, the total amount of packaging waste is reported, but the relations between residential, commercial, and industrial waste producers are not revealed. The same reporting principle concerns hazardous waste, which is, however, justified, because hazardous waste is treated separately from other wastes at a hazardous waste treatment plant.

Commercial waste should be redifined by the EU. The most significant consequence of the redefinition of commercial waste is to raise legislators' interest in commercial waste at national and the EU level. Today, commercial waste is regarded as low volume waste that has mainly been controlled by packaging legislation, but its importance will increase in the future along with the increasing number of service companies.

The redefinition would result in the household, commercial, and industrial wastes forming harmonic unities and equalling the term municipal waste to household waste. The separation of commercial waste from household waste would allow creating commercial waste management practises resembling industrial waste management, aimed at waste producers operating in business. It would give the commercial waste producer the possibility to influence national planning more, to increase the binding level of national legislation, and to decrease that of local regulations. It would also result in improved statistics that could be exploited for development purposes. On the other hand, the

dependence of the national landfill tax on the collector must be removed and weight-based disposal costs introduced in order to promote the recovery of waste generated at commercial waste producers.

The clarification of the term commercial waste producer may be challenging, because these producers range from a one man office to shopping malls, offices, and institutional establishments. The waste generated for example at small offices located at residential establishments can be collected as household waste, while medium and high volume commercial waste producers need to organise their waste management practises. This principle has also been supported by the Finnish working group on waste management (see Section 4.2.2).

The take-back of packaging waste is organised by different schemes in the member states (see Section 2.1.1). The case study indicates that the operation of producer organisations in Finland needs to be developed to promote the recovery of packaging waste. The annual recovery fees to cover the costs of take-back are too low. For example the case company paid recovery fees on cardboard, paperboard, and plastics (see Section 4.2.1) worth of about 13 000 euros, or 150 euros per outlet in 2002, showing a negligible steering effect.

The take-back schemes do not reach all packaging waste. For example the recovery fee on cardboard covered the recovery costs of the cardboard packaging waste that was 100 % recycled in the case company (see Section 5.2). The recovery fee on paperboard did not benefit the case company, because the consumers were unaware that sales packaging waste generated outside the outlets can be collected by the collection scheme offered by the producer organisations and because the producer organisation did not offer a take-back scheme for liquid and paperboard waste generated as commercial waste.

The operation of producer organisations is not customer-oriented. For example, when the case company contacted the producer organisation of plastics and offered the annual amount of 35 tonnes of low density PE plastic waste for recycling, the answer was curt: ‘Look up the recyclers at the home pages and negotiate with them directly.’ Each of the six potential recyclers had different terms and test requirements. At this point, the need for time and effort exceeded the resources in the case company; and consequently, the waste remained non-recovered and was disposed of in landfills.

The customised take-back scheme promotes the recovery of packaging waste. At customised recovery, a waste producer contacts the relevant producer organisation or equivalent that finds internally suitable collection practises and recoverer for this waste producer. Efficient technical collection practises can be supported further by networking with equipment suppliers, who can innovate new solutions based on actual needs of various waste producers. The improved service can be financed by higher recovery fees that intensify the steering effect and motivate packagers to strive for waste reduction more intensively than today. For example the development of the take-back schemes for liquid packaging waste generated at commercial waste producers could be financed by redefining one-way sales packaging manufactured from liquid board. They were defined as 'Fibre-based consumer packaging/wrapping' having an annual recovery fee of 4.50 euros per tonne (vat excluded) in 2002 (see Section 4.2.1). The packaging material is, however, technically identical to 'Liquid packaging' whose recovery fee was higher, 20 euros per tonne.

The recovery of packaging waste in the fast food industry is complicated by the present obscure status of the industry. It resembles food industry from the production point of view, and restaurant and retail sector from the selling and consumption point of view (see Section 3.1). The definition of a fast food company is unclear, because the companies are heterogeneous operators, from internationally operating chains to single hot-dog stands, and operating in highly competed markets. They are generally low profit companies focusing on the lowest possible operative costs and having limited resources in support functions such as marketing, product development, and purchasing to support the business development. For example at one outlet of the case company, local demand for packaging waste recycling resulted in the outlet developing its own sorting practises. The unprofessional practises led to triple-priced disposal, the first disposal cost being the transportation cost of a waste component collected from the outlet to a recovery plant, the second a penalty fee because a waste component was not recovery acceptable, and the third transportation and treatment cost of a waste component transported from the recovery plant to a landfill for disposal.

These factors have hindered the development of the fast food industry. There is no national and international parent organisation or an equivalent scheme to advance the industry's general interests such as the development of schemes for packaging waste

management. For example in the case member state, the fast food companies are members of the Hotel and Restaurant Association offering support mainly on collective agreements. From the operational point of view, the industry can be integrated to the Food and Drink Industries' Federation as a fast food industry branch or have an own parent organisation.

Also, the fast food industry is not integrated to the stakeholders of PYR to manage the packaging waste in Finland (see Section 4.2.1). The share of packaging waste placed on the market by the fast food industry is, however, significant. The results of this study indicate that the share of packaging waste generated by the case company from the total annual amount of packaging waste in Finland is small (0.44 %) (see Section 5.1). The actual amount is, however, higher, because only the packaging of food, food raw materials, and sales packaging were included in the study. For example the children's menu includes toys, whose packaging generates about 100 tonnes of packaging waste annually that was excluded from the calculations of this study. The two main hamburger selling chains operating in the case member state (McDonald's Oy and Hesburger Oy, see Section 4.3) are estimated to produce at least 1 % of the annual packaging waste. The share is, however, neglible in the total annual amount of municipal and solid waste (0.0745 % and 0.00152 %, respectively (see Section 5.1)).

6.5 Conclusions and recommendations

The main research problem of this study was to find out the means of promoting the recovery of packaging waste generated in the fast food industry. The recovery of packaging waste is demanded by legislation and expected by the public. In order to define these means, a literature review and a case study were combined. The conclusions of this research and recommendations for further study are presented in this section.

The existing solid waste infrastructure does not promote the recovery of packaging waste generated in the fast food industry. The theoretical recovery rate of packaging waste generated in the case company is high, 93 %, with only 7 % of sales, primary, and secondary packaging being manufactured from unrecoverable packaging materials (Table 27 and Figure 15). However, it is possible to recover only 29 % of the packaging waste in the existing solid waste infrastructure. The amount of this packaging waste is 564 tonnes and it originates from secondary packaging manufactured from cardboard, disposed of in the kitchen area at the outlets.

The theoretical recovery rate is especially influenced by the fast food industry and the manufacturers of the sales packaging (see Section 6.1). The fast food industry can improve the recoverability of packaging waste for example by limiting the number of different packaging materials and by replacing the packaging manufactured from composites and having low recoverability with alternatives having higher recoverability. The internationally operating fast food industry can improve the recoverability of sales packaging at the national level by introducing sets of sales packaging manufactured from different packaging materials that are chosen on the basis of the national solid waste infrastructure of the daughter companies.

The recoverability of packaging waste can be especially promoted by the manufacturers of sales packaging. Today, the sales opportunities are missed by them, mainly because of traditional salesmanship. The sales potential can be exploited by deeper knowledge of the fast food industry's needs, by proactive sales methods, by packaging with alternative

Table 27. Total amount, amount of actually recovered packaging waste, amount of packaging waste that could be recovered and cannot be recovered, by waste category and component.

Waste category and component	Total amount	Amount of actually recovered packaging waste	Amount of packaging waste that could be recovered	Amount of packaging waste that cannot be recovered
	tonnes	tonnes	tonnes	tonnes
Sales packaging disposed of outside the outlets of which	477	0	410	55
Recoverable packaging waste of which	465	-	-	-
Recyclable (fibre) waste	255	0	253	2
Biodegradable waste	155	0	146	9
Combustible waste	55	0	11	44
Mixed waste	12	-	-	-
Sales packaging disposed of in the dining area of which	755	0	235	514
Recoverable packaging waste of which	749	-	-	-
Recyclable (fibre) waste	429	0	24	405
Biodegradable waste	193	0	185	8
Combustible waste	127	0	25	102
Mixed waste	6	-	-	-
Primary and secondary packaging disposed of in the kitchen area of which	704	564	2.4	14
Recoverable packaging waste of which	580	-	-	-
Recyclable (fibre) waste	570	564	0.4	6
Biodegradable waste	0	0	0	0
Combustible waste	10	0	2	8
Mixed waste	124	-	-	-
Total amount of packaging waste of which	1 937	564	647	583
Recoverable packaging waste of which	1 795	-	-	-
Recyclable (fibre) waste	1 256	564	277	413
Biodegradable waste	348	0	331	17
Combustible waste	191	0	38	154
Mixed waste	142	-	-	-

materials and improved functionality, and by providing the use of decision supporting tools such as customer surveys or pilot marketing for the fast food industry.

The total recovery potential of packaging waste is 64 %, resulting in 1 230 tonnes of recoverable packaging waste that is not currently recovered by the existing solid waste infrastructure. The total recovery potential is a sum of the achievable and the theoretical recovery potential.

The achievable recovery potantial of 33 %, equalling 647 tonnes of packaging waste, could be recovered by the existing solid waste infrastructure, but is not recovered mainly because of non-working waste management practises (see Section 6.2). The sorting experiment in test outlet 1 indicated that it is possible to reach the achievable recovery potential in the existing solid waste infrastructure. The achievable recovery potential is influenced by the collectors. They have an important role in the development of waste producer -oriented waste management practises by understanding the needs of the fast food industry better, by co-operating with municipalities, recoverers, producer organisations, equipment suppliers, and other third parties. The development of pricing principles and weight-based pricing for all medium and high volume commercial waste are preconditions for the achievement of packaging waste recovery targets.

The theoretical recovery potential of 31 %, equalling 583 tonnes of packaging, could not be recovered by the existing solid waste infrastructure. The experiments at test outlets 1 and 2 indicated that it is not possible to reach the theoretical recovery potential. The government as a national policy maker has the most significant influence on the theoretical recovery potential. Consistency with the EU legislation has resulted in clear objectives and targets, whose achievement is, however, threatened by the obscure status of commercial waste (see Section 6.4) and municipal autonomy resulting in inconsistent local waste regulations and solid waste infrastructure (see Section 6.3). The government has the potential to promote the recovery of packaging waste by decreasing the system complexity for example by implementing the already existing common standard for the terminology, introducing colour coding of different waste components, improving the steering effect of the national landfill taxes by higher values, and redefining the commercial waste. It is also recommended that national and international policy makers introduce a national and international systematic procedure to evaluate a waste producer

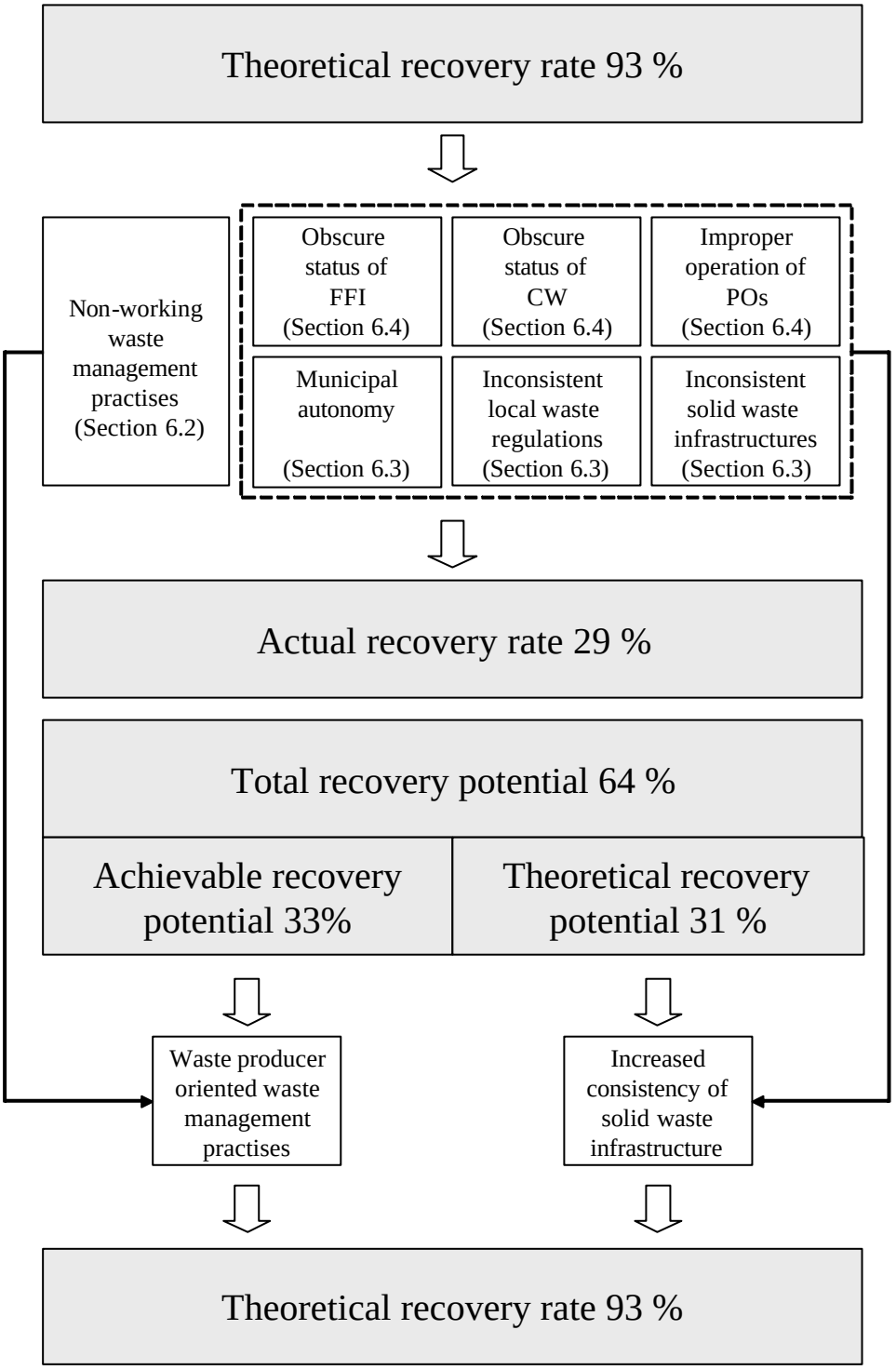

Figure 15. Conclusions of the study. Used abbreviations. FFI - Fast food industry, CW – Commercial waste, PO – Producer organisation

that generates waste differently from the common patterns and to decide when these waste amounts are high enough to be considered in waste management practises. The identification of a new waste producing pattern contributes also to the efficient operation of the take-back schemes offered by the producer organisations.

The recovery of packaging waste in the fast food industry is complicated by the present obscure status. The national and international parent organisation or an equivalent scheme is needed to minister the industry's general interests, such as the development of schemes for packaging waste management (see Section 6.4), because the share of packaging waste placed on the market by the fast food industry is significant. The packaging waste studied in this researh represented 0.44 % of the total annual amount of packaging waste in Finland in 2002 (see Section 5.1).

In general, the recovery of packaging waste can be promoted by changing the focus of waste management from the interests of high volume waste operators, such as collectors (focusing on efficient logistics) and municipalities (focusing on residential waste producers) to operationally easy waste producer-oriented practises that are available for all waste producers regardless of the generated volumes. Even though time is needed for stakeholders to adapt to the required changes, it is important to develop the packaging waste infrastructure actively and constantly. For example the packaging waste practises in the case company were identical in 2002 and in 1997 when the Government Decision on Packaging and Packaging Waste 962/1997 was introduced. The case company can reach the proposed recovery target of 53 % of fibre-based packaging (see Section 4.2.1) only when a take-back scheme for liquid and paperboard waste generated as commercial waste is offered by the producer organisation. The minimum recycling target of plastic packaging (15 %) cannot be reached in the existing solid waste infrastructure.

This study has presented the packaging waste management in the fast food industry in the conditions that existed in 2002. Especially the implementation of the Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the incineration of waste, as well as the recent studies questioning the preference of the Waste Hierarchy in all conditions (see Section 2.4.1) will affect the packaging waste management in the future by increasing the incineration of packaging waste with energy recovery. On the basis of this study, the optimal solution for the packaging waste management in the fast

food industry would combine every preference of the Waste Hierarchy, in other words, the harmonisation of packaging materials for a reduced amount of packaging waste, the recycling of secondary packaging manufactured from cardboard and primary packaging manufactured from plastics (PE), disposal of mixed waste in landfills, and the recovery of remaining waste components as energy for operationally easy waste management practises (Figure 16). The solution would result in the avoidance of 315 tonnes of packaging waste, the recycling of 554 tonnes of fibre and PE plastic waste, and the recovery of 932 tonnes of combustible waste. The amount of packaging waste disposed of in landfills would be only 136 tonnes in comparison to the amount of 1 373 tonnes that was disposed of in landfills in 2002. The solution requires, however, that the consistency of the solid waste infrastructure has been increased by the means discussed above.

This study revealed that not only the solid waste (Lagerkvist 2006) but also the packaging waste has received no major academic interest since the 1990s. The recent academic interest in the fast food industry has mainly focused on the influence of fast food in nutrition (see Section 3.1) and operational principles, such as franchising (for example Lafontaine 1998) and suggestive selling (for example Ebster *et al.* 2006). The packaging waste management of fast food industry has received no academic interest. It was impossible to find any references on studies similar to this one. The study of Mason *et al.* (2004) was the only one in this area, but it focused on the waste generation at one cafeteria located on an Australian university campus selling fast food type products, such as wrapped sandwiches.

This study revealed that the fast food industry offers a number of interesting research topics for different disciplines. The general legislative status of commercial waste, the operative status of medium and small volume commercial waste producers, the criteria to consider a new business sector in legislative work, and the allocation of the fast food industry need further research at international and national level. It is of outmost interest to analyse further the consequences of municipal autonomy on the solid waste infrastructure, the responsibilities of organising waste management principles, the conditions for transparent pricing of waste disposal, and the identification of correct steering capacity of economic instruments at the national level, work that has already been initiated for example in Finland. The legislative recovery targets cannot be met without

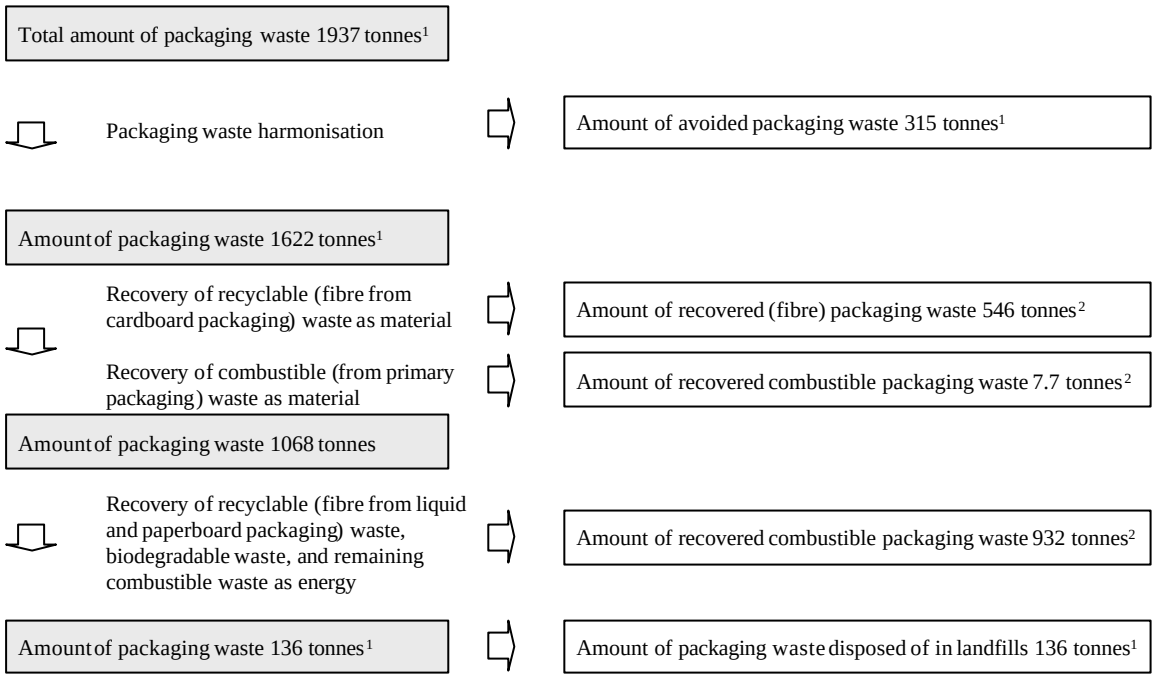

Figure 16. Optimal solution for the packaging waste generated in the fast food industry. [1] From Table 24, [2] From Appendix 7

working waste management practises that offer such research topics as alternative collection methods (cost efficient weighing systems and compactors targeted to light waste generated at low to medium volumes). Finally, consumers' preferences and/or attitudes towards sales packaging in the fast food industry have not been studied academically and offer an interesting topic for further research.

This study has shown the challenges of multidisciplinary research. It was not possible to study each discipline in great detail, and as a consequence the results per discipline verified the already publised results. On the other hand, by combining the results, it is possible to reveal the challenges of today's packaging waste management, especially from the point of view of the fast food industry.

7. Summary

After the Second World War, the western world has experienced rapid and permanent changes that have influenced the society in many different ways, especially by changing the consumption patterns. The increased consumption has irrevocably resulted in the increased waste amounts. A variety of international treaties and agreements have been introduced to restrict the generation of waste. They have been translated to for example the EU environmental legislation that gives the basis for national solid waste infrastructure through national legislation.

A part of waste originates from packaging whose amount has increased mainly because of increased consumption and the one-way characteristics of packaging. The use of packaging has been limited by introducing the Extended producer responsibility – principle through the EU Directive to national legislation. The Principle recognises the packager's (producer's/manufacturer's) role in reducing the environmental impacts of its product throughout the entire life cycle, including waste management. This way, it shifts part, or all, of this responsibility from taxpayers, local authorities, and conventional waste operators to producers, who are required to accept the waste back after the use. The Directive aims at the recovery of packaging waste by setting numeric recovery targets for the packaging waste generated in the member states.

A part of packaging waste is generated by the fast food industry, which has been created to meet the needs of modern eating habits. The packaging waste legislation binds the fast food industry, because it is a packager, packing products to one-way sales packaging and releasing them on the market. The fast food industry also produces packaging waste at production. The recovery of packaging waste is also expected by the public. Practical experiences show that the packaging waste is mostly disposed of in landfills despite of its high recoverability.

The main research problem of this study was to find out the means of promoting the recovery of the packaging waste generated in the fast food industry. In order to define these means, a literature review and a case study were combined. The general factors

influencing the packaging waste management were analysed by a multidisciplinary literature review. It focused on packaging waste legislation controlling the generation and the treatment of packaging waste, packaging materials having a direct influence on the recoverability of packaging waste, waste producers' behaviour contributing directly to such factors as the amount and the quality of sorted waste components, and the existing solid waste infrastructure having an influence on how much of the recoverable packaging waste can be recovered.

The general factors were studied in the fast food industry by a case study. McDonald's Oy operating in Finland was chosen as the case company, because detailed data on their packaging waste management was available for research purposes.

The main research problem was approached through the following three subproblems focusing on the packaging waste generated in the case company presently. The theoretical recovery rate of packaging waste, which illustrates how much of the packaging waste can be recovered, the actual recovery rate of packaging waste, which illustrates how much of the packaging waste is actually recovered by the existing solid waste infrastructure, and the recovery potential of packaging waste, which illustrates how much of the packaging waste could be recovered. The recovery potential is influenced by the waste producers' behaviour, the existing solid waste infrastructure, and the packaging waste legislation.

The research revealed that the existing solid waste infrastructure does not promote the recovery of packaging waste generated in the fast food industry. The theoretical recovery rate of packaging waste generated in the case company is high, 93 %, with only 7 % of sales, primary, and secondary packaging manufactured from unrecoverable packaging materials. However, it was possible to recover only 29 % of the packaging waste in the existing solid waste infrastructure. The amount of this packaging waste was 564 tonnes and it originated from secondary packaging manufactured from cardboard, disposed of in the kitchen area at the outlets. The theoretical recovery rate is especially influenced by the fast food industry that can influence the amount of packaging waste and number of different packaging materials by the choice of packaging. The recoverability of packaging waste can be promoted by the manufacturers of sales packaging. The sales potential can be exploited by deeper knowledge of the fast food industry's needs, by proactive sales methods, by packaging with alternative materials and improved functionality, and by

providing the use of decision supporting tools such as customer surveys or pilot marketing for the fast food industry.

The total recovery potential of packaging waste was 64 %, resulting in 1 230 tonnes of recoverable packaging waste that was not recovered by the existing solid waste infrastructure. The total recovery potential is a sum of the achievable and the theoretical recovery potential.

The achievable recovery potential of 33 %, equalling 647 tonnes of packaging waste could be recovered by the existing solid waste infrastructure, but was not recovered mainly because of non-working waste management practises. The sorting experiment in test outlet 1 indicated that it was possible to reach the achievable recovery potential in the existing solid waste infrastructure. The achievable recovery potential is influenced by the collectors. They have an important role in the development of waste producer -oriented waste management practises for example by the development of pricing principles and weight-based pricing for all medium and high volume commercial waste.

The theoretical recovery potential of 31 %, equalling 583 tonnes of packaging could not be recovered by the existing solid waste infrastructure. The experiments at test outlets 1 and 2 indicated that it was not possible to reach the theoretical recovery potential. The government has the potential to promote the recovery of packaging waste by decreasing the system complexity for example by implementing the already existing common standard for the terminology, introducing colour coding of different waste components, improving the steering effect of the national landfill taxes by higher values, and redefining the commercial waste. It is also recommended that national and international policy makers introduce a national and international systematic procedure to evaluate a waste producer that generates waste differently from the common patterns and to decide when these waste amounts are high enough to be considered in waste management practises. The identification of a new waste producing pattern would contribute also to the efficient operation of take-back schemes offered by the producer organisations.

The recovery of packaging waste in the fast food industry is complicated by the present obscure status. The national and international parent organisation or an equivalent scheme is needed to minister the industry's general interests, such as the development of schemes for packaging waste management, because the share of packaging waste placed on market

by the fast food industry is significant. The packaging waste studied in this researh represented 0.44 % of the total annual amount of packaging waste in Finland in 2002 (see Section 5.1).

In general, the recovery of packaging waste can be promoted by changing the focus of waste management from the interests of high volume waste operators such as collectors (focusing on efficient logistics) and municipalities (focusing on residential waste producers) to operationally easy waste producer-oriented practises that are available for all waste producers regardless of the generated volumes. Even though time is needed for stakeholders to adapt to the required changes, it is important to develop the packaging waste infrastructure actively and constantly. For example the packaging waste practises in the case company were identical in 2002 and in 1997 when the Government Decision on Packaging and Packaging Waste 962/1997 was introduced. The case company can reach the proposed recovery target of 53 % of fibre-based packaging only when a take-back scheme for liquid and paperboard waste generated as commercial waste is offered by the producer organisation. The minimum recycling target of plastic packaging (15 %) cannot be reached in the existing solid waste infrastructure.

This study has presented the packaging waste management in the fast food industry on the conditions that existed in 2002. Especially the implementation of the Directive 00/76/EC of the European Parliament and the Council of 4 December 2000 on the incineration of waste, and the recent studies questioning the preference of the Waste Hierarchy on all conditions will affect the packaging waste management in the future by increasing the incineration of packaging waste with energy recovery. On the basis of this study, the optimal solution for the packaging waste management in the fast food industry would combine every preference of the Waste Hierarchy, in other words, the harmonisation of packaging materials for a reduced amount of packaging waste, the recycling of secondary packaging manufactured from cardboard and primary packaging manufactured from plastics (PE), the disposalof mixed waste in landfills, and the recovery of remaining waste components as energy for operationally easy waste management practises. The solution would result in the avoidance of 315 tonnes of packaging waste, the recycling of 554 tonnes of fibre and PE plastic waste, and the recovery of 932 tonnes of combustible waste. The amount of packaging waste disposed of in landfills would be only 136 tonnes in comparison to the amount of 1 373 tonnes that was disposed of in landfills in 2002. The

solution requires, however, that the consistency of the solid waste infrastructure has been increased by above discussed means.

This study revealed that the packaging waste management of the fast food industry has received no academic interest recently, but it offers a number of interesting research topics for different disciplines. This study indicated the challenges of multidisciplinary research. It was not possible to study each discipline in great detail, and as a consequence the results per discipline verified the already publised results. On the other hand, by combining the results, it is possible to reveal the challenges of today's packaging waste management, especially from the point of view of the fast food industry.

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Appendix 1. Amounts and theoretical recovery rate of packaging waste

A. Total amounts and theoretical recovery rate of packaging waste

	Total annual amount of packaging waste	of which			
		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
	kg	kg	kg	kg	kg
Sales packaging disposed of outside the outlets	477 228	255 487	155 133	54 594	12 014
Sales packaging disposed of in the dining area	755 350	428 956	193 532	126 855	6 007
Primary and secondary packaging diposed of in the kitchen area	704 265	570 473	0	9 825	123 967
Total	1 936 843	1 254 916	348 665	191 275	141 988
of which recyclable packaging waste	1 794 856				
Theoretical recovery rate (%)	93				

B. Sales packaging disposed of outside the outlets

Waste category		Household waste			
Packaging category		Sales			
Disposal location		Outside the outlet			
Packaging material		Paperboard, Liquid board	Paper, Wood	Plastic	Composite
Preferred waste treatment option		Recycling (fibre)	Composting	Energy recovery	Disposal in landfills
Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
1. Sales Packaging - Paperboard					
Sales Packaging -1	IN	-	-	-	-
Sales Packaging -2	IN, OUT	3 038	-	-	-
Sales Packaging -3	IN, OUT	18 191	-	-	-
Sales Packaging -4	IN, OUT	1 395	-	-	-
Sales Packaging -5	IN, OUT	10 106	-	-	-
Sales Packaging -6	IN, OUT	5 512	-	-	-
Sales Packaging -7	IN, OUT	34 056	-	-	-
Sales Packaging -8	IN, OUT	5 587	-	-	-
Sales Packaging -9	IN, OUT	805	-	-	-
Sales Packaging -10	IN, OUT	1 490	-	-	-
Sales Packaging -11	IN, OUT	523	-	-	-
Sales Packaging -12	IN, OUT	5 132	-	-	-
Sales Packaging -13	IN, OUT	176	-	-	-
Sales Packaging -14	OUT	14 113	-	-	-
Sales Packaging -15	OUT	941	-	-	-
Sales Packaging -16	OUT	38 580	-	-	-
Sales Packaging -17	OUT	18 403	-	-	-
Total	17	158 050	0	0	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		16	0	0	0
2. Sales packaging - Liquid board					
Sales packaging -18	IN, OUT	33 649	-	-	-
Sales packaging -19	IN, OUT	17 293	-	-	-
Sales packaging -20	IN, OUT	15 362	-	-	-
Sales packaging -21	IN, OUT	8 281	-	-	-
Sales packaging -22	IN, OUT	6 312	-	-	-
Sales packaging -23	IN, OUT	857	-	-	-
Sales packaging -24	IN, OUT	2 266	-	-	-
Sales packaging -25	IN, OUT	6 495	-	-	-
Sales packaging -26	IN, OUT	272	-	-	-
Sales packaging -27	IN, OUT	3 013	-	-	-
Sales packaging -28	IN, OUT	3 638	-	-	-
Total	11	97 438	0	0	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		11	0	0	0
3. Sales Packaging - Paper					
Sales packaging -29	IN	-	-	-	-
Sales packaging -30	IN, OUT	-	60 214	-	-
Sales packaging -31	IN, OUT	-	288	-	-
Sales packaging -32	IN, OUT	-	1 856	-	-
Sales packaging -33	IN, OUT	-	277	-	-
Sales packaging -34	IN, OUT	-	933	-	-
Sales packaging -35	IN, OUT	-	97	-	-
Sales packaging -36	IN, OUT	-	60	-	-
Sales packaging -37	IN, OUT	-	6	-	-
Sales packaging -38	IN, OUT	-	1 980	-	-
Sales packaging -39	IN, OUT	-	781	-	-
Sales packaging -40	IN, OUT	-	462	-	-
Sales packaging -41	IN, OUT	-	768	-	-
Sales packaging -42	IN, OUT	-	1 624	-	-
Sales packaging -43	IN, OUT	-	441	-	-
Sales packaging -44	IN, OUT	-	2 700	-	-
Sales packaging -45	IN, OUT	-	1 257	-	-

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Sales packaging -46	IN, OUT	-	158	-	-
Sales packaging -47	IN, OUT	-	158	-	-
Sales packaging -48	IN, OUT	-	454	-	-
Sales packaging -49	IN, OUT	-	67	-	-
Sales packaging -50	IN, OUT	-	1 089	-	-
Sales packaging -51	IN, OUT	-	410	-	-
Sales packaging -52	IN, OUT	-	82	-	-
Sales packaging -53	IN, OUT	-	142	-	-
Sales packaging -54	IN, OUT	-	286	-	-
Sales packaging -55	OUT	-	13 206	-	-
Sales packaging -56	OUT	-	32 784	-	-
Sales packaging -57	OUT	-	27 843	-	-
Sales packaging -58	OUT	-	4 379	-	-
Total	30	0	154 803	0	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		0	29	0	0
4. Sales packaging - Wood					
Sales Packaging -59	IN, OUT	-	222	-	-
Sales Packaging -60	IN, OUT	-	109	-	-
Total	2	0	330	0	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		0	2	0	0
5. Sales packaging - Plastics					
Sales packaging -61	IN, OUT	-	-	3 704	-
Sales packaging -62	IN, OUT	-	-	2 471	-
Sales packaging -63	IN, OUT	-	-	1 102	-
Sales packaging -64	IN, OUT	-	-	1 104	-
Sales packaging -65	IN, OUT	-	-	665	-
Sales packaging -66	IN, OUT	-	-	468	-
Sales packaging -67	IN, OUT	-	-	257	-
Sales packaging -68	IN, OUT	-	-	1 129	-
Sales packaging -69	IN, OUT	-	-	4 142	-
Sales packaging -70	IN, OUT	-	-	2 061	-
Sales packaging -71	IN, OUT	-	-	596	-
Sales packaging -72	IN, OUT	-	-	36 025	-
Sales packaging -73	IN, OUT	-	-	146	-
Sales packaging -74	OUT	-	-	497	-
Sales packaging -75	OUT	-	-	227	-
Total	15	0	0	54 594	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		0	0	15	0
6. Sales packagaing - Composites					
Sales packaging -76	IN	-	-	-	85
Sales packaging -77	IN, OUT	-	-	-	90
Sales packaging -78	IN, OUT	-	-	-	57
Sales packaging -79	IN, OUT	-	-	-	350
Sales packaging -80	IN, OUT	-	-	-	1 049
Sales packaging -81	IN, OUT	-	-	-	108
Sales packaging -82	IN, OUT	-	-	-	125
Sales packaging -83	IN, OUT	-	-	-	140
Sales packaging -84	IN, OUT	-	-	-	46
Sales packaging -85	IN, OUT	-	-	-	75
Sales packaging -86	IN, OUT	-	-	-	74
Sales packaging -87	IN, OUT	-	-	-	142
Sales packaging -88	IN, OUT	-	-	-	52
Sales packaging -89	IN, OUT	-	-	-	101
Sales packaging -90	IN, OUT	-	-	-	81
Sales packaging -91	OUT	-	-	-	9 439
Total	16	0	0	0	12 014
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		0	0	0	16

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
7. Food raw materials					
Raw material -1	IN	-	-	-	-
Raw material -2	IN	-	-	-	-
Raw material -3	IN	-	-	-	-
Raw material -4	IN	-	-	-	-
Raw material -5	IN	-	-	-	-
Raw material -6	IN	-	-	-	-
Raw material -7	IN	-	-	-	-
Raw material -8	IN	-	-	-	-
Raw material -9	IN	-	-	-	-
Raw material -10	IN	-	-	-	-
Raw material -11	IN	-	-	-	-
Raw material -12	IN	-	-	-	-
Raw material -13	IN	-	-	-	-
Raw material -14	IN	-	-	-	-
Raw material -15	IN	-	-	-	-
Raw material -16	IN	-	-	-	-
Raw material -17	IN	-	-	-	-
Raw material -18	IN	-	-	-	-
Raw material -19	IN	-	-	-	-
Raw material -20	IN	-	-	-	-
Raw material -21	IN	-	-	-	-
Raw material -22	IN	-	-	-	-
Raw material -23	IN	-	-	-	-
Raw material -24	IN	-	-	-	-
Raw material -25	IN	-	-	-	-
Raw material -26	IN	-	-	-	-
Raw material -27	IN	-	-	-	-
Raw material -28	IN	-	-	-	-
Raw material -29	IN	-	-	-	-
Raw material -30	IN	-	-	-	-
Raw material -31	IN	-	-	-	-
Raw material -32	IN	-	-	-	-
Raw material -33	IN	-	-	-	-
Raw material -34	IN	-	-	-	-
Raw material -35	IN	-	-	-	-
Raw material -36	IN	-	-	-	-
Raw material -37	IN	-	-	-	-
Raw material -38	IN	-	-	-	-
Raw material -39	IN	-	-	-	-
Raw material -40	IN	-	-	-	-
Raw material -41	IN	-	-	-	-
Raw material -42	IN	-	-	-	-
Raw material -43	IN	-	-	-	-
Raw material -44	IN	-	-	-	-
Raw material -45	IN	-	-	-	-
Raw material -46	IN	-	-	-	-
Raw material -47	IN	-	-	-	-
Raw material -48	IN	-	-	-	-
Raw material -49	IN	-	-	-	-
Raw material -50	IN	-	-	-	-
Raw material -51	IN	-	-	-	-
Raw material -52	IN	-	-	-	-
Raw material -53	IN	-	-	-	-
Raw material -54	IN	-	-	-	-
Raw material -55	IN	-	-	-	-
Raw material -56	IN	-	-	-	-
Raw material -57	IN	-	-	-	-
Raw material -58	IN	-	-	-	-
Raw material -59	IN	-	-	-	-
Raw material -60	IN	-	-	-	-
Raw material -61	IN	-	-	-	-
Raw material -62	IN	-	-	-	-
Raw material -63	IN	-	-	-	-
Raw material -64	IN	-	-	-	-
Raw material -65	IN	-	-	-	-
Raw material -66	IN	-	-	-	-

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Raw material -67	IN	-	-	-	-
Raw material -68	IN	-	-	-	-
Raw material -69	IN	-	-	-	-
Raw material -70	IN	-	-	-	-
Raw material -71	IN	-	-	-	-
Raw material -72	IN	-	-	-	-
Raw material -73	IN	-	-	-	-
Raw material -74	IN	-	-	-	-
Raw material -75	IN	-	-	-	-
Raw material -76	IN	-	-	-	-
Raw material -77	IN	-	-	-	-
Raw material -78	IN	-	-	-	-
Raw material -79	IN	-	-	-	-
Raw material -80	IN	-	-	-	-
Raw material -81	IN	-	-	-	-
Raw material -82	IN	-	-	-	-
Raw material -83	IN	-	-	-	-
Raw material -84	IN	-	-	-	-
Raw material -85	IN	-	-	-	-
Raw material -86	IN	-	-	-	-
Raw material -87	IN	-	-	-	-
Raw material -88	IN	-	-	-	-
Raw material -89	IN	-	-	-	-
Raw material -90	IN	-	-	-	-
Raw material -91	IN	-	-	-	-
Raw material -92	IN	-	-	-	-
Raw material -93	IN	-	-	-	-
Raw material -94	IN	-	-	-	-
Raw material -95	IN	-	-	-	-
Raw material -96	IN	-	-	-	-
Raw material -97	IN	-	-	-	-
Raw material -98	IN	-	-	-	-
Raw material -99	IN	-	-	-	-
Raw material -100	IN	-	-	-	-
Raw material -101	IN	-	-	-	-
Raw material -102	IN	-	-	-	-
Raw material -103	IN	-	-	-	-
Raw material -104	IN	-	-	-	-
Raw material -105	IN	-	-	-	-
Raw material -106	IN	-	-	-	-
Total	106	0	0	0	0
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		0	0	0	0
TOTAL (1-7)	197	255 487	155 133	54 594	12 014
Number of packaging items (IN)		-	-	-	-
Number of packaging items (OUT)		27	31	15	16
[1] IN - Packaging disposed of at the outlets					
OUT - Packaging disposed of outside the outlets					

C. Sales packaging disposed of in the dining area

Waste category		Commercial/industrial waste			
Packaging category		Sales			
Disposal location		Dining area			
Packaging material		Paperboard, Liquid board	Paper, Wood	Plastic	Composite
Preferred waste treatment option		Recycling (fibre)	Composting	Energy recovery	Disposal in landfills
Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
1. Sales Packaging - Paperboard					
Sales Packaging -1	IN	907	-	-	-
Sales Packaging -2	IN, OUT	7 088	-	-	-
Sales Packaging -3	IN, OUT	42 446	-	-	-
Sales Packaging -4	IN, OUT	3 256	-	-	-
Sales Packaging -5	IN, OUT	23 581	-	-	-
Sales Packaging -6	IN, OUT	12 862	-	-	-
Sales Packaging -7	IN, OUT	79 464	-	-	-
Sales Packaging -8	IN, OUT	13 037	-	-	-
Sales Packaging -9	IN, OUT	1 878	-	-	-
Sales Packaging -10	IN, OUT	3 476	-	-	-
Sales Packaging -11	IN, OUT	1 220	-	-	-
Sales Packaging -12	IN, OUT	11 975	-	-	-
Sales Packaging -13	IN, OUT	412	-	-	-
Sales Packaging -14	OUT	-	-	-	-
Sales Packaging -15	OUT	-	-	-	-
Sales Packaging -16	OUT	-	-	-	-
Sales Packaging -17	OUT	-	-	-	-
Total	17	201 601	0	0	0
Number of packaging items (IN)		13	0	0	0
Number of packaging items (OUT)		-	-	-	-
2. Sales packaging - Liquid board					
Sales packaging -18	IN, OUT	78 515	-	-	-
Sales packaging -19	IN, OUT	40 350	-	-	-
Sales packaging -20	IN, OUT	35 845	-	-	-
Sales packaging -21	IN, OUT	19 323	-	-	-
Sales packaging -22	IN, OUT	14 727	-	-	-
Sales packaging -23	IN, OUT	1 999	-	-	-
Sales packaging -24	IN, OUT	5 286	-	-	-
Sales packaging -25	IN, OUT	15 155	-	-	-
Sales packaging -26	IN, OUT	634	-	-	-
Sales packaging -27	IN, OUT	7 029	-	-	-
Sales packaging -28	IN, OUT	8 490	-	-	-
Total	11	227 354	0	0	0
Number of packaging items (IN)		11	0	0	0
Number of packaging items (OUT)		-	-	-	-
3. Sales Packaging - Paper					
Sales packaging -29	IN	-	13 589	-	-
Sales packaging -30	IN, OUT	-	140 500	-	-
Sales packaging -31	IN, OUT	-	671	-	-
Sales packaging -32	IN, OUT	-	4 331	-	-
Sales packaging -33	IN, OUT	-	647	-	-
Sales packaging -34	IN, OUT	-	2 177	-	-
Sales packaging -35	IN, OUT	-	227	-	-
Sales packaging -36	IN, OUT	-	140	-	-
Sales packaging -37	IN, OUT	-	13	-	-
Sales packaging -38	IN, OUT	-	4 620	-	-
Sales packaging -39	IN, OUT	-	1 823	-	-
Sales packaging -40	IN, OUT	-	1 078	-	-
Sales packaging -41	IN, OUT	-	1 791	-	-
Sales packaging -42	IN, OUT	-	3 788	-	-
Sales packaging -43	IN, OUT	-	1 029	-	-
Sales packaging -44	IN, OUT	-	6 300	-	-
Sales packaging -45	IN, OUT	-	2 933	-	-

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Sales packaging -46	IN, OUT	-	370	-	-
Sales packaging -47	IN, OUT	-	370	-	-
Sales packaging -48	IN, OUT	-	1 058	-	-
Sales packaging -49	IN, OUT	-	156	-	-
Sales packaging -50	IN, OUT	-	2 540	-	-
Sales packaging -51	IN, OUT	-	958	-	-
Sales packaging -52	IN, OUT	-	191	-	-
Sales packaging -53	IN, OUT	-	544	-	-
Sales packaging -54	IN, OUT	-	917	-	-
Sales packaging -55	OUT	-	-	-	-
Sales packaging -56	OUT	-	-	-	-
Sales packaging -57	OUT	-	-	-	-
Sales packaging -58	OUT	-	-	-	-
Total	30	0	192 762	0	0
Number of packaging items (IN)		0	26	0	0
Number of packaging items (OUT)		-	-	-	-
4. Sales packaging - Wood					
Sales Packaging -59	IN, OUT	-	517	-	-
Sales Packaging -60	IN, OUT	-	253	-	-
Total	2	0	770	0	0
Number of packaging items (IN)		0	2	0	0
Number of packaging items (OUT)		-	-	-	-
5. Sales packaging - Plastics					
Sales packaging -61	IN, OUT	-	-	8 643	-
Sales packaging -62	IN, OUT	-	-	5 765	-
Sales packaging -63	IN, OUT	-	-	2 572	-
Sales packaging -64	IN, OUT	-	-	2 577	-
Sales packaging -65	IN, OUT	-	-	1 552	-
Sales packaging -66	IN, OUT	-	-	1 092	-
Sales packaging -67	IN, OUT	-	-	599	-
Sales packaging -68	IN, OUT	-	-	2 634	-
Sales packaging -69	IN, OUT	-	-	9 664	-
Sales packaging -70	IN, OUT	-	-	4 808	-
Sales packaging -71	IN, OUT	-	-	1 391	-
Sales packaging -72	IN, OUT	-	-	84 057	-
Sales packaging -73	IN, OUT	-	-	341	-
Sales packaging -74	OUT	-	-	1 159	-
Sales packaging -75	OUT	-	-	-	-
Total	15	0	0	126 855	0
Number of packaging items (IN)		0	0	14	0
Number of packaging items (OUT)		-	-	-	-
6. Sales packagaing - Composites					
Sales packaging -76	IN	-	-	-	198
Sales packaging -77	IN, OUT	-	-	-	210
Sales packaging -78	IN, OUT	-	-	-	134
Sales packaging -79	IN, OUT	-	-	-	818
Sales packaging -80	IN, OUT	-	-	-	2 447
Sales packaging -81	IN, OUT	-	-	-	252
Sales packaging -82	IN, OUT	-	-	-	291
Sales packaging -83	IN, OUT	-	-	-	327
Sales packaging -84	IN, OUT	-	-	-	107
Sales packaging -85	IN, OUT	-	-	-	174
Sales packaging -86	IN, OUT	-	-	-	172
Sales packaging -87	IN, OUT	-	-	-	330
Sales packaging -88	IN, OUT	-	-	-	122
Sales packaging -89	IN, OUT	-	-	-	235
Sales packaging -90	IN, OUT	-	-	-	189
Sales packaging -91	OUT	-	-	-	-
Total	16	0	0	0	6 007
Number of packaging items (IN)		0	0	0	15
Number of packaging items (OUT)		-	-	-	-

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount kg	Annual amount kg	Annual amount kg	Annual amount kg
7. Food raw materials					
Raw material -1	IN	-	-	-	-
Raw material -2	IN	-	-	-	-
Raw material -3	IN	-	-	-	-
Raw material -4	IN	-	-	-	-
Raw material -5	IN	-	-	-	-
Raw material -6	IN	-	-	-	-
Raw material -7	IN	-	-	-	-
Raw material -8	IN	-	-	-	-
Raw material -9	IN	-	-	-	-
Raw material -10	IN	-	-	-	-
Raw material -11	IN	-	-	-	-
Raw material -12	IN	-	-	-	-
Raw material -13	IN	-	-	-	-
Raw material -14	IN	-	-	-	-
Raw material -15	IN	-	-	-	-
Raw material -16	IN	-	-	-	-
Raw material -17	IN	-	-	-	-
Raw material -18	IN	-	-	-	-
Raw material -19	IN	-	-	-	-
Raw material -20	IN	-	-	-	-
Raw material -21	IN	-	-	-	-
Raw material -22	IN	-	-	-	-
Raw material -23	IN	-	-	-	-
Raw material -24	IN	-	-	-	-
Raw material -25	IN	-	-	-	-
Raw material -26	IN	-	-	-	-
Raw material -27	IN	-	-	-	-
Raw material -28	IN	-	-	-	-
Raw material -29	IN	-	-	-	-
Raw material -30	IN	-	-	-	-
Raw material -31	IN	-	-	-	-
Raw material -32	IN	-	-	-	-
Raw material -33	IN	-	-	-	-
Raw material -34	IN	-	-	-	-
Raw material -35	IN	-	-	-	-
Raw material -36	IN	-	-	-	-
Raw material -37	IN	-	-	-	-
Raw material -38	IN	-	-	-	-
Raw material -39	IN	-	-	-	-
Raw material -40	IN	-	-	-	-
Raw material -41	IN	-	-	-	-
Raw material -42	IN	-	-	-	-
Raw material -43	IN	-	-	-	-
Raw material -44	IN	-	-	-	-
Raw material -45	IN	-	-	-	-
Raw material -46	IN	-	-	-	-
Raw material -47	IN	-	-	-	-
Raw material -48	IN	-	-	-	-
Raw material -49	IN	-	-	-	-
Raw material -50	IN	-	-	-	-
Raw material -51	IN	-	-	-	-
Raw material -52	IN	-	-	-	-
Raw material -53	IN	-	-	-	-
Raw material -54	IN	-	-	-	-
Raw material -55	IN	-	-	-	-
Raw material -56	IN	-	-	-	-
Raw material -57	IN	-	-	-	-
Raw material -58	IN	-	-	-	-
Raw material -59	IN	-	-	-	-
Raw material -60	IN	-	-	-	-
Raw material -61	IN	-	-	-	-
Raw material -62	IN	-	-	-	-
Raw material -63	IN	-	-	-	-
Raw material -64	IN	-	-	-	-
Raw material -65	IN	-	-	-	-
Raw material -66	IN	-	-	-	-

Waste component		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Raw material -67	IN	-	-	-	-
Raw material -68	IN	-	-	-	-
Raw material -69	IN	-	-	-	-
Raw material -70	IN	-	-	-	-
Raw material -71	IN	-	-	-	-
Raw material -72	IN	-	-	-	-
Raw material -73	IN	-	-	-	-
Raw material -74	IN	-	-	-	-
Raw material -75	IN	-	-	-	-
Raw material -76	IN	-	-	-	-
Raw material -77	IN	-	-	-	-
Raw material -78	IN	-	-	-	-
Raw material -79	IN	-	-	-	-
Raw material -80	IN	-	-	-	-
Raw material -81	IN	-	-	-	-
Raw material -82	IN	-	-	-	-
Raw material -83	IN	-	-	-	-
Raw material -84	IN	-	-	-	-
Raw material -85	IN	-	-	-	-
Raw material -86	IN	-	-	-	-
Raw material -87	IN	-	-	-	-
Raw material -88	IN	-	-	-	-
Raw material -89	IN	-	-	-	-
Raw material -90	IN	-	-	-	-
Raw material -91	IN	-	-	-	-
Raw material -92	IN	-	-	-	-
Raw material -93	IN	-	-	-	-
Raw material -94	IN	-	-	-	-
Raw material -95	IN	-	-	-	-
Raw material -96	IN	-	-	-	-
Raw material -97	IN	-	-	-	-
Raw material -98	IN	-	-	-	-
Raw material -99	IN	-	-	-	-
Raw material -100	IN	-	-	-	-
Raw material -101	IN	-	-	-	-
Raw material -102	IN	-	-	-	-
Raw material -103	IN	-	-	-	-
Raw material -104	IN	-	-	-	-
Raw material -105	IN	-	-	-	-
Raw material -106	IN	-	-	-	-
Total	106	0	0	0	0
Number of packaging items (IN)		0	0	0	0
Number of packaging items (OUT)		-	-	-	-
TOTAL (1-7)	197	428 956	193 532	126 855	6 007
Number of packaging items (IN)		24	28	14	15
Number of packaging items (OUT)		-	-	-	-
[1] IN - Packaging disposed of at the outlets					
OUT - Packaging disposed of outside the outlets					

D. Primary and secondary packaging disposed of in the kitchen area

Waste category	Commercial/industrial waste				
Packaging category		Secondary	Primary		
Packaging material		Cardboard	Liquid board	Plastic	Composite
Preferred waste treatment option		Recycling (fibre)	Recycling (fibre)	Energy recovery	Disposal in landfills
Waste component		Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
1. Sales Packaging - Paperboard					
Sales Packaging -1	IN	58	-	17	-
Sales Packaging -2	IN, OUT	3 167	-	175	-
Sales Packaging -3	IN, OUT	3 339	-	-	-
Sales Packaging -4	IN, OUT	274	-	-	-
Sales Packaging -5	IN, OUT	1 589	-	-	-
Sales Packaging -6	IN, OUT	1 109	-	-	-
Sales Packaging -7	IN, OUT	11 825	-	1 348	-
Sales Packaging -8	IN, OUT	1 940	-	221	-
Sales Packaging -9	IN, OUT	187	-	-	-
Sales Packaging -10	IN, OUT	229	-	-	-
Sales Packaging -11	IN, OUT	80	-	-	-
Sales Packaging -12	IN, OUT	1 489	-	190	-
Sales Packaging -13	IN, OUT	19	-	-	-
Sales Packaging -14	OUT	979	-	-	-
Sales Packaging -15	OUT	65	-	-	-
Sales Packaging -16	OUT	2 616	-	-	-
Sales Packaging -17	OUT	1 545	-	-	-
Total	17	30 510	0	1 951	0
Number of packaging items (IN)		17	0	5	0
Number of packaging items (OUT)		-	-	-	-
2. Sales packaging - Liquid board					
Sales packaging -18	IN, OUT	10 785	-	1 510	-
Sales packaging -19	IN, OUT	4 010	-	501	-
Sales packaging -20	IN, OUT	4 300	-	630	-
Sales packaging -21	IN, OUT	3 011	-	435	-
Sales packaging -22	IN, OUT	2 135	-	-	-
Sales packaging -23	IN, OUT	269	-	40	-
Sales packaging -24	IN, OUT	646	-	90	-
Sales packaging -25	IN, OUT	1 998	-	301	-
Sales packaging -26	IN, OUT	80	-	15	-
Sales packaging -27	IN, OUT	1 018	-	217	-
Sales packaging -28	IN, OUT	1 448	-	236	-
Total	11	29 701	0	3 975	0
Number of packaging items (IN)		11	0	10	0
Number of packaging items (OUT)		-	-	-	-
3. Sales Packaging - Paper					
Sales packaging -29	IN	1 738	-	-	-
Sales packaging -30	IN, OUT	15 180	-	-	-
Sales packaging -31	IN, OUT	30	-	-	-
Sales packaging -32	IN, OUT	619	-	-	-
Sales packaging -33	IN, OUT	37	-	3	-
Sales packaging -34	IN, OUT	95	-	-	-
Sales packaging -35	IN, OUT	15	-	2	-
Sales packaging -36	IN, OUT	24	-	-	-
Sales packaging -37	IN, OUT	77	-	12	-
Sales packaging -38	IN, OUT	163	-	28	-
Sales packaging -39	IN, OUT	28	-	12	-
Sales packaging -40	IN, OUT	33	-	6	-
Sales packaging -41	IN, OUT	78	-	7	-
Sales packaging -42	IN, OUT	147	-	22	-
Sales packaging -43	IN, OUT	39	-	6	-
Sales packaging -44	IN, OUT	223	-	39	-
Sales packaging -45	IN, OUT	137	-	8	-

Waste component		Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location1	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Sales packaging -46	IN, OUT	13	-	3	-
Sales packaging -47	IN, OUT	13	-	3	-
Sales packaging -48	IN, OUT	55	-	8	-
Sales packaging -49	IN, OUT	20	-	7	-
Sales packaging -50	IN, OUT	1 028	-	932	-
Sales packaging -51	IN, OUT	388	-	352	-
Sales packaging -52	IN, OUT	370	-	-	-
Sales packaging -53	IN, OUT	117	-	1	-
Sales packaging -54	IN, OUT	159	-	1	-
Sales packaging -55	OUT	-	-	311	-
Sales packaging -56	OUT	300	-	-	-
Sales packaging -57	OUT	283	-	-	-
Sales packaging -58	OUT	62	-	-	-
Total	30	21 469	0	1 763	0
Number of packaging items (IN)		29	0	20	0
Number of packaging items (OUT)		-	-	-	-
4. Sales packaging - Wood					
Sales Packaging -59	IN, OUT	71	-	-	-
Sales Packaging -60	IN, OUT	18	-	-	-
Total	2	90	0	0	0
Number of packaging items (IN)		2	0	0	0
Number of packaging items (OUT)		-	-	-	-
5. Sales packaging - Plastics					
Sales packaging -61	IN, OUT	2 260	-	726	-
Sales packaging -62	IN, OUT	1 586	-	549	-
Sales packaging -63	IN, OUT	760	-	127	-
Sales packaging -64	IN, OUT	765	-	113	-
Sales packaging -65	IN, OUT	356	-	48	-
Sales packaging -66	IN, OUT	405	-	23	-
Sales packaging -67	IN, OUT	285	-	34	-
Sales packaging -68	IN, OUT	552	-	93	-
Sales packaging -69	IN, OUT	1 833	-	278	-
Sales packaging -70	IN, OUT	1 145	-	84	-
Sales packaging -71	IN, OUT	249	-	38	-
Sales packaging -72	IN, OUT	-	-	-	-
Sales packaging -73	IN, OUT	112	-	-	-
Sales packaging -74	OUT	192	-	24	-
Sales packaging -75	OUT	48	-	-	-
Total	15	10 547	0	2 136	0
Number of packaging items (IN)		14	0	12	0
Number of packaging items (OUT)		-	-	-	-
6. Sales packagaing - Composites					
Sales packaging -76	IN	584	-	-	-
Sales packaging -77	IN, OUT	435	-	-	-
Sales packaging -78	IN, OUT	277	-	-	-
Sales packaging -79	IN, OUT	1 695	-	-	-
Sales packaging -80	IN, OUT	-	-	-	-
Sales packaging -81	IN, OUT	338	-	-	-
Sales packaging -82	IN, OUT	443	-	-	-
Sales packaging -83	IN, OUT	498	-	-	-
Sales packaging -84	IN, OUT	168	-	-	-
Sales packaging -85	IN, OUT	265	-	-	-
Sales packaging -86	IN, OUT	196	-	-	-
Sales packaging -87	IN, OUT	378	-	-	-
Sales packaging -88	IN, OUT	140	-	-	-
Sales packaging -89	IN, OUT	268	-	-	-
Sales packaging -90	IN, OUT	280	-	-	-
Sales packaging -91	OUT	6 443	-	-	-
Total	16	12 409	0	0	0
Number of packaging items (IN)		15	0	0	0
Number of packaging items (OUT)		-	-	-	-

Waste component		Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location1	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
7. Food raw materials					
Raw material -1	IN	1 346	-	-	888
Raw material -2	IN	686	-	-	453
Raw material -3	IN	901	-	-	743
Raw material -4	IN	3 624	-	-	253
Raw material -5	IN	1 779	-	-	324
Raw material -6	IN	2 003	-	-	365
Raw material -7	IN	442	-	-	35
Raw material -8	IN	2 706	-	-	4 747
Raw material -9	IN	4 358	-	-	1 406
Raw material -10	IN	123 535	-	-	17 648
Raw material -11	IN	1 037	-	-	79
Raw material -12	IN	17 344	-	-	697
Raw material -13	IN	1 094	-	-	44
Raw material -14	IN	6 868	-	-	276
Raw material -15	IN	49 669	-	-	2 152
Raw material -16	IN	4 237	-	-	1 206
Raw material -17	IN	838	-	-	226
Raw material -18	IN	28	-	-	35
Raw material -19	IN	375	-	-	16
Raw material -20	IN	1 389	-	-	88
Raw material -21	IN	1 221	-	-	78
Raw material -22	IN	321	-	-	20
Raw material -23	IN	349	-	-	191
Raw material -24	IN	177	-	-	77
Raw material -25	IN	743	-	-	162
Raw material -26	IN	960	-	-	1 284
Raw material -27	IN	235	-	-	129
Raw material -28	IN	839	-	-	459
Raw material -29	IN	190	-	-	42
Raw material -30	IN	320	-	-	22
Raw material -31	IN	862	-	-	246
Raw material -32	IN	-	-	-	334
Raw material -33	IN	48	-	-	10
Raw material -34	IN	69	-	-	13
Raw material -35	IN	19 973	-	-	2 189
Raw material -36	IN	189	-	-	175
Raw material -37	IN	2 519	-	-	3 887
Raw material -38	IN	3 695	-	-	6 840
Raw material -39	IN	448	-	-	727
Raw material -40	IN	199	-	-	324
Raw material -41	IN	71	-	-	109
Raw material -42	IN	101	-	-	166
Raw material -43	IN	2 393	-	-	3 509
Raw material -44	IN	277	-	-	213
Raw material -45	IN	289	-	-	100
Raw material -46	IN	1 379	-	-	1 061
Raw material -47	IN	20 675	-	-	4 465
Raw material -48	IN	5 494	-	-	1 186
Raw material -49	IN	7 003	-	-	1 512
Raw material -50	IN	2 357	-	-	509
Raw material -51	IN	1 549	-	-	550
Raw material -52	IN	10 986	-	-	2 961
Raw material -53	IN	11 495	-	-	3 099
Raw material -54	IN	15 308	-	-	1 036
Raw material -55	IN	131	-	-	15
Raw material -56	IN	14 160	-	-	4 800
Raw material -57	IN	458	-	-	117
Raw material -58	IN	3 704	-	-	1 411
Raw material -59	IN	608	-	-	51
Raw material -60	IN	2 093	-	-	1 177
Raw material -61	IN	27 080	-	-	4 452
Raw material -62	IN	37 191	-	-	10 740
Raw material -63	IN	1 053	-	-	328
Raw material -64	IN	108	-	-	34
Raw material -65	IN	2 648	-	-	2 212
Raw material -66	IN	66	-	-	55

Waste component		Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Annual amount	Annual amount	Annual amount	Annual amount
		kg	kg	kg	kg
Raw material -67	IN	1 210	-	-	415
Raw material -68	IN	689	-	-	236
Raw material -69	IN	974	-	-	334
Raw material -70	IN	7 193	-	-	1 744
Raw material -71	IN	6 518	-	-	2 717
Raw material -72	IN	26	-	-	10
Raw material -73	IN	229	-	-	101
Raw material -74	IN	65	-	-	29
Raw material -75	IN	5 237	-	-	1 348
Raw material -76	IN	1 033	-	-	243
Raw material -77	IN	119	-	-	232
Raw material -78	IN	169	-	-	42
Raw material -79	IN	133	-	-	34
Raw material -80	IN	507	-	-	14
Raw material -81	IN	59	-	-	860
Raw material -82	IN	1 122	-	-	495
Raw material -83	IN	588	-	-	259
Raw material -84	IN	343	-	-	151
Raw material -85	IN	654	-	-	206
Raw material -86	IN	1 989	-	-	966
Raw material -87	IN	681	-	-	-
Raw material -88	IN	1	-	-	-
Raw material -89	IN	3 056	-	-	718
Raw material -90	IN	53	151	-	-
Raw material -91	IN	-	203	-	-
Raw material -92	IN	-	2 483	-	-
Raw material -93	IN	-	3 967	-	-
Raw material -94	IN	-	-	-	189
Raw material -95	IN	-	-	-	863
Raw material -96	IN	-	-	-	12
Raw material -97	IN	-	-	-	2
Raw material -98	IN	-	-	-	139
Raw material -99	IN	-	-	-	5 109
Raw material -100	IN	-	-	-	6 802
Raw material -101	IN	-	-	-	1 216
Raw material -102	IN	-	-	-	157
Raw material -103	IN	-	-	-	3 328
Raw material -104	IN	-	-	-	211
Raw material -105	IN	-	-	-	16
Raw material -106	IN	-	-	-	13
Total	106	458 942	6 805	0	123 967
Number of packaging items (IN)		89	4	0	100
Number of packaging items (OUT)		-	-	-	-
TOTAL (1-7)	197	563 668	6 805	9 825	123 967
Number of packaging items (IN)		177	4	47	100
Number of packaging items (OUT)		-	-	-	-
[1] IN - Packaging disposed of at the outlets					
OUT - Packaging disposed of outside the outlets					

Appendix 2. Solid waste infrastructure in the 37 case municipalities

A. Mandatory and voluntary collection of waste components generated as household and commercial waste

	Waste components whose collection is[1] mandatory on the basis of local waste regulations										organised by a PO	
	cardboard waste		liquid board waste		biodegradable waste		combustible waste		mixed waste		liquid board waste	
	HW	CW	HW	CW	HW	CW	HW	CW	HW	CW	HW	CW
Municipality -1	0	1	0	0	0	0	0	0	1	1	1	0
Municipality -2	0	1	0	0	0	1	0	0	1	1	1	0
Municipality -3	0	1	0	0	0	0	0	0	1	1	1	0
Municipality -4	0	1	0	0	1	1	0	0	1	1	0	0
Municipality -5	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -6	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -7	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -8	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -9	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -10	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -11	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -12	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -13	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -14	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -15	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -16	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -17	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -18	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -19	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -20	0	1	0	0	1	1	0	0	1	1	1	0
Municipality -21	0	1	1	0	1	1	0	0	1	1	0	0
Municipality -22	0	1	1	1	1	1	0	0	1	1	0	0
Municipality -23	0	1	1	0	1	1	0	0	1	1	0	0
Municipality -24	0	1	1	1	1	1	0	0	1	1	0	0
Municipality -25	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -26	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -27	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -28	0	1	1	0	1	1	1	1	1	1	0	0
Municipality -29	0	1	1	0	1	1	1	1	1	1	0	0
Municipality -30	0	1	1	0	1	1	1	1	1	1	0	0
Municipality -31[2]	0	1	1	1	1	1	1	1	1	1	0	0
Municipality -32[3]	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -33[3]	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -34[3]	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -35[4]	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -36[4]	0	1	0	0	1	1	1	1	1	1	1	0
Municipality -37[5]	0	1	0	0	1	1	1	1	1	1	1	0
TOTAL	0	37	8	3	34	35	13	13	37	37	28	0

[1] PO - Producer organisation. HW - Household waste. CW - Commercial waste. 1 - Mandatory collection regardless of the limitations in the number of households per property or weekly waste amounts. The data is based on local waste regulations at each municipality in October 2002.
The data was collected from the local waste regulations available at the municipalities' homepages, from printed regulations and from PO's homepage.

[2] Combustible waste refers to plastic packaging.

[3] Combustible and mixed household waste are collected together and separated later at a separation facility.

[4] Combustible and mixed household and commercial waste are collected together and recovered as energy.

[5] Biodegradable and packaging household and commercial waste are collected together and recovered as energy.

B. Terminology and definition (in Finnish) of waste components

i. Waste (jäte) and municipal solid waste (yhdyskuntajäte)

Municipality	Waste components and their definitions[1]	
	Jäte/Waste	Yhdyskuntajäte/Municipal waste
Municipality -1		
Municipality -2		YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte, ei kuitenkaan ongelmajäte.
Municipality -3		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -4	JÄTE: Aine tai esine, jonka sen haltija on poistanut tai aikoo poistaa käytöstä tai on velvollinen poistamaan käytöstä	
Municipality -5		YHDYSKUNTAJÄTE: Yleisnimike, asumisessa syntynyt jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettavaan teollisuus-, palvelu tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -6		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte eikä käymäläjäte.
Municipality -7		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte eikä käymäläjäte.
Municipality -8		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte eikä käymäläjäte.
Municipality -9		YHDYSKUNTAJÄTE: Kotitalouksissa, laitoksissa, myymälöissä, .. ja muissa vastaavissa tiloissa syntyvä talous- ja sekajäte, josta ei ole muuta säädetty tai määrätty. Yhteiskuntajätteeksi katsotaan myös muu ominaisuudeltaan ja koostumukseltaan kuljetuksen ja käsittelyn kannalta siihen rinnastettava jäte. Yhdyskuntajätteenä ei pidetä ongelma- eikä erityisjätettä.
Municipality -10		YHDYSKUNTAJÄTE: Kotitalouksissa, myymälöissä ja toimistoissa kertyvät roskat ja talousjätteet sekä niihin käsittelyn kannalta verrattavat jäteaineet samoin kuin … mikäli niiden käsittely jätteiden laadun ja määrän takia ei aiheuta erityisiä toimenpiteitä.
Municipality -11		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -12		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -13		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte eikä käymäläjäte.
Municipality -14		
Municipality -15	JÄTE: Aine tai esine, jonka jätteen haltija on poistanut tai aikoo poistaa tai on velvollinen poistamaan käytöstä.	YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte, ei kuitenkaan ongelmajäte, kuivakäymäläjäte eikä jätevesi.

Municipality	Waste components and their definitions[1]	
	Jäte/Waste	Yhdyskuntajäte/Municipal waste
Municipality -16		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte.
Municipality -17		YHDYSKUNTAJÄTE: Yleisnimike, asumisessa syntynyt jäte tai ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte
Municipality -18		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -19		YHDYSKUNTAJÄTE. Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte eikä käymäläjäte.
Municipality -20		YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, yritys-, palvelu- tai muussa toiminnassa syntyvä jäte, joka voidaan kuljettaa, käsitellä ja/tai loppusijoittaa muun yhdyskuntajätteen tavoin, ei kuitenkaan ongelmajäte.
Municipality -21	JÄTE: Aine tai esine, jonka sen haltija on poistanut tai aikoo poistaa käytöstä taikka on velvollinen poistamaan käytöstä.	YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte.
Municipality -22		YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte sekä sekajäte, josta suurinta osaa hyödyntämiskelpoisesta jätteestä ei ole kerätty talteen, ei kuitenkaan ongelmajäte, kuivakäymäläjäte ja liete
Municipality -23	JÄTE: Aine tai esine, jonka sen haltija on poistanut tai aikoo poistaa käytöstä tai on velvollinen poistamaan käytöstä.	YHDYSKUNTAJÄTE: Asumisesta syntynyt jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte, ei kuitenkaan ongelmajäte.
Municipality -24		YHDYSKUNTAJÄTE: Kotitalouksissa,.., myymälöissä,.. ja muissa vastaavissa tiloissa kertyvät talous- ja sekajätteet, josta ei ole muuta säädetty tai määrätty. Yhdyskuntajätteeksi katsotaan myös muu ominaisuuksiltaan tai koostumukseltaan kuljetuksen tai käsittelyn kannalta siihen rinnastettava jäte..
Municipality -25		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte, kuivakäymäläjäte ja liete.
Municipality -26	JÄTE: Aine tai esine, jonka sen haltija on poistanut tai aikoo poistaa käytöstä tai on velvollinen poistamaan käytöstä.	YHDYSKUNTAJÄTE: Yleisnimikkeenä asumisessa syntynyt jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte, ei kuitenkaan ongelmajäte.
Municipality -27		YHDYSKUNTAJÄTE: Kotitalouksissa,.., myymälöissä,.. ja muissa vastaavissa tiloissa kertyvät talousjätteet ja niihin käsittelyn ja kuljetuksen kannalta verrattavat muut jätteet … ei kuitenkaan ongelmajätteitä.
Municipality -28		YHDYSKUNTAJÄTE: Asumisesta syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelma- eikä käymäläjäte. Kaatopaikalle loppusijoitettavasta yhdyskuntajätteestä käytetään nimitystä kaatopaikkajäte.
Municipality -29		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte eikä käymäläjäte. Kaatopaikalle loppusijoitettavasta jätteestä käytetään nimitystä kaatopaikkajäte.

Municipality	Waste components and their definitions[1]	
	Jäte/Waste	Yhdyskuntajäte/Municipal waste
Municipality -30		YHDYSKUNTAJÄTE: Asumisessa syntynyt jäte sekä ominaisuuksiltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntynyt jäte; ei kuitenkaan ongelmajäte eikä käymäläjäte. Kaatopaikalle loppusijoitettavasta jätteestä käytetään nimitystä kaatopaikkajäte.
Municipality -31	JÄTE: Aine tai esine, jonka sen haltija on poistanut tai aikoo poistaa käytöstä taikka on velvollinen poistamaan käytöstä.	YHDYSKUNTAJÄTE: Kotitalouksissa, myymälöissä, ..syntyvät roskat ja talousjätteet ja ominaisuudeltaan ja koostumukseltaan kuljetuksen ja käsittelyn kannalta niihin rinnastettavat jätteet, ei kuitenkaan kuivakäymäläjätteet, …
Municipality -32		YHDYSKUNTAJÄTE: Yleisnimike, asumisessa syntynyt jäte tai ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -33		YHDYSKUNTAJÄTE: Yleisnimikkeenä asumisessa syntynyt jäte sekä ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu- tai muussa toiminnassa syntyvä jäte, ei kuitenkaan ongelmajäte.
Municipality -34		YHDYSKUNTAJÄTE: Yleisnimike, asumisessa syntynyt jäte tai ominaisuudeltaan, koostumukseltaan ja määrältään siihen rinnastettava teollisuus-, palvelu tai muussa toiminnassa syntynyt jäte, ei kuitenkaan ongelmajäte.
Municipality -35		YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte ja muu koostumukseltaan ja ominaisuuksiltaan samantyyppinen jäte, jota syntyy teollisuus-, yritys- ja palvelutoiminnasta … ja jota voidaan kuljettaa, käsitellä ja/tai loppusijoittaa samalla tavalla.
Municipality -36		YHDYSKUNTAJÄTE: Asumisesta syntyvä jäte ja muu koostumukseltaan ja ominaisuuksiltaan samantyyppinen jäte, jota syntyy teollisuus-, yritys- ja palvelutoiminnasta … ja jota voidaan kuljettaa, käsitellä ja/tai loppusijoittaa samalla tavalla.
Municipality -37		YHDYSKUNTAJÄTE: Jäte, joka syntyy kotitalouksissa, myymälöissä ja toimistoissa kertyvistä talousjätteistä samoin kuin …Yhdyskuntajäte jaotellaan jätteen syntypaikan ja käsittelytavan mukaan seuraavasti…
Number of municipalities defining the term	6	34
Number of terms	1	1
Terms in Finnish	Jäte	Yhdyskuntajäte
Terms in English	Waste	Municipal waste

[1] The data is based on local waste regulations at each municipality in October 2002. The data was collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

ii. Mixed waste (sekajäte) and combustible waste (energiajäte)

Municipality	Waste components and their definitions[1]	
	Sekajäte/Mixed waste	Energiajäte/Combustible waste
Municipality -1	SEKAJÄTE (YHDYSKUNTAJÄTE): Kotit - alouksissa, myymälöissä, ... kertyvä talousjäte ja roska sekä niihin kuljetuksen ja käsittelyn kannalta verrattava muu jäte.	
Municipality -2	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	ENERGIAJÄTE: Jäte, jota ei voida käyttää aineena mutta jonka sisältämä energia voidaan ottaa talteen ja käyttöön.
Municipality -3	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	POLTTOON KELPAAVA JÄTE: Syntypaikalla eroteltu polttokelpoinen muovi, paperi, puu ja muu palava jäte, jonka polttamisesta ei aiheudu haittaa ympäristölle ja terveydelle.
Municipality -4	SEKAJÄTE: Kotitalouksissa, ... tai niiden kaltaisissa paikoissa kertyvä lajittelematon talousjäte sekä niihin kuljetuksen ja käsittelyn kannalta verrattava hyötykäyttöön kelpaamaton jäte	ENERGIAJAE eli POLTTOKELPOINEN JÄTE: Syntypaikalla lajiteltu polttolaitoksen polttoon kelpaava jäte, ei kuitenkaan kierrätys-kelpoinen paperi ja pahvi.
Municipality -5	KAATOPAIKKAJÄTE: jäte, joka voidaan si-joittaa vain kaatopaikalle ja joka jää jäljelle, kun hyödynnettävät jätteet, ongelma- ja erityisjätteet kerätään erikseen. KUIVAJÄTE: Asumisessa syntyvä ja siihen rinnastettava jäte, joka jää jäljelle, kun biojäte, muut hyödynnettävät jätteet, ongelmajätteet ja erityisjätteet on poistettu	ENERGIAJÄTE: Erikseen kerätty energiatuo-tannossa hyödyntämiskelpoinen jäte, joka ei ole materiaalina hyödynnettävissä ja joka ei sisällä PVC:tä tai muita haitallisia aineita.
Municipality -6	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	ENERGIAJÄTE: Jätepolttoaineen valmistuk - seen ja muuhun energiahyötykäyttöön soveltuva erilliskerätty jäte
Municipality -7	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	ENERGIAJÄTE: Jätepolttoaineen valmistuk - seen ja muuhun energiahyötykäyttöön soveltuva erilliskerätty jäte.
Municipality -8	SEKAJÄT E: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen	ENERGIAJÄTE: Jätepolttoaineen valmistuk - seen ja muuhun energiahyötykäyttöön soveltuva erilliskerätty jäte
Municipality -9	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen	
Municipality -10		
Municipality -11	SEKAJÄTE: Yhdyskuntajäte, josta on poistettu näiden määräysten mukaan lajikohtaisesti erik - seen kerättävä hyötykelpoinen jäte.	
Municipality -12	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erik - seen.	
Municipality -13	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan lajitella lajikohtaisesti erik - seen.	ENERGIAJÄTE: Jätepolttoaineen valmistuk - seen ja muuhun energiahyötykäyttöön soveltuva erilliskerätty jäte.
Municipality -14	KUIVAJÄTE: Jäte, joka jää jäljelle, kun biojät - teet, hyödynnettävät jätteet, ongelmajätteet ja erityisjätteet on poistettu.	ENERGIAJÄTE: Polttokelpoinen muovi, pape - ri- ja pahvinkeräykseen kelpaamaton paperi, pahvi ja puujäte
Municipality -15	SEKAJÄTE: Jäte, joka jää jäljelle, kun hyödyn-nettävät jätteet, ongelmajätteet ja erityisjätteet on poistettu. KUIVAJÄTE: Jäte, joka jää jäljelle, kun biojätteet, hyödynnettävät jätteet, ongelma - jätteet ja erityisjätteet on poistettu	ENERGIAJÄTE: Jäte, joka voidaan polttamalla hyödyntää energiaksi esim. puu, polttokelpoinen muovi, paperi tai pahvi, jota ei hyödynnetä mate-riaalina, energiajätteen keräilyastiat on merkitty tekstillä polttokelpoinen jäte.
Municipality -16	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen	

Municipality	Waste components and their definitions[1]	
	Sekajäte/Mixed waste	Energiajäte/Combustible waste
Municipality -17	SEKAJÄTE eli KAATOPAIKKAJÄTE: Jäte, joka on yhdyskuntajätettätai jota ei näiden jätehuoltomääräysten mukaan kerätä lajikohtaisesti erikseen. Sekajätteestä on syntypaikalla lajiteltu erilleen ongelma- ja erityisjätteet sekä hyötyjätteet.	ENERGIAJÄTE: Kierrätykseen kelpaamaton paperi, pahvi, muovi (ei PVC) ja puuta sisältävä lajiteltu jäte. energiajäte on puhdasta ja energiatuotantoon soveltuvaa jätettä.
Municipality -18	LAJITTELEMATON YHDYSKUNTAJÄTE eli SEKAJÄTE: Yhdyskuntajäte, joka jää jäljelle, kun hyödynnettävät jätteet on pidetty siitä erillään	
Municipality -19	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	ENERGIAJÄTE: Jätepolttoaineen valmistukseen ja muuhun energiahyötykäyttöön soveltuva erilliskerätty jäte.
Municipality -20	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	
Municipality -21	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	
Municipality -22		ENERGIAJÄTE: Jäte, josta kierrätyskelpoinen aine on eroteltu ja jota voidaan hyödyntää energiana ja josta voidaan valmistaa kierrätyspolttoainetta.
Municipality -23	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	
Municipality -24	SEKAJÄTE: Jäte, joka jää jäljelle kun hyödynnettävät jätteet on eroteltu.	
Municipality -25	SEKAJÄTE: Lajittelematon yhdyskunta-, rakennus-, teollisuusjäte ja erityisjäte, joka sisältää hyöty- ja kaatopaikkajätteen. KAATOPAIKKAJÄTE: Jäte, josta hyötyjätteet on lajiteltu erilleen joko syntypaikalla tai laitoksessa.	KUIVAJÄTE: Yhdyskuntajäte, joka on syntypaikalla lajiteltu siten, että se ei sisällä biojätettä, ongelmajätettä eikä merkittäviä määriä hyötyjätteitä ja josta voidaan laitoskäsittelyllä valmistaa poltettavaa materiaalia.
Municipality -26	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	KIERRÄTYSPOLTTOAINE: Yhdyskuntien ja yritysten polttokelpoisista, kuivista, kiinteistä ja syntypaikalla lajitellusta jätteestä valmistettu polttoaine.
Municipality -27		ENERGIAJÄTE: Sellainen polttokelpoinen yhdyskuntajäte, joka on syntypaikallaan lajiteltu ja jonka sisältämä energia on tarkoitettu hyödynnettäväksi polttamalla laitosmaisesti.
Municipality -28	KAATOPAIKKAJÄTE: Kaatopaikalle loppusijoitettava jäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erilleen hyötykäyttöä varten.	ENERGIAJÄTE: Haitattomaksi esikäsiteltävä ja poltettava jäte, kuten materiaalihyötykäyttöön soveltumaton muovi-, paperi-, pahvi- ja kartonkijäte.
Municipality -29	KAATOPAIKKAJÄTE: Kaatopaikalle loppusijoitettava jäte, jota ei näiden määräysten mukaan kerätä erilleen hyötykäyttöä varten.	ENERGIAJÄTE: Haitattomasti esikäsiteltävä ja poltettava jäte, kuten materiaalihyötykäyttöön soveltumaton muovi-, paperi-, pahvi- ja kartonkijäte.
Municipality -30	KAATOPAIKKAJÄTE: Kaatopaikalle loppusijoitettava jäte, jota ei näiden määräysten mukaan kerätä erilleen hyötykäyttöä varten.	ENERGIAJÄTE: Haitattomasti esikäsiteltävä ja poltettava jäte, kuten materiaalihyötykäyttöön soveltumaton muovi-, paperi-, pahvi- ja kartonkijäte.
Municipality -31	SEKAJÄTE: Yhdyskuntajäte, jota ei näiden määräysten mukaan kerätä lajikohtaisesti erikseen.	
Municipality -32	KAATOPAIKKAJÄTE: Loppusijoitettava kuivajäte, josta on syntypaikalla lajiteltu erilleen ongelma- ja erityisjätteet sekä hyötyjätteet.	KUIVAJÄTE (VAALEAPUSSI): Yhdyskuntajäte, joka on lajiteltu siten, että se ei sisällä … biojätettä eikä muuta erilliskerättävää hyötyjätettä. Kuivajätteestä saadaan laitoskäsittelyssä eroteltua polttokelpoinen energiajäte ja loppusijoitettava kaatopaikkajäte.

Municipality	Waste components and their definitions[1]	
	Sekajäte/Mixed waste	Energiajäte/Combustible waste
Municipality -33	KAATOPAIKKAJÄTE: Loppusijoitettava kuivajäte, josta on syntypaikalla lajiteltu erilleen ongelma- ja erityisjätteet sekä hyötyjätteet	KUIVAJÄTE (VAALEAPUSSI): Yhdyskuntajäte, joka on lajiteltu siten, että se ei sisällä … biojätettä eikä muuta erilliskerättävää hyötyjätettä. Kuivajätteestä saadaan laitoskäsittelyssä eroteltua polttokelpoinen energiajäte ja loppusijoitettava kaatopaikkajäte.
Municipality -34	KAATOPAIKKAJÄTE: Loppusijoitettava kuivajäte, josta on syntypaikalla lajiteltu erilleen ongelma- ja erityisjätteet sekä hyötyjätteet	KUIVAJÄTE (VAALEAPUSSI): Yhdyskuntajäte, joka on lajiteltu siten, että se ei sisällä … biojätettä eikä muuta erilliskerättävää hyötyjätettä. Kuivajätteestä saadaan laitoskäsittelyssä eroteltua polttokelpoinen energiajäte ja loppusijoitettava kaatopaikkajäte.
Municipality -35	LAJITTELEMATON JÄTE: Jäte, joka sisältää enemmän kuin 10 prosenttia väärin lajiteltuja jätteitä. LOPPUSIJOITETTAVA JÄTE: Jäte, jota ei voida hyödyntää, mutta joka voidaan loppusijoittaa kaatopaikalle.	KUIVAJÄTE: Jäte, jota voimassa olevien lajiteluohjeiden mukaan voidaan käyttää polttoaineen valmistukseen.
Municipality -36	LAJITTELEMATON JÄTE: Jäte, joka sisältää enemmän kuin 10 prosenttia väärin lajiteltuja jätteitä. LOPPUSIJOITETTAVA JÄTE: Jäte, jota ei voida hyödyntää, mutta joka voidaan loppusijoittaa kaatopaikalle.	KUIVAJÄTE: Jäte, jota voimassa olevien lajiteluohjeiden mukaan voidaan käyttää polttoaineen valmistukseen.
Municipality -37	KARKEAJÄTE: Ab Avfallsservice Stormossen Jätehuolto Oy:n (ASJ) kaatopaikalle loppusijoitettava biokaasulaitokselle soveltumaton jäte, jolle ei ole hyötykäyttöä.	POLTETTAVA JÄTE: Ewapowerin laitoksessa käsiteltävä polttokelpoinen energiajäte. KEITTIÖJÄTE: Ab Avfallsservice Stormossen Jätehuolto Oy:n (ASJ) biokaasulaitoksen käsittelyyn soveltuva ruoka- ja pakkausjäte.
Number of municipalities defining the term	34	25
Number of terms	8	9
Terms in Finnish	Sekajäte, Lajittelematon yhdyskuntajäte, lajittelematon jäte, loppusijoitettava jäte, kaatopaikkajäte, karkeajäte, kuivajäte, yhdyskuntajäte	Energiajäte, energiajae, polttokelpoinen jäte, polttoon kelpaava jäte, poltettava jäte, kuivajäte, kierrätyspolttoaine, kuivajäte (vaalea pussi), keittiöjäte
Terms in English	Mixed waste, unsorted municipal waste, unsorted waste, waste to be finally disposed of, landfill waste, coarse waste, dry waste, municipal waste	Energy waste, energy fraction, waste suitable for combustion, combustible waste, waste to be combusted, recycled fuel, dry waste (white bag), kitchen waste

[1] The data is based on local waste regulations at each municipality in October 2002. The data was collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

iii. Biodegradable waste (biojäte) and Recoverables (hyötyjäte)

Municipality	Waste components and their definitions[1]	
	Biojäte/Biodegradable waste	Hyötyjäte//Recoverables
Municipality -1	ELOPERÄINEN JÄTE: Jäte, joka sisältää kasvis- tai eläinperäisiä aineita, joita voidaan käsitellä kompostoimalla.	HYÖTYJÄTE: Sellainen osa jätteestä, jota voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä raaka-aine tai energia voidaan hyödyntää.
Municipality -2	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte. ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet … sekä elintarvikkeiden kaupassa syntyvä biojäte.	HYÖDYNTÄMISKELPOINEN JÄTE: Jäte, jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on järjestetty keräys tai vastaanotto.
Municipality -3	BIOJÄTE: Eloperäinen kokonaisuudessaan biologisesti hajoava jäte… ovat mm. elintarvike- ja puutarhajäte. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuan tähteet…sekä elintarvikkeet.	
Municipality -4	BIOJÄTE: Kasvi- tai eläinperäinen jäte, jota voidaan käsitellä kompostoimalla tai laitosmaisesti mädättämällä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuan tähteet…	HYÖTYJÄTE: sellainen osa jätteestä (esim. paperi, pahvi, lasi ja metalli), jota voidaan käyttää uudelleen sellaisenaan tai, jonka sisältämä raaka-aine tai energia voidaan hyödyntää.
Municipality -5		HYÖDYNTÄMISKELPOINEN JÄTE: Jäte, joka näissä määräyksissä tai niiden nojalla annettavissa määräyksissä tai ohjeissa edellytetään kerättäväksi aineena tai energiana hyödyntämistä varten.
Municipality -6	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	
Municipality -7	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	
Municipality -8	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	
Municipality -9	BIOJÄTE: Kompostointiin soveltuva biologisesti hajoava, kiinteä ja myrkytön jäte, kuten ruokajäte ja muu elintarvikejäte, … eloperäinen tuotantojäte, …	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja joka kerätään lajikohtaisesti erikseen. Hyötyjätteitä ovat mm. puhdas paperi
Municipality -10	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte.	HYÖDYNTÄMISKELPOINEN JÄTE: Jäte, joka kunnallisessa jätehuoltomääräyksissä tai niiden nojalla annettavissa määräyksissä tai ohjeissa edellytetään kerättäväksi aineena tai energiana hyödyntämistä varten.
Municipality -11	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuan tähteet…sekä elintarvikkeiden kaupassa syntyvä biojäte.	

Municipality	Waste components and their definitions[1]	
	Biojäte/Biodegradable waste	Hyötyjäte//Recoverables
Municipality -12	BIOJÄTE: Eloperäinen talous- ja elintarvikejäte, joka on kokonaisuudessaan biologisesti hajoavaa. ELINTARVIKEJÄTE: Laitosmaisen ruoan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-aineet ja elintarvikkeet … ja elintarvikkeiden kaupassa syntyvä elintarvikejäte.	HYÖTYJÄTE: Se osa jätteestä, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä raaka-aine tai energia voidaan muuten hyödyntää.
Municipality -13	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	
Municipality -14	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava myrkytön jäte.	
Municipality -15	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava myrkytön jäte. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet samoin kuin elintarvikkeiden valmistuksessa ja…	
Municipality -16	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoava. ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet … ja kaupassa syntyvä	
Municipality -17	BIOJÄTE: Kompostointiin soveltuva eloperäinen kokonaisuudessaan biologisesti hajoava, kiinteä ja myrkytön jäte; elintarvikejäte ja puutarhajäte. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan taikka jonka sisältämä materiaali tai energia voidaan hyödyntää ja jonka uudelleen- tai hyötykäyttö on järjestetty.
Municipality -18	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava ja myrkytön jäte.	HYÖTYJÄTE: Sellainen osa jätteestä, jota voidaan käyttää uudelleen sellaisenaan tai, jonka sisältämä raaka-aine tai energia voidaan hyödyntää.
Municipality -19	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa, kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	
Municipality -20	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte.	HYÖTYJÄTE: Sellainen osa jätteestä, jota voidaan käyttää uudelleen sellaisenaan tai, jonka sisältämä raaka-aine (ensisijaisesti) tai energia (toissijaisesti) voidaan hyödyntää. Tällaisia jätteitä ovat mm. biojätteet, …, keräyspahvi, … keräysmuovi, …
Municipality -21	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte.	HYÖTYJÄTE: Jäte, jota voidaan käyttää uudelleen sellaisenaan tai, jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu vastaanottopaikka. Hyötyjätteitä ovat mm. .. pahvi, …
Municipality -22	BIOJÄTE: Kompostointiin soveltuva biologisesti hajoava kiinteä ja myrkytön jäte, kuten ruokajäte, muu elintarvikejäte ja puutarhajäte.	HYÖTYJÄTE: Hyötykäyttöä varten lajitellut jätejakeet, jotka voidaan käyttää uudelleen sellaisenaan tai joiden sisältämä aine tai energia voidaan hyödyntää ja joille on osoitettu vastaanottopiste. Hyötyjakeita ovat mm. nestekartonki, …, keräyspahvi, …, biojäte, …

Municipality	Waste components and their definitions[1]	
	Biojäte/Biodegradable waste	Hyötyjäte//Recoverables
Municipality -23	BIOJÄTE: Eloperäinen, kokonaisuudessaan biologisesti hajoava jäte.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu vastanottopaikka. Hyötyjätteitä ovat mm.. pahvi, ., muovi,…
Municipality -24	KOMPOSTOITUVA JÄTE eli BIOJÄTE: Kompostointiin soveltuva eloperäinen biologisesti hajoava kiinteä ja myrkytön jäte, kuten ruokajäte, muu elintarvikejäte… eloperäinen tuotantojäte… ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää. Hyötyjätteitä ovat mm. .. pahvi, kompostoituva jäte, …sekä sellainen muovi, jolla on järjestetty vastaanotto.
Municipality -25	BIOJÄTE: Kompostointiin soveltuva biologisesti hajoava, kiinteä ja myrkytön jäte, kuten ruokajäte, muu elintarvikejäte ja puutarhajäte.	HYÖTYJÄTE: Hyötykäyttöä varten lajitellut jätejakeet, jotka voidaan käyttää uudelleen sellaisenaan tai joiden sisältämä materiaali tai energia voidaan hyödyntää ja joille on osoitettu vastaanottopiste. Hyötyjakeita ovat mm. … keräyspahvi, ., biojäte, ..
Municipality -26	ELOPERÄINEN JÄTE eli BIOJÄTE: Jäte, joka sisältää kasvis- ja eläinperäisiä aineita, jotka hajoavat biologisesti. ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet …	HYÖTYJÄTE: Jäte, jonka raaka-aine tai energiasisältö voidaan käyttää uudelleen, ottaa talteen tai muutoin hyödyntää. Hyötyjätteitä ovat mm. keräyspahvi, …, keräysmuovi, …
Municipality -27	BIOJÄTE: Eloperäinen, kiinteä ja kokonaisuudessaan biologisesti hajoava eli maatuva jäte.	HYÖTYJÄTE: Sellaiset käyttökelpoiset jätteet, jonka kierrätykselle tai uusiokäytölle on olemassa edellytykset. Tällaisia jätteitä ovat mm. … pahvi-, kartonki-, …, muovi-, …jäte.
Municipality -28	BIOJÄTE: Kompostointiin soveltuva eloperäinen biologisesti hajoava kiinteä ja myrkytön jäte, kuten ruokajäte, muu elintarvikejäte… eloperäinen tuotantojäte…	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu yleinen vastaanottopaikka. Hyötyjätteitä ovat mm…, pahvi, nestepakkauskartonki, pahvi- ja paperipakkausjäte, biojäte,…
Municipality -29	BIOJÄTE: Kompostointiin soveltuva eloperäinen biologisesti hajoava, kiinteä ja myrkytön jäte, kuten ruokajäte ja muu elintarvikejäte, … eloperäinen tuotantojäte, …	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu yleinen vastaanottopaikka. Hyötyjätteitä ovat mm…, pahvi, nestepakkauskartonki, pahvi- ja paperipakkausjäte, biojäte, …
Municipality -30	BIOJÄTE: Kompostointiin soveltuva eloperäinen biologisesti hajoava, kiinteä ja myrkytön jäte, kuten ruokajäte ja muu elintarvikejäte, … eloperäinen tuotantojäte, …	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu yleinen vastaanottopaikka. Hyötyjätteitä ovat mm…, pahvi, nestepakkauskartonki, pahvi- ja paperipakkausjäte, biojäte, …
Municipality -31	BIOJÄTE: Eloperäinen elintarvike- ja puutarhajäte, joka on kokonaisuudessaan biologisesti hajoavaa kiinteää ja myrkytöntä jätettä. ELINTARVIKEJÄTE: Ruuan valmistuksen tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan tai jonka sisältämä materiaali tai energia voidaan hyödyntää ja jolle on osoitettu vastaanottopaikka (mm. …, pahvi, kompostoituva jäte, …, muovi ja hyödynnettävä pakkausjäte).
Municipality -32	BIOJÄTE (MUSTAPUSSI): Kompostointiin soveltuva eloperäinen kokonaisuudessaan biologisesti hajoava, kiinteä ja myrkytön jäte.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan taikka jonka sisältämä materiaali tai energia voidaan hyödyntää ja jonka uudelleen- tai hyötykäyttö on järjestetty.
Municipality -33	BIOJÄTE (MUSTAPUSSI): Kompostointiin soveltuva eloperäinen kokonaisuudessaan biologisesti hajoava, kiinteä ja myrkytön jäte.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan taikka jonka sisältämä materiaali tai energia voidaan hyödyntää ja jonka uudelleen- tai hyötykäyttö on järjestetty.
Municipality -34	BIOJÄTE (MUSTAPUSSI): Kompostointiin soveltuva eloperäinen kokonaisuudessaan biologisesti hajoava, kiinteä ja myrkytön jäte.	HYÖTYJÄTE: Jäte, joka voidaan käyttää uudelleen sellaisenaan taikka jonka sisältämä materiaali tai energia voidaan hyödyntää ja jonka uudelleen- tai hyötykäyttö on järjestetty.

Municipality	Waste components and their definitions[1]	
	Biojäte/Biodegradable waste	Hyötyjäte//Recoverables
Municipality -35	ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet …sekä elintarvikkeiden kaupassa syntyvä bio-jäte. MÄRKÄJÄTE (MUSTAPUSSI): Jäte, joka soveltuu biologisesti käsiteltäväksi.	HYÖTYJÄTE: Jäte, jota voidaan käyttää uu-delleen tai hyödyntää raaka-aineena tai ener-giana.
Municipality -36	ELINTARVIKEJÄTE: Ruuan valmistuksessa tai tarjoilun yhteydessä käyttämättä jääneet ruoka-ainekset ja elintarvikkeet sekä ruuantähteet …sekä elintarvikkeiden kaupassa syntyvä bio-jäte. MÄRKÄJÄTE (MUSTAPUSSI): Jäte, joka soveltuu biologisesti käsiteltäväksi.	HYÖTYJÄTE: Jäte, jota voidaan käyttää uu-delleen tai hyödyntää raaka-aineena tai ener-giana.
Municipality -37	BIOJÄTE: Myymälöissä, toimistoissa, ym. kiin-teistöissä syntyvä pääosin eloperäinen jäte.	HYÖTYJÄTE: Paperi-, pahvi, … ym. jäte, joka ohjataan erilliskeräyksen kautta uudelleenkäyttöön.
Number of municipalities defining the term	36	27
Number of terms	6	2
Terms in Finnish	Biojäte, eloperäinen jäte, kompostoituva jäte, elintarvikejäte, märkäjäte (musta pussi), biojäte (musta pussi)	Hyötyjäte, hyödyntämiskelpoinen jäte
Terms in English	Biowaste, organic waste, compostable waste, food waste, wet waste (black bag), biowaste (black bag)	Recoverables, recoverable waste

[1] The data is based on local waste regulations at each municipality in October 2002. The data was collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

iv. Plastic waste (keräysmuovi), cardboard waste (keräyspahvi) and paperboard and paper packaging waste (pahvi- ja paperipakkausjäte)

Municipality	Waste components and their definitions[1]		
	Keräysmuovi/Plastic waste	Keräyspahvi/ Cardboard waste	Pahvi- ja paperipakkausjäte/ Paperboard and paper packaging waste
Municipality -1			
Municipality -2		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -3		PAHVI: Puhdas ja kuiva, käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi, joka täyttää hyötykäytön vaatimukset.	
Municipality -4			
Municipality -5		KERÄYSPAHVI: Puhdas ja kuiva ruskea pahvi, kartonki ja voimapaperi, jotka eivät sisällä uudelleenkäyttöä oleellisesti haittaavia aineita.	
Municipality -6		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -7		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -8		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -9			
Municipality -10			
Municipality -11	KERÄYSMUOVI: Käytöstä poistetut muovipakkaukset ja muu käytöstä poistettu keräyskelpoinen muovi.	KERÄYSPAHVI: Puhdas ja kuiva, käytöstä poistettu keräyskelpoinen pahvi.	
Municipality -12		KERÄYSPAHVI: Puhdas ja kuiva, käytöstä poistettu pahvi, kartonki ja voimapaperi, joka ei sisällä uusiokäyttöä olennaisesti haittaavia aineita.	
Municipality -13		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -14			
Municipality -15	KERÄYSMUOVI: Käytöstä poistetut muovipakkaukset ja muu käytöstä poistettu/keräyskelpoinen muovi, joka täyttää kulloisetkin hyötykäytön edellyttämät vaatimukset.	KERÄYSPAHVI. Puhdas ja kuiva pahvi, joka ei sisällä uudelleenkäyttöä oleellisesti haittaavia aineita ja täyttää hyötykäytön edellyttämät laatuvaatimukset.	
Municipality -16	KERÄYSMUOVI: Tyhjät muovipakkaukset ja muu puhdas muovi.	KERÄYSPAHVI: Puhdas ja kuiva pahvi, kartonki ja voimapaperi.	

Municipality	Waste components and their definitions[1]		
	Keräysmuovi/Plastic waste	Keräyspahvi/ Cardboard waste	Pahvi- ja paperipakkausjäte/ Paperboard and paper packaging waste
Municipality -17		KERÄYSPAHVI: Puhdas ja kuiva, käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	PAHVI- JA PAPERIPAKKAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset sekä nestekartonkipakkaukset.
Municipality -18	MUOVI: Kierrätettävät muovipullot sekä energiahyötykäyttöön tai raaka-aineen uusiokäyttöön soveltuva muovituote.	KERÄYSPAHVI: Puhdas ja kuiva ruskea pahvi, kartonki ja voimapaperi.	
Municipality -19		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -20	KERÄYSMUOVI: Käytöstä poistetut muovipakkaukset ja muu käytöstä poistettu/keräyskelpoinen muovi, joka täyttää keräysmuoville asetetut laatuvaatimukset.	KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi, joka täyttää keräyspahville asetetut laatuvaatimukset.	
Municipality -21			
Municipality -22		KERÄYSPAHVI: Puhdas ja kuiva uusiokäyttöön soveltuva käytöstä poistettu keräyskelpoinen paperi, kartonki ja pahvi.	
Municipality -23			
Municipality -24		PAHVIJÄTE: Puhdas ja kuiva ruskea pahvi, kartonki ja voimapaperi, jotka eivät sisällä uudelleenkäyttöä oleellisesti haittaavia aineita.	HYÖDYNNETTÄVÄ PAKKAUSJÄTE: Erikseen myöhemmin määriteltävä hyödyntämiseen soveltuva jäte.
Municipality -25		KERÄYSPAHVI: Puhdas ja kuiva uusiokäyttöön soveltuva käytöstä poistettu keräyskelpoinen pahvi. Keräyspahviksi ei sovellu likainen pahvi.	
Municipality -26			
Municipality -27			
Municipality -28			PAHVI- JA PAPERIPAKKAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset ja nestekortonkipakkaukset (kuten maito- ja mehutölkit) jota voidaan kerätä hyödyntämistä varten yhteiseen keräysvälineeseen.
Municipality -29			PAHVI- JA PAPERIPAKKAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset ja nestekortonkipakkaukset (kuten maito- ja mehutölkit) jota voidaan kerätä hyödyntämistä varten yhteiseen keräysvälineeseen.

Municipality	Waste components and their definitions[1]		
	Keräysmuovi/Plastic waste	Keräyspahvi/ Cardboard waste	Pahvi- ja paperipakkausjäte/ Paperboard and paper packaging waste
Municipality -30			PAHVI- JA PAPERIPAK-KAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset ja nestekortonkipakkaukset (kuten maito- ja mehutölkit) jota voidaan kerätä hyödyntämistä varten yhteiseen keräysvälineeseen.
Municipality -31		KERÄYSPAHVI: Puhdas ja kuiva käytöstä poistettu keräyskelpoinen pahvi, kartonki ja voimapaperi.	
Municipality -32			PAHVI- JA PAPERIPAK-KAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset sekä nestekartonkipakkaukset.
Municipality -33			PAHVI- JA PAPERIPAK-KAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset ja nestekartonkipakkaukset.
Municipality -34			PAHVI- JA PAPERIPAK-KAUSJÄTE: Materiaalihyötykäyttöön soveltuva pahvi-, kartonki- ja paperipakkaukset sekä nestekartonkipakkaukset.
Municipality -35		PAHVI: Puhdas ja kuiva pahvi ja voimapaperi	
Municipality -36			
Municipality -37			
Number of municipalities defining the term	5	20	8
Number of terms	2	3	2
Terms in Finnish	Keräysmuovi, muovi	Keräyspahvi, pahvi, pahvijäte	Pahvi- ja paperipakkausjäte, hyödynnettävä pakkausjäte
Terms in English	Plastic waste, plastic	Cardboard waste, cardboard, waste cardboard	Paperboard and paper packaging waste, recoverable packaging waste

[1] The data is based on local waste regulations at each municipality in October 2002. The data was collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

v. Liquid board waste (nestekartonkijäte) and paperboard waste (keräyskartonki)

Municipality	Waste components and their definitions[1]	
	Nestekartonkijäte/Liquid board waste	Keräyskartonki/paperboard waste
Municipality -1		
Municipality -2		
Municipality -3		
Municipality -4		
Municipality -5		KERÄYSKARTONKI: Erikseen kerätyt kuitupakkaukset, kuten maito- ja mehutölkit, paperi- ja kartonkipakkaukset yms, jotka voidaan hyötykäyttää.
Municipality -6		
Municipality -7		
Municipality -8		
Municipality -9		
Municipality -10		
Municipality -11		
Municipality -12	NESTEPAKKAUSJÄTE: Maito- ja mehutölkit sekä muu niihin verrattava nestepakkausten pinnoitettu kartonkijäte	
Municipality -13		
Municipality -14		
Municipality -15		
Municipality -16		
Municipality -17		
Municipality -18	NESTEKARTONKIPAKKAUS: Pahvista valmistetut maito-, mehu-, kerma- ja jogurttitölkit.	
Municipality -19		
Municipality -20		
Municipality -21		
Municipality -22	NESTEKARTONKI: Kierrätettävät kartonkiset maito-, piimä-…yms ja myös alumiinilla vuoratut pakkaukset (tölkit) sekä…	
Municipality -23		
Municipality -24		KERÄYSKARTONKI: Puhdas ja kuiva kotitaloudessa tai muussa vastaavassa paikassa jätteenä käytöstä poistettu kartonkipohjainen kuluttajapakkaus mukaan lukien nestepakkaukset
Municipality -25		
Municipality -26		
Municipality -27		
Municipality -28		
Municipality -29		
Municipality -30		
Municipality -31	NESTEPAKKAUS: Kartonkiset maito-, piimä-, kerma- jogurtti- ja mehutölkit.	
Municipality -32		
Municipality -33		
Municipality -34		
Municipality -35		
Municipality -36		
Municipality -37		

Municipality	Waste components and their definitions[1]	
	Nestekartonkijäte/Liquid board waste	Keräyskartonki/paperboard waste
Number of municipalities defining the term	4	2
Number of terms	4	1
Terms in Finnish	Nestepakkausjäte, nestekartonkipakkaus, nestepakkaus, nestekartonki	Keräyskartonki
Terms in English	Liquid packaging waste, liquid board packaging, liquid packaging, liquid board	Paperboard waste

[1] The data is based on local waste regulations at each municipality in October 2002. The data was collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

C. Colour coding of waste components

Municipality	Colours[1]			
	Grey	Green	Brown	Red
Municipality -1	mixed waste	waste paper	organic waste	hazardous waste
Municipality -5	dry waste, biowaste, landfill waste	waste paper and cardboard waste	compostable waste	hazardous waste
Municipality -6	mixed waste	waste paper	biowaste	hazardous waste and biological waste
Municipality -7	mixed waste	waste paper	biowaste	hazardous waste and biological waste
Municipality -8	mixed waste	waste paper	biowaste	hazardous waste and biological waste
Municipality -11	mixed waste	waste paper	biowaste	hazardous waste
Municipality -12	mixed waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -14	dry waste	waste paper	biowaste	hazardous waste
Municipality -15	dry waste	waste paper	biowaste	hazardous waste
Municipality -17	mixed waste	waste paper	biowaste	hazardous waste
Municipality -18	municipal waste	waste paper	biowaste	hazardous waste
Municipality -19	mixed waste	waste paper and cardboard waste	biowaste	hazardous waste and biological waste
Municipality -21	mixed waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -22	municipal waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -23	mixed waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -24	mixed waste/municipal waste	waste paper, cardboard waste, paperboard waste	compostable waste	hazardous waste
Municipality -25	dry waste, mixed waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -28	landfill waste	waste paper, cardboard waste, paperboard and paper packaging waste	biowaste	hazardous waste
Municipality -29	landfill waste	waste paper, cardboard waste, paperboard and paper packaging waste	biowaste	hazardous waste
Municipality -30	landfill waste	waste paper, cardboard waste, paperboard and paper packaging waste	biowaste	hazardous waste
Municipality -31	mixed waste	waste paper and cardboard waste	biowaste	hazardous waste
Municipality -32	dry waste, biowaste, landfill waste	waste paper	biowaste	-
Municipality -33	dry waste, biowaste, landfill waste	waste paper	biowaste	-
Municipality -34	dry waste, biowaste, landfill waste	waste paper	biowaste	-
Municipality -37	coarse waste	waste paper and cardboard waste	kitchen waste and biowaste	hazardous waste
Number of municipalities	25	25	25	22
Number of terms	8	5	5	2

Municipality	Colours[1]				
	Blue	Yellow	White	Black	Orange
Municipality -1	-	-	-	-	-
Municipality -5	paperboard waste and other recoverable waste	-	waste glass	-	-
Municipality -6	waste metal	-	-	-	-
Municipality -7	waste metal	-	-	-	-
Municipality -8	waste metal	-	-	-	-
Municipality -11	waste metal	-	waste glass	-	-
Municipality -12	waste glass	liquid board waste	-	-	-
Municipality -14	waste glass	-	-	-	energy waste
Municipality -15	waste glass, waste metal	-	-	-	energy waste
Municipality -17	cardboard waste	other recyclables (liquid board, textiles)	waste glass	waste metal	energy waste
Municipality -18	waste glass, waste metal	liquid board packaging	-	-	-
Municipality -19	waste metal	liquid board packaging	waste glass	-	-
Municipality -21	-	plastic	waste glass	waste metal	-
Municipality -22	waste glass	textiles, liquid board packaging, etc.	-	waste metal	-
Municipality -23	-	plastic	waste glass	waste metal	-
Municipality -24	recoverable waste	-	waste glass	-	-
Municipality -25	waste glass	textiles, liquid board packaging, etc.	-	waste metal	-
Municipality -28	-	-	-	landfill waste	energy waste
Municipality -29	-	-	-	landfill waste	energy waste
Municipality -30	-	-	-	landfill waste	energy waste
Municipality -31	plastic waste	recoverable packaging waste (liquid board)	waste glass	-	-
Municipality -32	cardboard waste	other recyclables (liquid board, textiles)	waste glass	waste metal	dry waste
Municipality -33	cardboard waste	other recyclables (liquid board, textiles)	waste glass	waste metal	dry waste
Municipality -34	cardboard waste	other recyclables (liquid board, textiles)	waste glass	waste metal	dry waste
Municipality -37	waste glass, waste metal	-	-	-	inciberable waste
Number of municipalities	19	12	11	11	10
Number of terms	7	6	1	2	3

[1] The data is based on local waste regulations at each municipality in October 2002. The data collected from the local waste regulations available at the municipalities' homepages or from printed regulations.

D. Collection of mixed waste: the organiser, the validity of a contract and the collector's company form (Suomen Kuntaliitto 2003, 72-22, 136-140)

Municipality	The collection of mixed waste organised by			Validity of a contract	Collector's company form		
	a property	a municipality	combined	years	Regional waste management company	Federation of municipalities	Public utilities
Municipality -1	1						
Municipality -2			1	5	1	1	
Municipality -3			1	4	1		
Municipality -4	1						1
Municipality -5		1		5	1		
Municipality -6			1	5		1	
Municipality -7			1	5		1	
Municipality -8			1	5		1	
Municipality -9		1		5	1		1
Municipality -10		1		5	1		
Municipality -11			1	3			1
Municipality -12					1		
Municipality -13		1		4	1		
Municipality -14	1				1		
Municipality -15					1		
Municipality -16			1	4	1		
Municipality -17	1				1		
Municipality -18	1				1		
Municipality -19			1	5		1	
Municipality -20			1		1		
Municipality -21	1						1
Municipality -22			1	3			
Municipality -23	1						1
Municipality -24		1		5	1		
Municipality -25		1		4	1		
Municipality -26	1				1		
Municipality -27		1			1		
Municipality -28	1				1		
Municipality -29			1	5	1		
Municipality -30	1				1		
Municipality -31		1					
Municipality -32			1	4	1		
Municipality -33		1		4	1		
Municipality -34			1		1		
Municipality -35	1				1		
Municipality -36	1				1		
Municipality -37	1				1		
Total	13	9	13		26	5	5
Average				4.4			

E. Treatment charges of mixed and biodegradable waste (vat excluded)

(Suomen Kuntaliitto 2003, 78-83)

Municipality	Mixed waste[1]						Biodegradable waste	
	C1	C1	C2	C2	C3	C3		
	euros/tonne	euros/m^3	euros/tonne	euros/m^3	euros/tonne	euros/m^3	euros/tonne	euros/m^3
Municipality -1	59.00	20.70	70.00	7.00	70.00	7.00	33.00	19.80
Municipality -3		13.74		4.04		4.44		
Municipality -4	41.48		52.54		47.83		22.33	
Municipality -5	50.00		50.00		60.00		25.00	
Municipality -6	49.50		49.50		49.50		15.57	
Municipality -7	49.50		49.50		49.50		15.57	
Municipality -8	49.50		49.50		49.50		15.57	
Municipality -9	59.84		59.84		59.84		61.48	
Municipality -10	40.98		40.98		40.98		21.32	
Municipality -11	44.99		44.99				33.35	
Municipality -12	43.18		43.18		43.18			
Municipality -13	75.00		61.48		61.48		61.48	
Municipality -14	79.05		79.05		79.05		40.37	
Municipality -16	42.74		48.25					
Municipality -17	58.14		58.14					
Municipality -18	50.46		50.46		50.46		21.86	
Municipality -19	45.49		45.49		45.49		15.57	
Municipality -20	53.82		53.82		53.82		43.73	
Municipality -21	48.78		48.78		48.78		10.09	
Municipality -22	57.18		57.18		57.18		38.69	
Municipality -23	48.78		48.78		48.78		10.09	
Municipality -24	39.36		39.36		39.36			
Municipality -25	53.82		53.82		53.82		42.05	
Municipality -26	45.00		45.00		45.00		45.00	
Municipality -27		5.50		5.50				
Municipality -29	65.59		65.59		65.59		25.00	
Municipality -30	65.59		65.59		65.59		25.00	
Municipality -31	58.02		58.02		58.02		43.39	
Municipality -32	61.48		61.48		61.48		61.48	
Municipality -33	61.48		61.48		61.48		61.48	
Municipality -34	61.48		61.48		61.48		61.48	
Municipality -35		5.71		5.71				
Municipality -36		5.71		5.71				
Municipality -37	127.10		127.10		127.10		88.80	
Average	56.21	10.27	56.68	5.59	57.57	5.72		
Std	16.58	6.80	16.08	1.05	16.57	1.81		
in %	29	66	28	19	29	32		
Min	39.36	5.50	39.36	4.04	39.36	4.44		
Max	127.10	20.70	127.10	7.00	127.10	7.00		

Total	Mixed waste euros/tonne	Biodegradable waste euros/tonne
Average	56.79	36.11
Std	16.28	20.28
in %	29	56
Min	39.36	10.09
Max	127.10	88.80

[1] C1 Mixed waste that is transported in a refuse collection vehicle or a container equipped with a compactor
C2 Mixed waste that is transported in a container that the waste has been collected in
C3 Mixed waste that is transported by other means than C1 and C2

F. Unit prices of mixed waste collected in different containers (vat excluded) (Suomen Kuntaliitto 2003, 122-125)

Bin liner 0.2 m^3

Municipality	Contract[1]	Transport charge	Treatment charge	Total[2]	Contract price
		euros/unit	euros/unit	euros/unit	euros/pick-up
Municipality -1	P	2.69	0.86	3.55	
Municipality -2	M				
Municipality -3	C/P		1.06		
Municipality -4	P	1.90	0.84	2.74	
Municipality -5	M	2.05	0.8	2.85	
Municipality -6	C/M	2.81	0.48	3.29	
Municipality -7	C/M	2.81	0.48	3.29	
Municipality -8	C/M				
Municipality -9	M	1.59	0.98	2.57	1.59
Municipality -10	M	1.30	0.82	2.12	2
Municipality -11	C/M	1.30	0.87	2.17	1.2
Municipality -13	M	1.66	1.99	3.65	1.66
Municipality -14	P	4.64	2.03	6.67	
Municipality -16	C/M			2.1	1.26
Municipality -17	P	1.88	1.55	3.43	
Municipality -18	P				
Municipality -19	C/M	2.93	0.96	3.89	2.29
Municipality -20	C/P			2	
Municipality -21	P	2.85	1.19	4.04	
Municipality -22	C/P	2.28	1.14	3.42	
	C/M	2.55	1.14	3.39	
Municipality -23	P	2.85	1.19	4.04	
Municipality -24	M	1.31	1.38	2.69	1.31
Municipality -25	M				
Municipality -26	P		1.07		
Municipality -27	M				
Municipality -28	P				
Municipality -29	C/P				
	C/M				
Municipality -30	P				
Municipality -31	M				
Municipality -32	C/M				
Municipality -33	M				
Municipality -34	C				
Municipality -35	P				
Municipality -36	P				
	M			3.06	
Municipality -37	P			4.78	
	P			6.32	
Contract P					
Average		2.80	1.25	4.45	-
Std		1.01	0.42	1.40	-
	in %	36	34	31	-
Min		1.88	0.84	2.74	-
Max		4.54	2.03	6.67	-
Contract M					
Average		1.58	1.19	2.82	1.64
Std		0.31	0.50	0.51	0.28
	in %	19	42	18	17
Min		1.30	0.80	2.12	1.31
Max		2.05	1.99	3.65	2.00
Contract CM					
Average		2.48	0.79	3.02	1.58
Std		0.67	0.30	0.72	0.61
	in %	27	38	24	39
Min		1.30	0.48	2.10	1.20
Max		2.93	1.14	3.89	2.29

[1] The collection of mixed waste is organised by a property (P), by a municipality (M). When a combination is used, the collection is organised by a municipality (CM) (from App. 2D).

[2] Unit price

Container 0.24 m^3

Municipality	Contract[1]	Transport charge	Treatment charge	Total[2]	Contract price
		euros/unit	euros/unit	euros/unit	euros/pick-up
Municipality -1	P	2.61	0.99	3.60	
Municipality -2	M	1.22	1.56	2.78	
Municipality -3	C/P		1.70		
Municipality -4	P	2.21	0.96	3.17	
Municipality -5	M	2.03	0.72	2.75	
Municipality -6	C/M	2.21	0.75	2.96	
Municipality -7	C/M	2.21	0.75	2.96	
Municipality -8	C/M				
Municipality -9	M	1.59	0.98	2.57	1.59
Municipality -10	M	2.00	0.90	2.90	2.57
Municipality -11	C/M	1.34	0.92	2.26	1.24
Municipality -13	M	1.59	2.07	3.65	1.59
Municipality -14	P	3.98	2.03	6.01	
Municipality -16	C/M			2.10	1.26
Municipality -17	P	1.78	1.70	3.48	
Municipality -18	P	1.80	1.21	3.01	
Municipality -19	C/M	2.70	0.77	3.47	2.10
Municipality -20	C/P			2.00	
Municipality -21	P	2.85	1.48	4.33	
Municipality -22	C/P	2.59	1.26	3.85	
	C/M	2.50	1.26	3.76	
Municipality -23	P	2.85	1.48	4.33	
Municipality -24	M	1.39	1.08	2.47	1.39
Municipality -25	M			2.93	1.35
Municipality -26	P		1.16		
Municipality -27	M	1.26	1.32	2.58	
Municipality -28	P				
Municipality -29	C/P			4.66	
	C/M			5.38	
Municipality -30	P				
Municipality -31	M				
Municipality -32	C/M	1.22	1.29	2.88	1.22
Municipality -33	M	1.44	1.27	2.71	1.33
Municipality -34	C				
Municipality -35	P	2.83	1.37	4.20	
Municipality -36	P	2.83	1.37	4.20	
	M			3.39	
Municipality -37	P			8.40	
	P			11.34	
Contract P					
Average		2.64	1.38	5.10	-
Std		0-67	0.33	2.58	-
in %		25	24	51	-
Min		1.78	0	3.01	-
Max		3.98	0	11.34	-
Contract M					
Average		1.57	1.24	2.87	1.64
Std		0.31	0.43	0.37	0.47
in %		20	35	13	29
Min		1.22	0.72	2.47	1.33
Max		2.03	2.07	3.65	2.57
Contract CM					
Average		2.03	0.96	2.91	1.46
Std		0.61	0.25	0.59	0.43
in %		30	27	20	30
Min		1.22	0.75	2.10	1.22
Max		2.70	1.29	3.76	2.10

[1] The collection of mixed waste is organised by a property (P) or by a municipality (M). When a combination is used, the collection is organised by a municipality (CM) (from App. 2D).

[2] Unit price

Container 0.6 m^3

Municipality	Contract[1]	Transport charge	Treatment charge	Total[2]	Contract price
		euros/unit	euros/unit	euros/unit	euros/pick-up
Municipality -1	P	3.25	2.31	5.56	
Municipality -2	M	1.20	3.90	5.10	
Municipality -3	C/P		4.67		
Municipality -4	P	3.12	2.23	5.35	
Municipality -5	M	2.35	1.80	3.50	
Municipality -6	C/M	2.21	1.65	3.86	
Municipality -7	C/M	2.21	1.65	3.86	
Municipality -8	C/M				
Municipality -9	M	1.39	3.61	4.99	1.39
Municipality -10	M	2.00	1.46	3.46	2.88
Municipality -11	C/M	1.47	2.41	3.88	1.37
Municipality -13	M	1.47	5.41	6.88	1.47
Municipality -14	P	5.22	5.07	10.29	
Municipality -16	C/M			3.93	0.66
Municipality -17	P	2.52	3.31	5.83	
Municipality -18	P	1.92	3.03	4.95	
Municipality -19	C/M	3.26	1.93	5.19	2.65
Municipality -20	C/P			2.00	
Municipality -21	P	1.85	3.34	5.19	
Municipality -22	C/P	2.93	2.74	5.67	
	C/M	3.24	2.74	5.98	
Municipality -23	P	1.85	3.34	5.19	
Municipality -24	M	1.43	2.56	3.99	1.43
Municipality -25	M			4.46	1.15
Municipality -26	P				
Municipality -27	M	1.12	3.29	4.41	
Municipality -28	P				
Municipality -29	C/P				
	C/M				
Municipality -30	P				
Municipality -31	M				
Municipality -32	C/M	1.15	2.89	4.41	1.15
Municipality -33	M	1.44	2.75	4.19	1.23
Municipality -34	C				
Municipality -35	P	3.67	3.43	7.10	
Municipality -36	P	3.67	3.43	7.10	
	M			5.71	
Municipality -37	P				
	P				
Contract P					
Average		3.14	3.31	6.45	-
Std		1.11	0.87	1.74	-
in %		35	26	27	-
Min		1.85	2.23	5.19	-
Max		5.22	5.07	10.29	-
Contract M					
Average		1.55	3.10	4.69	1.59
Std		0.42	1.26	1.11	0.64
in %		27	41	24	40
Min		1.12	1.46	3.46	1.15
Max		2.35	5.41	6.88	2.88
Contract CM					
Average		2.26	2.21	4.44	1.06
Std		0.87	0.55	0.84	0.85
in %		39	25	19	80
Min		1.15	1.65	3.86	0.66
Max		3.26	2.89	5.98	2.65

[1] The collection of mixed waste is organised by a property (P) or by a municipality (M). When a combination is used, the collection is organised by a municipality (CM) (from App. 2D.).
[2] Unit price

G. Experimental data on special unit weights

Table i

Municipality	Type and volume of the container for mixed waste[1]				Biodegradable waste
	Bin liner 0.2 m^3	Container 0.24 m^3	Container 0.6 m^3	Container equipped with a compactor	
	kg/unit	kg/unit	kg/unit	kg/m^3	kg/m^3
Municipality -5	15	16	36	210	167
Municipality -6	10	16	35	100	95
Municipality -7	10	16	35	100	95
Municipality -8	10	16	35	100	95
Municipality -10[2]	20	22	54	350	500
Municipality -10[3]	16	17	32	350	500
Municipality -11[4]	15	30	30		250
Municipality -11[5]	25		60		
Municipality -17	25	28	55		288
Municipality -22	20	22	48	600	300
Municipality -25[4]		18	50		450
Municipality -25[5]					850
Municipality -33		17	40		
Average	16.60	19.82	42.50	258.57	326.36
Std	5.78	5.08	10.29	187.57	233.19
in %	35	26	24	73	71
Min	10	16	30	100	95
Max	25	30	60	600	850

[1] Suomen Kuntaliitto 2003. 132-133
[2] Including biodegradable waste
[3] Excluding biodegradable waste
[4] Minimum values
[5] Maximum values

Table ii

Municipality	Mixed waste[1]			
	Bin liner 0.2 m^3	Container 0.24 m^3	Container 0.6 m^3	Total
	kg/m^3	kg/m^3	kg/m^3	kg/m^3
Municipality -5	75	67	60	
Municipality -6	50	67	58	
Municipality -7	50	67	58	
Municipality -8	50	67	58	
Municipality -10[2]	100	92	90	
Municipality -10[3]	80	71	53	
Municipality -11[4]	75	125	50	
Municipality -11[5]	125		100	
Municipality -17	125	117	92	
Municipality -22	100	92	80	
Municipality -25[4]		75	83	
Municipality -25[5]				
Municipality -33		71	67	
Average	83.00	82.58	70.83	78.43
Std	28.89	21.15	17.15	22.58
in %	35	26	24	29
Min	50	67	50	50
Max	125	125	100	125

[1] Calculated from the data in Table i
[2] Including biodegradable waste
[3] Excluding biodegradable waste
[4] Minimum values
[5] Maximum values

Appendix 3. Achievable and theoretical recovery potential of packaging waste

A. Sales packaging disposed of outside the outlets

	Waste component (kg)					
	Recyclable (fibre) waste (liquid board) M	Recyclable (fibre) waste (liquid board) PO	Recyclable (fibre) waste (total) M+PO	Biodegradable waste M	Combustible waste M	Mixed waste M
Annual amount (kg) from App.1			255 487	155 133	54 594	12 014
Municipality						
Municipality -1	0	8 431	8 431	0	0	396
Municipality -2	0	4 854	4 854	0	0	228
Municipality -3	0	2 299	2 299	0	0	108
Municipality -4	0	0	0	1 241	0	96
Municipality -5	0	22 227	22 227	13 497	0	1 045
Municipality -6	0	73 325	73 325	44 523	0	3 448
Municipality -7	0	20 950	20 950	12 721	0	985
Municipality -8	0	16 351	16 351	9 929	0	769
Municipality -9	0	3 577	3 577	2 172	0	168
Municipality -10	0	3 832	3 832	2 327	0	180
Municipality -11	0	2 299	2 299	1 396	0	108
Municipality -12	0	4 088	4 088	2 482	0	192
Municipality -13	0	2 810	2 810	1 706	0	132
Municipality -14	0	2 044	2 044	1 241	0	96
Municipality -15	0	5 621	5 621	3 413	0	264
Municipality -16	0	1 788	1 788	1 086	0	84
Municipality -17	0	1 788	1 788	1 086	0	84
Municipality -18	0	2 044	2 044	1 241	0	96
Municipality -19	0	2 810	2 810	1 706	0	132
Municipality -20	0	2 555	2 555	1 551	0	120
Municipality -21	2 299	0	2 299	1 396	0	108
Municipality -22	4 343	0	4 343	2 637	0	204
Municipality -23	5 621	0	5 621	3 413	0	264
Municipality -24	7 665	0	7 665	4 654	0	360
Municipality -25	0	9 198	9 198	5 585	1 965	433
Municipality -26	0	1 788	1 788	1 086	382	84
Municipality -27	0	2 299	2 299	1 396	491	108
Municipality -28	0	8 431	8 431	5 119	1 802	396
Municipality -29	0	2 555	2 555	1 551	546	120
Municipality -30	0	1 788	1 788	1 086	382	84
Municipality -31 [2]	0	2 555	2 555	1 551	546	120
Municipality -32 [3]	0	1 788	1 788	1 086	382	84
Municipality -33 [3]	0	2 810	2 810	1 706	601	132
Municipality -34 [3]	0	5 365	5 365	3 258	1 146	252
Municipality -35 [4]	0	2 555	2 555	1 551	546	120
Municipality -36 [4]	0	2 810	2 810	1 706	601	132
Municipality -37 [5]	0	5 876	5 876	3 568	1 256	276
Total	19 928	233 515				
Total achievable amount			253 443	145 670	10 646	
Total theoretical (unachievable) amount						
Total mixed waste						12 014

[1] M - mandatory collection based on local waste regulations. PO - voluntary collection based on waste collection points organised by producer organisation (from App. 2A).
The waste amout at an individual outlet was calculated from the total annual amount of packaging waste in relation to annual sales.
[2] Combustible waste refers to plastic packaging.
[3] Combustible and mixed household waste are collected together and separated later at separation facility.
[4] Combustible and mixed household and commercial waste are collected together and recovered as energy.
[5] Biodegradable and packaging household and commercial waste are collected together and recovered as energy.
[6] The combined recovery rate of the collection based on local waste regulations and organised by a PO

	Waste component (kg)			
	Unrecovered recyclable (fibre) waste M+PO	Unrecovered biodegradable waste M	Unrecovered combustible waste M	Grand total
Annual amount (kg) from App.1				477 228
Municipality				
Municipality -1	0	5 119	1 802	
Municipality -2	0	2 948	1 037	
Municipality -3	0	1 396	491	
Municipality -4	2 044	0	437	
Municipality -5	0	0	4 750	
Municipality -6	0	0	15 668	
Municipality -7	0	0	4 477	
Municipality -8	0	0	3 494	
Municipality -9	0	0	764	
Municipality -10	0	0	819	
Municipality -11	0	0	491	
Municipality -12	0	0	874	
Municipality -13	0	0	601	
Municipality -14	0	0	437	
Municipality -15	0	0	1 201	
Municipality -16	0	0	382	
Municipality -17	0	0	382	
Municipality -18	0	0	437	
Municipality -19	0	0	601	
Municipality -20	0	0	546	
Municipality -21	0	0	491	
Municipality -22	0	0	928	
Municipality -23	0	0	1 201	
Municipality -24	0	0	1 638	
Municipality -25	0	0	0	
Municipality -26	0	0	0	
Municipality -27	0	0	0	
Municipality -28	0	0	0	
Municipality -29	0	0	0	
Municipality -30	0	0	0	
Municipality -31 [2]	0	0	0	
Municipality -32 [3]	0	0	0	
Municipality -33 [3]	0	0	0	
Municipality -34 [3]	0	0	0	
Municipality -35 [4]	0	0	0	
Municipality -36 [4]	0	0	0	
Municipality -37 [5]	0	0	0	
Total				
Total achievable amount				409 759
Total theoretical (unachievable) amount	2 044	9 463	43 948	55 455
Total mixed waste				12 014

B. Sales packaging disposed of in the dining area

		Waste component (kg)			
		Recyclable (fibre) waste (liquid board) M	Biodegradable waste M	Combustible waste M	Mixed waste M
Annual amount (kg)	from App.1	428 956	193 532	126 855	6 007
Municipality					
Municipality -1		0	0	0	198
Municipality -2		0	3 677	0	114
Municipality -3		0	0	0	54
Municipality -4		0	1 548	0	48
Municipality -5		0	16 837	0	523
Municipality -6		0	55 544	0	1 724
Municipality -7		0	15 870	0	493
Municipality -8		0	12 386	0	384
Municipality -9		0	2 709	0	84
Municipality -10		0	2 903	0	90
Municipality -11		0	1 742	0	54
Municipality -12		0	3 097	0	96
Municipality -13		0	2 129	0	66
Municipality -14		0	1 548	0	48
Municipality -15		0	4 258	0	132
Municipality -16		0	1 355	0	42
Municipality -17		0	1 355	0	42
Municipality -18		0	1 548	0	48
Municipality -19		0	2 129	0	66
Municipality -20		0	1 935	0	60
Municipality -21		0	1 742	0	54
Municipality -22		7 292	3 290	0	102
Municipality -23		0	4 258	0	132
Municipality -24		12 869	5 806	0	180
Municipality -25		0	6 967	4 567	216
Municipality -26		0	1 355	888	42
Municipality -27		0	1 742	1 142	54
Municipality -28		0	6 387	4 186	198
Municipality -29		0	1 935	1 269	60
Municipality -30		0	1 355	888	42
Municipality -31 [2]		4 290	1 935	1 269	60
Municipality -32 [3]		0	1 355	888	42
Municipality -33 [3]		0	2 129	1 395	66
Municipality -34 [3]		0	4 064	2 664	126
Municipality -35 [4]		0	1 935	1 269	60
Municipality -36 [4]		0	2 129	1 395	66
Municipality -37 [5]		0	4 451	2 918	138
Total achievable amount		24 450	185 404	24 737	
Total theoretical (unachievable) amount					
Total mixed waste					6 007

[1] M - mandatory collection based on local waste regulations, PO - voluntary collection based on waste collection points organised by producer organisation (from App. 2A).
The waste amout at an individual outlet was calculated from the total annual amount of packaging waste in relation to annual sales.
[2] Combustible waste refers to plastic packaging.
[3] Combustible and mixed household waste are collected together and separated later at separation facility.
[4] Combustible and mixed household and commercial waste are collected together and recovered as energy.
[5] Biodegradable and packaging household and commercial waste are collected together and recovered as energy.
[6] The combined recovery rate of the collection based on local waste regulations and organised by a PO

		Waste component (kg)			
		Unrecovered recyclable (fibre) waste	Unrecovered biodegradable waste	Unrecovered combustible waste	Grand total
Annual amount (kg)	from App.1				755 350
Municipality					
Municipality -1		14 156	6 387	4 186	
Municipality -2		8 150	0	2 410	
Municipality -3		3 861	1 742	1 142	
Municipality -4		3 432	0	1 015	
Municipality -5		37 319	0	11 036	
Municipality -6		123 110	0	36 407	
Municipality -7		35 174	0	10 402	
Municipality -8		27 453	0	8 119	
Municipality -9		6 005	0	1 776	
Municipality -10		6 434	0	1 903	
Municipality -11		3 861	0	1 142	
Municipality -12		6 863	0	2 030	
Municipality -13		4 719	0	1 395	
Municipality -14		3 432	0	1 015	
Municipality -15		9 437	0	2 791	
Municipality -16		3 003	0	888	
Municipality -17		3 003	0	888	
Municipality -18		3 432	0	1 015	
Municipality -19		4 719	0	1 395	
Municipality -20		4 290	0	1 269	
Municipality -21		3 861	0	1 142	
Municipality -22		0	0	2 157	
Municipality -23		9 437	0	2 791	
Municipality -24		0	0	3 806	
Municipality -25		15 442	0	0	
Municipality -26		3 003	0	0	
Municipality -27		3 861	0	0	
Municipality -28		14 156	0	0	
Municipality -29		4 290	0	0	
Municipality -30		3 003	0	0	
Municipality -31 [2]		0	0	0	
Municipality -32 [3]		3 003	0	0	
Municipality -33 [3]		4 719	0	0	
Municipality -34 [3]		9 008	0	0	
Municipality -35 [4]		4 290	0	0	
Municipality -36 [4]		4 719	0	0	
Municipality -37 [5]		9 866	0	0	
Total achievable amount					234 591
Total theoretical (unachievable) amount		404 506	8 128	102 118	514 752
Total mixed waste					6 007

C. Primary and secondary packaging disposed of in the kitchen area

		Waste component (kg)				
		Recyclable (fibre) waste (cardboard) M	Recyclable (fibre) waste (liquid board) M	Recyclable (fibre) waste (total) M	Combustible waste M	Mixed waste M
Annual amount (kg)	from App.1	563 668	6 805	570 473	9 825	123 967
Municipality						
Municipality -1		18 601	0	18 601	0	4 091
Municipality -2		10 710	0	10 710	0	2 355
Municipality -3		5 073	0	5 073	0	1 116
Municipality -4		4 509	0	4 509	0	992
Municipality -5		49 039	0	49 039	0	10 785
Municipality -6		161 773	0	161 773	0	35 579
Municipality -7		46 221	0	46 221	0	10 165
Municipality -8		36 075	0	36 075	0	7 934
Municipality -9		7 891	0	7 891	0	1 736
Municipality -10		8 455	0	8 455	0	1 860
Municipality -11		5 073	0	5 073	0	1 116
Municipality -12		9 019	0	9 019	0	1 983
Municipality -13		6 200	0	6 200	0	1 364
Municipality -14		4 509	0	4 509	0	992
Municipality -15		12 401	0	12 401	0	2 727
Municipality -16		3 946	0	3 946	0	868
Municipality -17		3 946	0	3 946	0	868
Municipality -18		4 509	0	4 509	0	992
Municipality -19		6 200	0	6 200	0	1 364
Municipality -20		5 637	0	5 637	0	1 240
Municipality -21		5 073	0	5 073	0	1 116
Municipality -22		9 582	116	9 698	0	2 107
Municipality -23		12 401	0	12 401	0	2 727
Municipality -24		16 910	204	17 114	0	3 719
Municipality -25		20 292	0	20 292	354	4 463
Municipality -26		3 946	0	3 946	69	868
Municipality -27		5 073	0	5 073	88	1 116
Municipality -28		18 601	0	18 601	324	4 091
Municipality -29		5 637	0	5 637	98	1 240
Municipality -30		3 946	0	3 946	69	868
Municipality -31 [2]		5 637	68	5 705	98	1 240
Municipality -32 [3]		3 946	0	3 946	69	868
Municipality -33 [3]		6 200	0	6 200	108	1 364
Municipality -34 [3]		11 837	0	11 837	206	2 603
Municipality -35 [4]		5 637	0	5 637	98	1 240
Municipality -36 [4]		6 200	0	6 200	108	1 364
Municipality -37 [5]		12 964	0	12 964	226	2 851
Total		563 668	388			
Total achievable amount				564 056	1 916	
Total theoretical (unachievable) amount						
Total mixed waste						123 967

[1] M - mandatory collection based on local waste regulations, PO - voluntary collection based on waste collection points organised by producer organisation (from App. 2A).
The waste amout at an individual outlet was calculated from the total annual amount of packaging waste in relation to annual sales.
[2] Combustible waste refers to plastic packaging.
[3] Combustible and mixed household waste are collected together and separated later at separation facility.
[4] Combustible and mixed household and commercial waste are collected together and recovered as energy.
[5] Biodegradable and packaging household and commercial waste are collected together and recovered as energy.
[6] The combined recovery rate of the collection based on local waste regulations and organised by a PO

		Waste component (kg)		
		Unrecovered recyclable (fibre) waste	Unrecovered combustible waste	Grand total
Annual amount (kg)	from App.1			1 274 738
Municipality				
Municipality -1		225	324	
Municipality -2		129	187	
Municipality -3		61	88	
Municipality -4		54	79	
Municipality -5		592	855	
Municipality -6		1 953	2 820	
Municipality -7		558	806	
Municipality -8		436	629	
Municipality -9		95	138	
Municipality -10		102	147	
Municipality -11		61	88	
Municipality -12		109	157	
Municipality -13		75	108	
Municipality -14		54	79	
Municipality -15		150	216	
Municipality -16		48	69	
Municipality -17		48	69	
Municipality -18		54	79	
Municipality -19		75	108	
Municipality -20		68	98	
Municipality -21		61	88	
Municipality -22		0	167	
Municipality -23		150	216	
Municipality -24		0	295	
Municipality -25		245	0	
Municipality -26		48	0	
Municipality -27		61	0	
Municipality -28		225	0	
Municipality -29		68	0	
Municipality -30		48	0	
Municipality -31 [2]		0	0	
Municipality -32 [3]		48	0	
Municipality -33 [3]		75	0	
Municipality -34 [3]		143	0	
Municipality -35 [4]		68	0	
Municipality -36 [4]		75	0	
Municipality -37 [5]		157	0	
Total				
Total achievable amount				565 972
Total theoretical (unachievable) amount		6 417	7 909	14 326
Total mixed waste				123 967

Appendix 4. Development of a sorting station: the results of an indicative customer observation and qualitative customer surveys

A. An indicative customer survey at phase 1

Means to support sorting by customers	Number of individual answers[1] Questions		
	How to ease sorting?	How to speed sorting?	How to improve the instructions?
Means to improve sorting station ergonomics	10	13	0
Removal of lids	1	1	0
Wider openings	0	2	0
Lower position of openings	0	0	0
Larger dustbins/more frequent emptying	4	3	0
More room for sorting	0	1	0
More sorting stations/outlet	3	5	0
Sorting stations at the dining tables	2	1	0
Means to improve sorting instructions	16	8	20
More instructions	3	1	2
Clearer instructions	5	3	8
Instructions in English	0	0	0
Instructions on trayliners, tables, ceilings	0	0	0
Colour coding/symbols/text	5	2	5
Use of pictures on packaging waste	1	1	3
Picture of every packaging waste item	0	0	0
Recycling principles	2	1	1
Fancy McDonald's figures	0	0	0
Prize for correct sorting	0	0	0
Sorting guides	0	0	1
Other means	9	4	3
Decreasing the number of packaging	5	1	1
Only one waste component	1	0	0
Sorting station to all outlets	0	0	0
National sorting campaign	0	0	0
Sorting by personnell	2	2	1
Irrelevant comment	1	1	1
No means (satisfied with the present practises)	6	9	5

[1] Total number of respondents 91

B. An indicative customer observation at phase 2

Observation	Share %[1]
A. Customers sorted packaging waste, in other words paid attention to where to throw, or did not throw all packaging waste to one dustbin	80
sorted as instructed, in other words used dustbins 1, 2 and 3[2]	53
sorted by using two of the three dustbins	27
dustbin 1 and 2	2
dustbin 1 and 3	2
dustbin 2 and 3	23
B. Customers did not sort, in other words threw all packaging waste into one dustbin	20
dustbin 1	0
dustbin 2	6
dustbin 3	14
C. Customers read instructions	14
D. Customers looked at the instructive pictures	40
E. Customers used the worktop for the tray	6

[1] Total number of observed customers 104

[2] Dustbin 1 for ‘Liquids and mixed waste’, dustbin 2 for ‘Paperboard and plastic waste’, and dustbin 3 for ‘Biowaste and paper’.

C. An indicative customer survey at phase 3

Means to support sorting by customers	Number of individual answers[1] Questions		
	How to ease sorting?	How to speed sorting?	How to improve the instructions?
Means to improve sorting station ergonomics	20	15	1
Removal of lids	0	0	0
Wider openings	15	8	1
Lower position of openings	1	1	0
Larger dustbins/more frequent emptying	1	0	0
More room for sorting	2	0	0
More sorting stations/outlet	1	6	0
Sorting stations at the dining tables	0	0	0
Means to improve sorting instructions	17	8	20
More instructions	0	0	0
Clearer instructions	11	1	7
Instructions in English	0	0	2
Instructions on trayliners, tables, ceilings	1	3	5
Colour coding/symbols/text	1	3	3
Use of pictures on packaging waste	0	0	1
Picture of every packaging waste item	3	1	2
Recycling principles	1	0	0
Fancy McDonald's figures	0	0	0
Prize for correct sorting	0	0	0
Sorting guides	0	0	0
Other means	9	8	2
Decreasing the number of packaging	2	2	1
Only one waste component	2	2	0
Sorting station to all outlets	1	1	1
National sorting campaign	0	0	0
Sorting by personnell	4	2	0
Irrelevant comment	0	1	0
No means (satisfied with the present practises)	6	7	11

[1] Total number of respondents 100

Appendix 5. Development of a sorting station: the purity indexes of waste components

A. ‘Paperboard and plastic waste’

	Packaging waste amount (g)					Purity index[1]
	'Paperboard and plastic'[2]	Missorted 'Biowaste and paper'[3]	Missorted mixed waste[4]	Total missorted waste	Grand total	
PHASE 1						
Friday 19.7.2002						
Bin liner -1	1 660	1 480	270	1 750	3 410	0.49
Bin liner -2	1 520	1 620	20	1 640	3 160	0.48
Bin liner -3	950	1 070	30	1 100	2 050	0.46
Bin liner -4	840	770	330	1 100	1 940	0.43
Bin liner -5	1 120	670	30	700	1 820	0.62
Wednesday 11.9.2002						
Bin liner -1	1 290	810	20	830	2 120	0.61
Bin liner -2	1 690	845	10	855	2 545	0.66
Bin liner -3	1 830	925	30	955	2 785	0.66
Bin liner -4	1 060	757	10	767	1 827	0.58
Bin liner -5	950	465	30	495	1 445	0.66
Bin liner -6	680	285	10	295	975	0.70
Bin liner -7	2 055	225	0	225	2 280	0.90
Bin liner -8	2 010	665	30	695	2 705	0.74
Average	1 358	814	63	877	2 236	0.61
Std	463	405	106	451	680	0.13
in %	34	50	169	51	30	21
Min	680	225	0	225	975	0.43
Max	2 055	1 620	330	1 750	3 410	0.90
PHASE 2						
Friday 4.11.2002						
Bin liner -1	840	660	20	680	1 520	0.55
Bin liner -2	910	505	10	515	1 425	0.64
Bin liner -3	645	480	10	490	1 135	0.57
Bin liner -4	945	520	10	530	1 475	0.64
Bin liner -5	770	680	50	730	1 500	0.51
Monday 11.11.2002						
Bin liner -1	1 015	195	10	205	1 220	0.83
Bin liner -2	705	215	20	235	940	0.75
Bin liner -3	1 055	295	5	300	1 355	0.78
Bin liner -4	805	155	20	175	980	0.82
Bin liner -5	705	295	10	305	1 010	0.70
Tuesday 26.11.2002						
Bin liner -1	1 375	535	20	555	1 930	0.71
Bin liner -2	745	145	10	155	900	0.83
Bin liner -3	665	95	0	95	760	0.88
Bin liner -4	925	355	20	375	1 300	0.71
Average	865	366	15	382	1 246	0.71
Std	196	196	12	203	316	0.11
in %	23	53	77	53	25	16
Min	645	95	0	95	760	0.51
Max	1 375	680	50	730	1 930	0.88

	Packaging waste amount (g)					Purity index[1]
	'Paperboard and plastic'[2]	Missorted 'Biowaste and paper'[3]	Missorted mixed waste[4]	Total missorted waste	Grand total	
PHASE 3						
Sunday 8.12.2002						
Bin liner -1	565	395	30	425	990	0.57
Bin liner -2	880	145	5	150	1 030	0.85
Bin liner -3	695	370	0	370	1 065	0.65
Bin liner -4	625	120	0	120	745	0.84
Monday 9.12.2002						
Bin liner -1	1 100	460	30	490	1 590	0.69
Bin liner -2	1 710	880	70	950	2 660	0.64
Bin liner -3	1 100	410	20	430	1 530	0.72
Bin liner -4	1 290	470	80	550	1 840	0.70
Friday 10.1.2003						
Bin liner -1	1 190	160	15	175	1 365	0.87
Bin liner -2	950	500	30	530	1 480	0.64
Bin liner -3	860	240	0	240	1 100	0.78
Bin liner -4	1 120	500	0	500	1 620	0.69
Bin liner -5	1 450	410	50	460	1 910	0.76
Average	1 041	389	25	415	1 456	0.72
Std	329	201	27	220	504	0.09
in %	32	52	107	53	35	13
Min	565	120	0	120	745	0.57
Max	1 710	880	80	950	2 660	0.87

Total number of analysed bin liners	40
Average weight of a bin liner (g)	1 636
Bin liner volume (m^3)	0.07
Specific weight (kg/m^3)	23

[1] The purity index was calculated by dividing the amount of 'Paperboard and plastic waste' by the grand total amount of packaging waste.

[2] 'Paperboard and plastic waste' consisted of packaging waste manufactured from paperbpard, liquid board, and plastic.

[3] Missorted 'Biowaste and paper' consisted of packaging waste manufactured from paper and wood and of food left-overs.

[4] Missorted mixed waste consisted of composites and other trash.

B. ‘Biowaste and paper’

	Packaging waste amount (g)							Purity index[1]
	'Biowaste and paper'[2]	Biodegradable fraction of 'Paperboard and plastic'[3]	Total Biodegradable waste	Missorted non-biodegradable fraction of 'Paperboard and plastic'[4]	Missorted mixed waste[5]	Total missorted waste	Grand total	
PHASE 1								
Wednesday 11.9.2002								
Bin liner -1	1 760	330	2 090	250	20	270	2 360	0.89
Bin liner -2	1 480	220	1 700	100	10	110	1 810	0.94
Bin liner -3	730	100	830	75	10	85	915	0.91
Bin liner -4	850	150	1 000	110	35	145	1 145	0.87
Bin liner -5	560	40	600	50	10	60	660	0.91
Bin liner -6	555	15	570	45	10	55	625	0.91
Bin liner -7	1 280	100	1 380	90	5	95	1 475	0.94
Average	1 031	136	1 167	103	14	117	1 284	0.91
Std	477	109	577	69	10	74	639	0.02
in %	46	80	49	67	71	63	50	3
Min	555	15	570	45	5	55	625	0.87
Max	1 760	330	2 090	250	35	270	2 360	0.94
PHASE 2								
Monday 4.11.2002								
Bin liner -1	1 925	325	2 250	100	55	155	2 405	0.94
Bin liner -2	4 465	330	4 795	50	20	70	4 865	0.99
Bin liner -3	2 305	300	2 605	100	10	110	2 715	0.96
Bin liner -4	2 385	280	2 665	200	10	210	2 875	0.93
Bin liner -5	3 455	410	3 865	350	50	400	4 265	0.91
Monday 11.11.2002								
Bin liner -1	1 740	235	1 975	50	50	100	2 075	0.95
Bin liner -2	1 610	120	1 730	50	10	60	1 790	0.97
Bin liner -3	1 470	90	1 560	40	30	70	1 630	0.96
Bin liner -4	690	75	765	15	40	55	820	0.93
Tuesday 26.11.2002								
Bin liner -1	2 745	265	3 010	200	50	250	3 260	0.92
Bin liner -2	2 295	70	2 365	45	5	50	2 415	0.98
Bin liner -3	1 485	70	1 555	45	5	50	1 605	0.97
Bin liner -4	1 335	90	1 425	25	15	40	1 465	0.97
Average	2 147	205	2 351	98	27	125	2 476	0.95
Std	989	122	1 081	97	20	106	1 141	0.02
in %	46	60	46	99	73	85	46	3
Min	690	70	765	15	5	40	820	0.91
Max	4 465	410	4 795	350	55	400	4 865	0.99

	Packaging waste amount (g)							Purity index[1]
	'Biowaste and paper'[2]	Biodegradable fraction of 'Paperboard and plastic'[3]	Total Biodegradable waste	Missorted non-biodegradable fraction of 'Paperboard and plastic'[4]	Missorted mixed waste[5]	Total missorted waste	Grand total	
PHASE 3								
Sunday 8.12.2002								
Bin liner -1	2 115	370	2 485	125	10	135	2 620	0.95
Bin liner -2	955	215	1 170	60	30	90	1 260	0.93
Bin liner -3	1 575	210	1 785	45	30	75	1 860	0.96
Bin liner -4	2 045	470	2 515	135	20	155	2 670	0.94
Monday 9.12.2002								
Bin liner -1	2 370	140	2 510	120	10	130	2 640	0.95
Bin liner -2	2 445	190	2 635	125	10	135	2 770	0.95
Bin liner -3	1 060	195	1 255	80	10	90	1 345	0.93
Bin liner -4	3 075	160	3 235	60	20	80	3 315	0.98
Friday 10.1.2003								
Bin liner -1	2 860	380	3 240	100	25	125	3 365	0.96
Bin liner -2	2 370	180	2 550	90	20	110	2 660	0.96
Bin liner -3	2 030	190	2 220	30	20	50	2 270	0.98
Average	2 082	245	2 327	88	19	107	2 434	0.95
Std	668	108	685	36	8	32	697	0.02
in %	32	44	29	41	42	30	29	2
Min	955	140	1 170	30	10	50	1 260	0.93
Max	3 075	470	3 240	135	30	155	3 365	0.98

Total number of analysed bin liners	31
Average weight of a bin liner (g)	2 192
Bin liner volume (m^3)	0.07
Specific weight (kg/m^3)	31

[1] The purity index was calculated by dividing the amount of total biodegradable waste by the grand total amount of packaging waste.
[2] 'Biowaste and paper' consisted of packaging waste manufactured from paper and wood and of food left-overs.
[3] Biodegradable fraction of 'Paperboard and plastic waste' consisted of packaging waste manufactured from paperboard.
[4] Missorted non-biodegradable fraction of 'Paperboard and plastic waste' consisted of packaging waste manufactures from liquid board and plastic.
[5] Missorted mixed waste consisted of composites and other trash.

Appendix 6. Waste management practises at outlets 1 and 2 before and after the introduction of packaging waste sorting

	Unit	Outlet 1		Outlet 2	
		Before	After	Before	After
'Paperboard and plastic waste' disposed of in the dining area					
Collector[1]	-	-	C4	-	C3
Unit size[2]	m^3/unit	-	4.00	-	5.00[dcc]
Number of units[2]	unit/pick-up	-	1	-	1
Pick-up frequency[2]	pick-ups/ week	-	1	-	2
Weekly capacity[3]	m^3/week	-	4.00[c]	-	10.00[uc]
Unit price[4]	euros/unit	-	20.00	-	20.00
of which transport charge	euros/unit	-	20.00	-	20.00
of which treatment charge	euros/unit	-	0	-	0
Weekly disposal costs[5]	euros/ week	-	20.00	-	40.00
Specific cost[6]	euros/m^3	-	5.00	-	4.00
Cardboard waste disposed of in the kitchen area					
Collector[1]	-	C1	-[7]	C2	C3
Unit size[2]	m^3/unit	0.75	-	0.75	0.75
Number of units[2]	unit/pick-up	1	-	1	2
Pick-up frequency[2]	pick-ups/ week	1	-	2	2
Weekly capacity[3]	m^3/week	0.75[c]	-	1.50[c]	3.00[c]
Unit price[4]	euros/unit	9.16	-	6.92	7.50
of which transport charge	euros/unit	9.16	-	6.92	7.50
of which treatment charge	euros/unit	0	-	0	0
Weekly disposal costs[5]	euros/ week	9.16	-	13.84	30.00
Specific cost[6]	euros/m^3	12.21	-	9.23	10.00

	Unit	Outlet 1		Outlet 2	
		Before	After	Before	After
'Biowaste and paper' disposed of in the dining area and biodegradable waste disposed of in the kitchen area					
Collector[1]	-	C1	C1	C2	C3
Unit size[2]	m^3/unit	0.24	0.24	0.24	0.75[dcc]
Number of units[2]	unit/pick-up	5	5	2	2
Pick-up frequency[2]	pick-ups/ week	1	2	2	2
Weekly capacity[3]	m^3/week	1.20[uc]	2.40[uc]	0.96[uc]	3.00[uc]
Unit price[4]	euros/unit	7.20	7.20	5.39	24.63
of which transport charge	euros/unit	5.80	5.80	3.41	22.00
of which treatment charge	euros/unit	1.40	1.40	1.98	2.63[8]
Weekly disposal costs[5]	euros/ week	36.00	72.00	21.56	98.52
Specific cost[6]	euros/m^3	30.00	30.00	22.46	32.84
Mixed waste disposed of in the dining and kitchen area					
Collector[1]	-	C1	C1	C2	C3
Unit size[2]	m^3/unit	0.60	0.60	0.34	5.00 [dcc]
Number of units[2]	unit/pick-up	3	2	4	1
Pick-up frequency[2]	pick-ups/ week	3	2	4	2
Weekly capacity[3]	m^3/week	5.40[c]	2.40[c]	5.44[c]	10.00[uc]
Unit price[4]	euros/unit	9.61	9.61	3.51	35.43
of which transport charge	euros/unit	7.00	7.00	2.29	18.00
of which treatment charge	euros/unit	2.61	2.61	1.22	17.43[9]
Weekly disposal costs[5]	euros/ week	86.49	38.44	56.16	70.86
Specific cost[6]	euros/m^3	16.02	16.02	10.32	7.09
Total weekly capacity	m^3/week	7.35	8.80	7.90	26.00
Total weekly disposal costs	euros/ week	131.65	130.44	91.56	239.38

[1] The collectors were named as C1, C2, C3, and C4.

[2] Unit size, the number of units, and pick-up frequency were defined in a contract the outlet had made with the collector.

[3] Weekly capacities were calculated as unit size (m^3) times the number of units (unit/pick-up) times pick-up frequency (pick-ups/week).

[4] Unit prices were defined in the invoices (vat excluded).

[5] Weekly disposal costs were calculated as the number of units (unit/pick-up) times pick-up frequency (pick-ups/week) times unit price (euros/unit) (vat excluded).

[6] Specific costs were calculated as unit price (euros/unit) divided by unit size (m^3/unit) (vat excluded).

[7] Cardboard waste was collected together with 'Paperboard and plastic waste'.

[8] The average weight was 0.13 tonnes/container (company confidential invoices) and the collection charge was 20.26 euros/tonne (defined in the invoice).

[9] The average weight was 0.28 tonnes/container (company confidential invoices) and the treatment charge was 62.26 euros/tonne (defined in the invoice).

[c] Mechanically compacted waste

[uc] Mechanically uncompacted waste

[dcc] Deep collection container

Appendix 7. Influence of packaging materials on the theoretical recovery rate

A. Total amounts and theoretical recovery rate of packaging waste

	Total annual amount of packaging waste	of which			
		Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
	kg	kg	kg	kg	kg
Sales packaging disposed of outside the outlets	379 940	166 602	189 712	13 716	9 910
Sales packaging disposed of in the dining area	552 450	245 560	274 027	32 004	859
Primary and secondary packaging diposed of in the kitchen area	687 569	555 245	0	7 662	124 662
Total	1 619 960	967 407	463 739	53 382	135 431
of which recyclable packaging waste	1 484 528				
Theoretical recovery rate (%)	92				

B. Sales packaging disposed of outside the outlets

Waste category			Household waste			
Packaging category			Sales			
Disposal location			Outside the outlets			
Packaging material			Paperboard, Liquid board	Paper, Wood	Plastic	Composite
Preferred waste treatment option			Recycling (fibre)	Composting	Energy recovery	Disposal in landfills
Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Changes at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
1. Sales Packaging - Paperboard						
Sales Packaging -1	IN	-	-	-	-	-
Sales Packaging -2	IN, OUT	-	3 038	-	-	-
Sales Packaging -3	IN, OUT	replacement with a paper alternative (Sales Packaging -34)	-	-	-	-
Sales Packaging -4	IN, OUT	replacement with a new paper alternative (Sales packaging -N2)	-	-	-	-
Sales Packaging -5	IN, OUT	replacement with a new paper alternative (Sales packaging -N3)	-	-	-	-
Sales Packaging -6	IN, OUT	replacement with a new paper alternative (Sales packaging -N4)	-	-	-	-
Sales Packaging -7	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -N5)	-	-	-	-
Sales Packaging -8	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -42)	-	-	-	-
Sales Packaging -9	IN, OUT	replacement with a new paper alternative (Sales packaging -N6)	-	-	-	-
Sales Packaging -10	IN, OUT	replacement with a new paper alternative (Sales packaging -N7)	-	-	-	-
Sales Packaging -11	IN, OUT	replacement with a new paper alternative (Sales packaging -N8)	-	-	-	-
Sales Packaging -12	IN, OUT	replacement with a new paper alternative (Sales packaging -N9)	-	-	-	-
Sales Packaging -13	IN, OUT	replacement with a new paper alternative (Sales packaging -N10)	-	-	-	-
Sales Packaging -14	OUT	-	-	-	-	-
Sales Packaging -15	OUT	-	-	-	-	-
Sales Packaging -16	OUT	change in amount	61 751	-	-	-
Sales Packaging -17	OUT	replacement with Sales Packaging -16	-	-	-	-
Sales packaging -N1	OUT	a new sales packaging	87	-	-	-
Total	6		64 875	0	0	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			3	0	0	0
2. Sales packaging - Liquid board						
Sales packaging -18	IN, OUT	-	33 649	-	-	-
Sales packaging -19	IN, OUT	change in amount	21 582	-	-	-
Sales packaging -20	IN, OUT	-	15 362	-	-	-
Sales packaging -21	IN, OUT	-	8 281	-	-	-
Sales packaging -22	IN, OUT	-	6 312	-	-	-
Sales packaging -23	IN, OUT	-	857	-	-	-
Sales packaging -24	IN, OUT	-	2 266	-	-	-
Sales packaging -25	IN, OUT	-	6 495	-	-	-
Sales packaging -26	IN, OUT	-	272	-	-	-
Sales packaging -27	IN, OUT	-	3 013	-	-	-
Sales packaging -28	IN, OUT	-	3 638	-	-	-
Total	11		101 727	0	0	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			11	0	0	0
3. Sales Packaging - Paper						
Sales packaging -29	IN	replacement with a new alternative (larger unit size) (Sales packaging -N11)	-	-	-	-
Sales packaging -30	IN, OUT	-	-	60 214	-	-
Sales packaging -31	IN, OUT	replacement with Sales Packaging -32	-	-	-	-
Sales packaging -32	IN, OUT	change in amount	-	14 087	-	-
Sales packaging -33	IN, OUT	-	-	277	-	-
Sales packaging -34	IN, OUT	change in amount	-	5 202	-	-
Sales packaging -35	IN, OUT	-	-	97	-	-
Sales packaging -36	IN, OUT	-	-	60	-	-
Sales packaging -37	IN, OUT	-	-	6	-	-
Sales packaging -38	IN, OUT	-	-	1 980	-	-
Sales packaging -39	IN, OUT	-	-	781	-	-
Sales packaging -40	IN, OUT	-	-	462	-	-
Sales packaging -41	IN, OUT	-	-	768	-	-
Sales packaging -42	IN, OUT	change in amount	-	3 064	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Changes at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Sales packaging -43	IN, OUT	-	-	441	-	-
Sales packaging -44	IN, OUT	-	-	2 700	-	-
Sales packaging -45	IN, OUT	-	-	1 257	-	-
Sales packaging -46	IN, OUT	-	-	158	-	-
Sales packaging -47	IN, OUT	-	-	158	-	-
Sales packaging -48	IN, OUT	-	-	454	-	-
Sales packaging -49	IN, OUT	-	-	67	-	-
Sales packaging -50	IN, OUT	limited use (one piece per a transaction)	-	899	-	-
Sales packaging -51	IN, OUT	limited use (one piece per a transaction)	-	410	-	-
Sales packaging -52	IN, OUT	limited use (one piece per a transaction)	-	82	-	-
Sales packaging -53	IN, OUT	-	-	142	-	-
Sales packaging -54	IN, OUT	-	-	286	-	-
Sales packaging -55	OUT	-	-	13 206	-	-
Sales packaging -56	OUT	-	-	32 784	-	-
Sales packaging -57	OUT	-	-	27 843	-	-
Sales packaging -58	OUT	-	-	4 379	-	-
Sales packaging -N2	IN, OUT	a new sales packaging	-	780	-	-
Sales packaging -N3	IN, OUT	a new sales packaging	-	2 270	-	-
Sales packaging -N4	IN, OUT	a new sales packaging	-	95	-	-
Sales packaging -N5	IN, OUT	a new sales packaging	-	9 314	-	-
Sales packaging -N6	IN, OUT	a new sales packaging	-	534	-	-
Sales packaging -N7	IN, OUT	a new sales packaging	-	1 306	-	-
Sales packaging -N8	IN, OUT	a new sales packaging	-	180	-	-
Sales packaging -N9	IN, OUT	a new sales packaging	-	998	-	-
Sales packaging -N10	IN, OUT	a new sales packaging	-	78	-	-
Sales packaging -N11	IN	a new sales packaging	-	-	-	-
Total	38		0	187 819	0	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			0	37	0	0
4. Sales packaging - Wood						
Sales Packaging -59	IN, OUT	-	-	222	-	-
Sales Packaging -60	IN, OUT	-	-	109	-	-
Sales packaging -N12	IN, OUT	a new sales packaging	-	850	-	-
Sales packaging -N13	IN, OUT	a new sales packaging	-	713	-	-
Total	4		0	1 892	0	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			0	4	0	0
5. Sales packaging - Plastics						
Sales packaging -61	IN, OUT	limited use (only in take away products)	-	-	2 249	-
Sales packaging -62	IN, OUT	limited use (only in take away products and for children's use)	-	-	2 946	-
Sales packaging -63	IN, OUT	limited use (only in take away products)	-	-	436	-
Sales packaging -64	IN, OUT	replacement with a new wooden alternative (Sales packaging -N12)	-	-	-	-
Sales packaging -65	IN, OUT	replacement with a new wooden alternative (Sales packaging -N13)	-	-	-	-
Sales packaging -66	IN, OUT	limited use (only in take away products)	-	-	468	-
Sales packaging -67	IN, OUT	limited used (only in take away products)	-	-	175	-
Sales packaging -68	IN, OUT	removal	-	-	-	-
Sales packaging -69	IN, OUT	-	-	-	4 142	-
Sales packaging -70	IN, OUT	-	-	-	2 061	-
Sales packaging -71	IN, OUT	-	-	-	596	-
Sales packaging -72	IN, OUT	replacement with Raw material -34 (larger unit size) and Sales packaging -19	-	-	-	-
Sales packaging -73	IN, OUT	-	-	-	146	-
Sales packaging -74	OUT	limited use (only in take away products)	-	-	497	-
Sales packaging -75	OUT	replacement with a new carton alternative (Sales packaging -N1)	-	-	-	-
Total	10		0	0	13 716	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			0	0	10	0

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Changes at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
6. Sales packagaing - Composites						
Sales packaging -76	IN	removal	-	-	-	-
Sales packaging -77	IN, OUT	removal	-	-	-	-
Sales packaging -78	IN, OUT	removal	-	-	-	-
Sales packaging -79	IN, OUT	removal	-	-	-	-
Sales packaging -80	IN, OUT	replacement with Raw material N -1 (larger unit size) and Sales packagir	-	-	-	-
Sales packaging -81	IN, OUT	replacement with Raw material -N2 (larger unit size)	-	-	-	-
Sales packaging -82	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -83	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -84	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -85	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -86	IN, OUT	-	-	-	-	74
Sales packaging -87	IN, OUT	-	-	-	-	142
Sales packaging -88	IN, OUT	-	-	-	-	52
Sales packaging -89	IN, OUT	-	-	-	-	101
Sales packaging -90	IN, OUT	removal	-	-	-	-
Sales packaging -91	OUT	replacement with a Sales Packaging -N14 (a larger unit size)	-	-	-	-
Sales packaging -N14	OUT	a new sales packaging	-	-	-	9 542
Total	5		0	0	0	9 910
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			0	0	0	5
7. Food raw materials						
Raw material -1	IN	-	-	-	-	-
Raw material -2	IN	-	-	-	-	-
Raw material -3	IN	-	-	-	-	-
Raw material -4	IN	-	-	-	-	-
Raw material -5	IN	-	-	-	-	-
Raw material -6	IN	-	-	-	-	-
Raw material -7	IN	-	-	-	-	-
Raw material -8	IN	-	-	-	-	-
Raw material -9	IN	-	-	-	-	-
Raw material -10	IN	-	-	-	-	-
Raw material -11	IN	-	-	-	-	-
Raw material -12	IN	-	-	-	-	-
Raw material -13	IN	-	-	-	-	-
Raw material -14	IN	-	-	-	-	-
Raw material -15	IN	-	-	-	-	-
Raw material -16	IN	-	-	-	-	-
Raw material -17	IN	-	-	-	-	-
Raw material -18	IN	-	-	-	-	-
Raw material -19	IN	-	-	-	-	-
Raw material -20	IN	-	-	-	-	-
Raw material -21	IN	-	-	-	-	-
Raw material -22	IN	-	-	-	-	-
Raw material -23	IN	-	-	-	-	-
Raw material -24	IN	-	-	-	-	-
Raw material -25	IN	-	-	-	-	-
Raw material -26	IN	-	-	-	-	-
Raw material -27	IN	-	-	-	-	-
Raw material -28	IN	-	-	-	-	-
Raw material -29	IN	-	-	-	-	-
Raw material -30	IN	-	-	-	-	-
Raw material -31	IN	-	-	-	-	-
Raw material -32	IN	-	-	-	-	-
Raw material -33	IN	-	-	-	-	-
Raw material -34	IN	change in amount	-	-	-	-
Raw material -35	IN	-	-	-	-	-
Raw material -36	IN	-	-	-	-	-
Raw material -37	IN	-	-	-	-	-
Raw material -38	IN	-	-	-	-	-
Raw material -39	IN	-	-	-	-	-
Raw material -40	IN	-	-	-	-	-
Raw material -41	IN	-	-	-	-	-
Raw material -42	IN	-	-	-	-	-
Raw material -43	IN	-	-	-	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Changes at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Raw material -44	IN	-	-	-	-	-
Raw material -45	IN	-	-	-	-	-
Raw material -46	IN	-	-	-	-	-
Raw material -47	IN	-	-	-	-	-
Raw material -48	IN	-	-	-	-	-
Raw material -49	IN	-	-	-	-	-
Raw material -50	IN	-	-	-	-	-
Raw material -51	IN	-	-	-	-	-
Raw material -52	IN	-	-	-	-	-
Raw material -53	IN	-	-	-	-	-
Raw material -54	IN	-	-	-	-	-
Raw material -55	IN	-	-	-	-	-
Raw material -56	IN	-	-	-	-	-
Raw material -57	IN	-	-	-	-	-
Raw material -58	IN	-	-	-	-	-
Raw material -59	IN	-	-	-	-	-
Raw material -60	IN	-	-	-	-	-
Raw material -61	IN	-	-	-	-	-
Raw material -62	IN	-	-	-	-	-
Raw material -63	IN	-	-	-	-	-
Raw material -64	IN	-	-	-	-	-
Raw material -65	IN	-	-	-	-	-
Raw material -66	IN	-	-	-	-	-
Raw material -67	IN	-	-	-	-	-
Raw material -68	IN	-	-	-	-	-
Raw material -69	IN	-	-	-	-	-
Raw material -70	IN	-	-	-	-	-
Raw material -71	IN	-	-	-	-	-
Raw material -72	IN	-	-	-	-	-
Raw material -73	IN	-	-	-	-	-
Raw material -74	IN	-	-	-	-	-
Raw material -75	IN	-	-	-	-	-
Raw material -76	IN	-	-	-	-	-
Raw material -77	IN	-	-	-	-	-
Raw material -78	IN	-	-	-	-	-
Raw material -79	IN	-	-	-	-	-
Raw material -80	IN	-	-	-	-	-
Raw material -81	IN	-	-	-	-	-
Raw material -82	IN	-	-	-	-	-
Raw material -83	IN	-	-	-	-	-
Raw material -84	IN	-	-	-	-	-
Raw material -85	IN	-	-	-	-	-
Raw material -86	IN	-	-	-	-	-
Raw material -87	IN	-	-	-	-	-
Raw material -88	IN	-	-	-	-	-
Raw material -89	IN	-	-	-	-	-
Raw material -90	IN	replacement with Raw material -91	-	-	-	-
Raw material -91	IN	change in amount	-	-	-	-
Raw material -92	IN	replacement with Raw material -N91 and Sales packaging -19	-	-	-	-
Raw material -93	IN	-	-	-	-	-
Raw material -94	IN	-	-	-	-	-
Raw material -95	IN	-	-	-	-	-
Raw material -96	IN	-	-	-	-	-
Raw material -97	IN	-	-	-	-	-
Raw material -98	IN	-	-	-	-	-
Raw material -99	IN	-	-	-	-	-
Raw material -100	IN	-	-	-	-	-
Raw material -101	IN	-	-	-	-	-
Raw material -102	IN	-	-	-	-	-
Raw material -103	IN	-	-	-	-	-
Raw material -104	IN	-	-	-	-	-
Raw material -105	IN	-	-	-	-	-
Raw material -106	IN	-	-	-	-	-
Raw material -N1	IN	new raw material	-	-	-	-
Raw material -N2	IN	new raw material	-	-	-	-
Raw material -N3	IN	new raw material	-	-	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Changes at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Total	106		0	0	0	0
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			0	0	0	0
TOTAL (1-7)	180		166 602	189 712	13 716	9 910
Number of packaging items (IN)			-	-	-	-
Number of packaging items (OUT)			14	41	10	5
[1] IN - Packaging disposed of at the outlets						
OUT - Packaging disposed of outside the outlets						

C. Sales packaging disposed of in the dining area

Waste category			Commercial/industrial waste			
Packaging category			Sales			
Disposal location			Dining area			
Packaging material			Paperboard, Liquid board	Paper, Wood	Plastic	Composite
Preferred waste treatment option			Recycling (fibre)	Composting	Energy recovery	Disposal in landfills
Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
1. Sales Packaging - Paperboard						
Sales Packaging -1	IN	-	907	-	-	-
Sales Packaging -2	IN, OUT	-	7 088	-	-	-
Sales Packaging -3	IN, OUT	replacement with a paper alternative (Sales Packaging -34)	-	-	-	-
Sales Packaging -4	IN, OUT	replacement with a new paper alternative (Sales packaging -N2)	-	-	-	-
Sales Packaging -5	IN, OUT	replacement with a new paper alternative (Sales packaging -N3)	-	-	-	-
Sales Packaging -6	IN, OUT	replacement with a new paper alternative (Sales packaging -N4)	-	-	-	-
Sales Packaging -7	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -N5)	-	-	-	-
Sales Packaging -8	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -42)	-	-	-	-
Sales Packaging -9	IN, OUT	replacement with a new paper alternative (Sales packaging -N6)	-	-	-	-
Sales Packaging -10	IN, OUT	replacement with a new paper alternative (Sales packaging -N7)	-	-	-	-
Sales Packaging -11	IN, OUT	replacement with a new paper alternative (Sales packaging -N8)	-	-	-	-
Sales Packaging -12	IN, OUT	replacement with a new paper alternative (Sales packaging -N9)	-	-	-	-
Sales Packaging -13	IN, OUT	replacement with a new paper alternative (Sales packaging -N10)	-	-	-	-
Sales Packaging -14	OUT	-	-	-	-	-
Sales Packaging -15	OUT	-	-	-	-	-
Sales Packaging -16	OUT	change in amount	-	-	-	-
Sales Packaging -17	OUT	replacement with Sales Packaging -16	-	-	-	-
Sales packaging -N1	OUT	a new sales packaging	203	-	-	-
Total	6		8 198	0	0	0
Number of packaging items (IN)			3	0	0	0
Number of packaging items (OUT)			-	-	-	-
2. Sales packaging - Liquid board						
Sales packaging -18	IN, OUT	-	78 515	-	-	-
Sales packaging -19	IN, OUT	change in amount	50 358	-	-	-
Sales packaging -20	IN, OUT	-	35 845	-	-	-
Sales packaging -21	IN, OUT	-	19 323	-	-	-
Sales packaging -22	IN, OUT	-	14 727	-	-	-
Sales packaging -23	IN, OUT	-	1 999	-	-	-
Sales packaging -24	IN, OUT	-	5 286	-	-	-
Sales packaging -25	IN, OUT	-	15 155	-	-	-
Sales packaging -26	IN, OUT	-	634	-	-	-
Sales packaging -27	IN, OUT	-	7 029	-	-	-
Sales packaging -28	IN, OUT	-	8 490	-	-	-
Total	11		237 362	0	0	0
Number of packaging items (IN)			11	0	0	0
Number of packaging items (OUT)			-	-	-	-
3. Sales Packaging - Paper						
Sales packaging -29	IN	replacement with a new alternative (larger unit size) (Sales packaging -N11)	-	-	-	-
Sales packaging -30	IN, OUT	-	-	140 500	-	-
Sales packaging -31	IN, OUT	replacement with Sales Packaging -32	-	-	-	-
Sales packaging -32	IN, OUT	change in amount	-	32 870	-	-
Sales packaging -33	IN, OUT	-	-	647	-	-
Sales packaging -34	IN, OUT	change in amount	-	12 138	-	-
Sales packaging -35	IN, OUT	-	-	227	-	-
Sales packaging -36	IN, OUT	-	-	140	-	-
Sales packaging -37	IN, OUT	-	-	13	-	-
Sales packaging -38	IN, OUT	-	-	4 620	-	-
Sales packaging -39	IN, OUT	-	-	1 823	-	-
Sales packaging -40	IN, OUT	-	-	1 078	-	-
Sales packaging -41	IN, OUT	-	-	1 791	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
Sales packaging -42	IN, OUT	change in amount	-	7 149	-	-
Sales packaging -43	IN, OUT	-	-	1 029	-	-
Sales packaging -44	IN, OUT	-	-	6 300	-	-
Sales packaging -45	IN, OUT	-	-	2 933	-	-
Sales packaging -46	IN, OUT	-	-	370	-	-
Sales packaging -47	IN, OUT	-	-	370	-	-
Sales packaging -48	IN, OUT	-	-	1 058	-	-
Sales packaging -49	IN, OUT	-	-	156	-	-
Sales packaging -50	IN, OUT	limited use (one piece per a transaction)	-	2 098	-	-
Sales packaging -51	IN, OUT	limited use (one piece per a transaction)	-	958	-	-
Sales packaging -52	IN, OUT	limited use (one piece per a transaction)	-	191	-	-
Sales packaging -53	IN, OUT	-	-	544	-	-
Sales packaging -54	IN, OUT	-	-	917	-	-
Sales packaging -55	OUT	-	-	-	-	-
Sales packaging -56	OUT	-	-	-	-	-
Sales packaging -57	OUT	-	-	-	-	-
Sales packaging -58	OUT	-	-	-	-	-
Sales packaging -N2	IN, OUT	a new sales packaging	-	1 819	-	-
Sales packaging -N3	IN, OUT	a new sales packaging	-	5 298	-	-
Sales packaging -N4	IN, OUT	a new sales packaging	-	222	-	-
Sales packaging -N5	IN, OUT	a new sales packaging	-	21 732	-	-
Sales packaging -N6	IN, OUT	a new sales packaging	-	1 245	-	-
Sales packaging -N7	IN, OUT	a new sales packaging	-	3 048	-	-
Sales packaging -N8	IN, OUT	a new sales packaging	-	419	-	-
Sales packaging -N9	IN, OUT	a new sales packaging	-	2 328	-	-
Sales packaging -N10	IN, OUT	a new sales packaging	-	182	-	-
Sales packaging -N11	IN	a new sales packaging	-	13 400	-	-
Total	38		0	269 611	0	0
Number of packaging items (IN)			0	34	0	0
Number of packaging items (OUT)			-	-	-	-
4. Sales packaging - Wood						
Sales Packaging -59	IN, OUT	-	-	517	-	-
Sales Packaging -60	IN, OUT	-	-	253	-	-
Sales packaging -N12	IN, OUT	a new sales packaging	-	1 982	-	-
Sales packaging -N13	IN, OUT	a new sales packaging	-	1 663	-	-
Total	4		0	4 416	0	0
Number of packaging items (IN)			0	4	0	0
Number of packaging items (OUT)			-	-	-	-
5. Sales packaging - Plastics						
Sales packaging -61	IN, OUT	limited use (only in take away products)	-	-	5 248	-
Sales packaging -62	IN, OUT	limited use (only in take away products and for children's use)	-	-	6 875	-
Sales packaging -63	IN, OUT	limited use (only in take away products)	-	-	1 018	-
Sales packaging -64	IN, OUT	replacement with a new wooden alternative (Sales packaging -N12)	-	-	-	-
Sales packaging -65	IN, OUT	replacement with a new wooden alternative (Sales packaging -N13)	-	-	-	-
Sales packaging -66	IN, OUT	limited use (only in take away products)	-	-	1 092	-
Sales packaging -67	IN, OUT	limited used (only in take away products)	-	-	407	-
Sales packaging -68	IN, OUT	removal	-	-	-	-
Sales packaging -69	IN, OUT	-	-	-	9 664	-
Sales packaging -70	IN, OUT	-	-	-	4 808	-
Sales packaging -71	IN, OUT	-	-	-	1 391	-
Sales packaging -72	IN, OUT	replacement with Raw material -34 (larger unit size) and Sales packaging -19	-	-	-	-
Sales packaging -73	IN, OUT	-	-	-	341	-
Sales packaging -74	OUT	limited use (only in take away products)	-	-	1 159	-
Sales packaging -75	OUT	replacement with a new carton alternative (Sales packaging -N1)	-	-	-	-
Total	10		0	0	32 004	0
Number of packaging items (IN)			0	0	10	0
Number of packaging items (OUT)			-	-	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
6. Sales packagaing - Composites						
Sales packaging -76	IN	removal	-	-	-	-
Sales packaging -77	IN, OUT	removal	-	-	-	-
Sales packaging -78	IN, OUT	removal	-	-	-	-
Sales packaging -79	IN, OUT	removal	-	-	-	-
Sales packaging -80	IN, OUT	replacement with Raw material N -1 (larger unit size) and Sales packagir	-	-	-	-
Sales packaging -81	IN, OUT	replacement with Raw material -N2 (larger unit size)	-	-	-	-
Sales packaging -82	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -83	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -84	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -85	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -86	IN, OUT	-	-	-	-	172
Sales packaging -87	IN, OUT	-	-	-	-	330
Sales packaging -88	IN, OUT	-	-	-	-	122
Sales packaging -89	IN, OUT	-	-	-	-	235
Sales packaging -90	IN, OUT	removal	-	-	-	-
Sales packaging -91	OUT	replacement with a Sales Packaging -N14 (a larger unit size)	-	-	-	-
Sales packaging -N14	OUT	a new sales packaging	-	-	-	-
Total	5		0	0	0	859
Number of packaging items (IN)			0	0	0	4
Number of packaging items (OUT)			-	-	-	-
7. Food raw materials						
Raw material -1	IN	-	-	-	-	-
Raw material -2	IN	-	-	-	-	-
Raw material -3	IN	-	-	-	-	-
Raw material -4	IN	-	-	-	-	-
Raw material -5	IN	-	-	-	-	-
Raw material -6	IN	-	-	-	-	-
Raw material -7	IN	-	-	-	-	-
Raw material -8	IN	-	-	-	-	-
Raw material -9	IN	-	-	-	-	-
Raw material -10	IN	-	-	-	-	-
Raw material -11	IN	-	-	-	-	-
Raw material -12	IN	-	-	-	-	-
Raw material -13	IN	-	-	-	-	-
Raw material -14	IN	-	-	-	-	-
Raw material -15	IN	-	-	-	-	-
Raw material -16	IN	-	-	-	-	-
Raw material -17	IN	-	-	-	-	-
Raw material -18	IN	-	-	-	-	-
Raw material -19	IN	-	-	-	-	-
Raw material -20	IN	-	-	-	-	-
Raw material -21	IN	-	-	-	-	-
Raw material -22	IN	-	-	-	-	-
Raw material -23	IN	-	-	-	-	-
Raw material -24	IN	-	-	-	-	-
Raw material -25	IN	-	-	-	-	-
Raw material -26	IN	-	-	-	-	-
Raw material -27	IN	-	-	-	-	-
Raw material -28	IN	-	-	-	-	-
Raw material -29	IN	-	-	-	-	-
Raw material -30	IN	-	-	-	-	-
Raw material -31	IN	-	-	-	-	-
Raw material -32	IN	-	-	-	-	-
Raw material -33	IN	-	-	-	-	-
Raw material -34	IN	change in amount	-	-	-	-
Raw material -35	IN	-	-	-	-	-
Raw material -36	IN	-	-	-	-	-
Raw material -37	IN	-	-	-	-	-
Raw material -38	IN	-	-	-	-	-
Raw material -39	IN	-	-	-	-	-
Raw material -40	IN	-	-	-	-	-
Raw material -41	IN	-	-	-	-	-
Raw material -42	IN	-	-	-	-	-
Raw material -43	IN	-	-	-	-	-
Raw material -44	IN	-	-	-	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Raw material -45	IN	-	-	-	-	-
Raw material -46	IN	-	-	-	-	-
Raw material -47	IN	-	-	-	-	-
Raw material -48	IN	-	-	-	-	-
Raw material -49	IN	-	-	-	-	-
Raw material -50	IN	-	-	-	-	-
Raw material -51	IN	-	-	-	-	-
Raw material -52	IN	-	-	-	-	-
Raw material -53	IN	-	-	-	-	-
Raw material -54	IN	-	-	-	-	-
Raw material -55	IN	-	-	-	-	-
Raw material -56	IN	-	-	-	-	-
Raw material -57	IN	-	-	-	-	-
Raw material -58	IN	-	-	-	-	-
Raw material -59	IN	-	-	-	-	-
Raw material -60	IN	-	-	-	-	-
Raw material -61	IN	-	-	-	-	-
Raw material -62	IN	-	-	-	-	-
Raw material -63	IN	-	-	-	-	-
Raw material -64	IN	-	-	-	-	-
Raw material -65	IN	-	-	-	-	-
Raw material -66	IN	-	-	-	-	-
Raw material -67	IN	-	-	-	-	-
Raw material -68	IN	-	-	-	-	-
Raw material -69	IN	-	-	-	-	-
Raw material -70	IN	-	-	-	-	-
Raw material -71	IN	-	-	-	-	-
Raw material -72	IN	-	-	-	-	-
Raw material -73	IN	-	-	-	-	-
Raw material -74	IN	-	-	-	-	-
Raw material -75	IN	-	-	-	-	-
Raw material -76	IN	-	-	-	-	-
Raw material -77	IN	-	-	-	-	-
Raw material -78	IN	-	-	-	-	-
Raw material -79	IN	-	-	-	-	-
Raw material -80	IN	-	-	-	-	-
Raw material -81	IN	-	-	-	-	-
Raw material -82	IN	-	-	-	-	-
Raw material -83	IN	-	-	-	-	-
Raw material -84	IN	-	-	-	-	-
Raw material -85	IN	-	-	-	-	-
Raw material -86	IN	-	-	-	-	-
Raw material -87	IN	-	-	-	-	-
Raw material -88	IN	-	-	-	-	-
Raw material -89	IN	-	-	-	-	-
Raw material -90	IN	replacement with Raw material -91	-	-	-	-
Raw material -91	IN	change in amount	-	-	-	-
Raw material -92	IN	replacement with Raw material -N91 and Sales packaging -19	-	-	-	-
Raw material -93	IN	-	-	-	-	-
Raw material -94	IN	-	-	-	-	-
Raw material -95	IN	-	-	-	-	-
Raw material -96	IN	-	-	-	-	-
Raw material -97	IN	-	-	-	-	-
Raw material -98	IN	-	-	-	-	-
Raw material -99	IN	-	-	-	-	-
Raw material -100	IN	-	-	-	-	-
Raw material -101	IN	-	-	-	-	-
Raw material -102	IN	-	-	-	-	-
Raw material -103	IN	-	-	-	-	-
Raw material -104	IN	-	-	-	-	-
Raw material -105	IN	-	-	-	-	-
Raw material -106	IN	-	-	-	-	-
Raw material -N1	IN	new raw material	-	-	-	-
Raw material -N2	IN	new raw material	-	-	-	-
Raw material -N3	IN	new raw material	-	-	-	-

Waste component			Recyclable (fibre) waste	Biodegradable waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Total	106		0	0	0	0
Number of packaging items (IN)			0	0	0	0
Number of packaging items (OUT)			-	-	-	-
TOTAL (1-7)	180		245 560	274 027	32 004	859
Number of packaging items (IN)			14	38	10	4
Number of packaging items (OUT)			-	-	-	-
[1] IN - Packaging disposed of at the outlets						
OUT - Packaging disposed of outside the outlets						

D. Primary and secondary packaging disposed of in the kitchen area

Waste category			Commercial/industrial waste			
Packaging category			Secondary	Primary		
Packaging material			Cardboard	Liquid board	Plastic	Composite
Preferred waste treatment option			Recycling (fibre)	Recycling (fibre)	Energy recovery	Disposal in landfills
Waste component			Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
1. Sales Packaging - Paperboard						
Sales Packaging -1	IN	-	58	-	17	-
Sales Packaging -2	IN, OUT	-	3 167	-	175	-
Sales Packaging -3	IN, OUT	replacement with a paper alternative (Sales Packaging -34)	-	-	-	-
Sales Packaging -4	IN, OUT	replacement with a new paper alternative (Sales packaging -N2)	-	-	-	-
Sales Packaging -5	IN, OUT	replacement with a new paper alternative (Sales packaging -N3)	-	-	-	-
Sales Packaging -6	IN, OUT	replacement with a new paper alternative (Sales packaging -N4)	-	-	-	-
Sales Packaging -7	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -N5)	-	-	-	-
Sales Packaging -8	IN, OUT	replacement with paper alternatives (Sales Packaging -32 and -42)	-	-	-	-
Sales Packaging -9	IN, OUT	replacement with a new paper alternative (Sales packaging -N6)	-	-	-	-
Sales Packaging -10	IN, OUT	replacement with a new paper alternative (Sales packaging -N7)	-	-	-	-
Sales Packaging -11	IN, OUT	replacement with a new paper alternative (Sales packaging -N8)	-	-	-	-
Sales Packaging -12	IN, OUT	replacement with a new paper alternative (Sales packaging -N9)	-	-	-	-
Sales Packaging -13	IN, OUT	replacement with a new paper alternative (Sales packaging -N10)	-	-	-	-
Sales Packaging -14	OUT	-	979	-	-	-
Sales Packaging -15	OUT	-	65	-	-	-
Sales Packaging -16	OUT	change in amount	4 187	-	-	-
Sales Packaging -17	OUT	replacement with Sales Packaging -16	-	-	-	-
Sales packaging -N1	OUT	a new sales packaging	232	-	7	-
Total	6		8 688	0	199	0
Number of packaging items (IN)			6	0	3	0
Number of packaging items (OUT)			-	-	-	-
2. Sales packaging - Liquid board						
Sales packaging -18	IN, OUT	-	10 785	-	1 510	-
Sales packaging -19	IN, OUT	change in amount	5 005	-	625	-
Sales packaging -20	IN, OUT	-	4 300	-	630	-
Sales packaging -21	IN, OUT	-	3 011	-	435	-
Sales packaging -22	IN, OUT	-	2 135	-	-	-
Sales packaging -23	IN, OUT	-	269	-	40	-
Sales packaging -24	IN, OUT	-	646	-	90	-
Sales packaging -25	IN, OUT	-	1 998	-	301	-
Sales packaging -26	IN, OUT	-	80	-	15	-
Sales packaging -27	IN, OUT	-	1 018	-	217	-
Sales packaging -28	IN, OUT	-	1 448	-	236	-
Total	11		30 696	0	4 099	0
Number of packaging items (IN)			11	0	10	0
Number of packaging items (OUT)			-	-	-	-
3. Sales Packaging - Paper						
Sales packaging -29	IN	replacement with a new alternative (larger unit size) (Sales packaging -N11)	-	-	-	-
Sales packaging -30	IN, OUT	-	15 180	-	-	-
Sales packaging -31	IN, OUT	replacement with Sales Packaging -32	-	-	-	-
Sales packaging -32	IN, OUT	change in amount	7 645	-	-	-
Sales packaging -33	IN, OUT	-	37	-	3	-
Sales packaging -34	IN, OUT	change in amount	531	-	-	-
Sales packaging -35	IN, OUT	-	15	-	2	-
Sales packaging -36	IN, OUT	-	24	-	-	-
Sales packaging -37	IN, OUT	-	77	-	12	-
Sales packaging -38	IN, OUT	-	163	-	28	-
Sales packaging -39	IN, OUT	-	28	-	12	-
Sales packaging -40	IN, OUT	-	33	-	6	-
Sales packaging -41	IN, OUT	-	78	-	7	-
Sales packaging -42	IN, OUT	change in amount	277	-	41	-
Sales packaging -43	IN, OUT	-	39	-	6	-
Sales packaging -44	IN, OUT	-	223	-	39	-

Waste component			Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Sales packaging -45	IN, OUT	-	137	-	8	-
Sales packaging -46	IN, OUT	-	13	-	3	-
Sales packaging -47	IN, OUT	-	13	-	3	-
Sales packaging -48	IN, OUT	-	55	-	8	-
Sales packaging -49	IN, OUT	-	20	-	7	-
Sales packaging -50	IN, OUT	limited use (one piece per a transaction)	849	-	770	-
Sales packaging -51	IN, OUT	limited use (one piece per a transaction)	388	-	352	-
Sales packaging -52	IN, OUT	limited use (one piece per a transaction)	370	-	-	-
Sales packaging -53	IN, OUT	-	117	-	1	-
Sales packaging -54	IN, OUT	-	159	-	1	-
Sales packaging -55	OUT	-	-	-	311	-
Sales packaging -56	OUT	-	300	-	-	-
Sales packaging -57	OUT	-	283	-	-	-
Sales packaging -58	OUT	-	62	-	-	-
Sales packaging -N2	IN, OUT	a new sales packaging	36	-	-	-
Sales packaging -N3	IN, OUT	a new sales packaging	284	-	-	-
Sales packaging -N4	IN, OUT	a new sales packaging	119	-	-	-
Sales packaging -N5	IN, OUT	a new sales packaging	816	-	116	-
Sales packaging -N6	IN, OUT	a new sales packaging	25	-	-	-
Sales packaging -N7	IN, OUT	a new sales packaging	61	-	-	-
Sales packaging -N8	IN, OUT	a new sales packaging	8	-	-	-
Sales packaging -N9	IN, OUT	a new sales packaging	87	-	12	-
Sales packaging -N10	IN, OUT	a new sales packaging	2	-	-	-
Sales packaging -N11	IN	a new sales packaging	1 217	-	-	-
Total	38		29 770	0	1 748	0
Number of packaging items (IN)			37	0	22	0
Number of packaging items (OUT)			-	-	-	-
4. Sales packaging - Wood						
Sales Packaging -59	IN, OUT	-	71	-	-	-
Sales Packaging -60	IN, OUT	-	18	-	-	-
Sales packaging -N12	IN, OUT	a new sales packaging	283	-	-	-
Sales packaging -N13	IN, OUT	a new sales packaging	158	-	-	-
Total	4		532	0	0	0
Number of packaging items (IN)			4	0	0	0
Number of packaging items (OUT)			-	-	-	-
5. Sales packaging - Plastics						
Sales packaging -61	IN, OUT	limited use (only in take away products)	1 372	-	441	-
Sales packaging -62	IN, OUT	limited use (only in take away products and for children's use)	1 892	-	655	-
Sales packaging -63	IN, OUT	limited use (only in take away products)	301	-	50	-
Sales packaging -64	IN, OUT	replacement with a new wooden alternative (Sales packaging -N12)	-	-	-	-
Sales packaging -65	IN, OUT	replacement with a new wooden alternative (Sales packaging -N13)	-	-	-	-
Sales packaging -66	IN, OUT	limited use (only in take away products)	405	-	23	-
Sales packaging -67	IN, OUT	limited used (only in take away products)	194	-	23	-
Sales packaging -68	IN, OUT	removal	-	-	-	-
Sales packaging -69	IN, OUT	-	1 833	-	278	-
Sales packaging -70	IN, OUT	-	1 145	-	84	-
Sales packaging -71	IN, OUT	-	249	-	38	-
Sales packaging -72	IN, OUT	replacement with Raw material -34 (larger unit size) and Sales packaging -19	-	-	-	-
Sales packaging -73	IN, OUT	-	112	-	-	-
Sales packaging -74	OUT	limited use (only in take away products)	192	-	24	-
Sales packaging -75	OUT	replacement with a new carton alternative (Sales packaging -N1)	-	-	-	-
Total	10		7 693	0	1 616	0
Number of packaging items (IN)			10	0	9	0
Number of packaging items (OUT)			-	-	-	-

Waste component			Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
6. Sales packagaing - Composites						
Sales packaging -76	IN	removal	-	-	-	-
Sales packaging -77	IN, OUT	removal	-	-	-	-
Sales packaging -78	IN, OUT	removal	-	-	-	-
Sales packaging -79	IN, OUT	removal	-	-	-	-
Sales packaging -80	IN, OUT	replacement with Raw material N -1 (larger unit size) and Sales packagir	-	-	-	-
Sales packaging -81	IN, OUT	replacement with Raw material -N2 (larger unit size)	-	-	-	-
Sales packaging -82	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -83	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -84	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -85	IN, OUT	replacement with Raw material -N3 (one alternative with a larger unit siz	-	-	-	-
Sales packaging -86	IN, OUT	-	196	-	-	-
Sales packaging -87	IN, OUT	-	378	-	-	-
Sales packaging -88	IN, OUT	-	140	-	-	-
Sales packaging -89	IN, OUT	-	268	-	-	-
Sales packaging -90	IN, OUT	removal	-	-	-	-
Sales packaging -91	OUT	replacement with a Sales Packaging -N14 (a larger unit size)	-	-	-	-
Sales packaging -N14	OUT	a new sales packaging	5 900	-	-	-
Total	5		6 881	0	0	0
Number of packaging items (IN)			5	0	0	0
Number of packaging items (OUT)			-	-	-	-
7. Food raw materials						
Raw material -1	IN	-	1 346	-	-	888
Raw material -2	IN	-	686	-	-	453
Raw material -3	IN	-	901	-	-	743
Raw material -4	IN	-	3 624	-	-	253
Raw material -5	IN	-	1 779	-	-	324
Raw material -6	IN	-	2 003	-	-	365
Raw material -7	IN	-	442	-	-	35
Raw material -8	IN	-	2 706	-	-	4 747
Raw material -9	IN	-	4 358	-	-	1 406
Raw material -10	IN	-	123 535	-	-	17 648
Raw material -11	IN	-	1 037	-	-	79
Raw material -12	IN	-	17 344	-	-	697
Raw material -13	IN	-	1 094	-	-	44
Raw material -14	IN	-	6 868	-	-	276
Raw material -15	IN	-	49 669	-	-	2 152
Raw material -16	IN	-	4 237	-	-	1 206
Raw material -17	IN	-	838	-	-	226
Raw material -18	IN	-	28	-	-	35
Raw material -19	IN	-	375	-	-	16
Raw material -20	IN	-	1 389	-	-	88
Raw material -21	IN	-	1 221	-	-	78
Raw material -22	IN	-	321	-	-	20
Raw material -23	IN	-	349	-	-	191
Raw material -24	IN	-	177	-	-	77
Raw material -25	IN	-	743	-	-	162
Raw material -26	IN	-	960	-	-	1 284
Raw material -27	IN	-	235	-	-	129
Raw material -28	IN	-	839	-	-	459
Raw material -29	IN	-	190	-	-	42
Raw material -30	IN	-	320	-	-	22
Raw material -31	IN	-	862	-	-	246
Raw material -32	IN	-	-	-	-	334
Raw material -33	IN	-	48	-	-	10
Raw material -34	IN	change in amount	946	-	-	173
Raw material -35	IN	-	19 973	-	-	2 189
Raw material -36	IN	-	189	-	-	175
Raw material -37	IN	-	2 519	-	-	3 887
Raw material -38	IN	-	3 695	-	-	6 840
Raw material -39	IN	-	448	-	-	727
Raw material -40	IN	-	199	-	-	324
Raw material -41	IN	-	71	-	-	109
Raw material -42	IN	-	101	-	-	166
Raw material -43	IN	-	2 393	-	-	3 509

Waste component			Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Raw material -44	IN	-	277	-	-	213
Raw material -45	IN	-	289	-	-	100
Raw material -46	IN	-	1 379	-	-	1 061
Raw material -47	IN	-	20 675	-	-	4 465
Raw material -48	IN	-	5 494	-	-	1 186
Raw material -49	IN	-	7 003	-	-	1 512
Raw material -50	IN	-	2 357	-	-	509
Raw material -51	IN	-	1 549	-	-	550
Raw material -52	IN	-	10 986	-	-	2 961
Raw material -53	IN	-	11 495	-	-	3 099
Raw material -54	IN	-	15 308	-	-	1 036
Raw material -55	IN	-	131	-	-	15
Raw material -56	IN	-	14 160	-	-	4 800
Raw material -57	IN	-	458	-	-	117
Raw material -58	IN	-	3 704	-	-	1 411
Raw material -59	IN	-	608	-	-	51
Raw material -60	IN	-	2 093	-	-	1 177
Raw material -61	IN	-	27 080	-	-	4 452
Raw material -62	IN	-	37 191	-	-	10 740
Raw material -63	IN	-	1 053	-	-	328
Raw material -64	IN	-	108	-	-	34
Raw material -65	IN	-	2 648	-	-	2 212
Raw material -66	IN	-	66	-	-	55
Raw material -67	IN	-	1 210	-	-	415
Raw material -68	IN	-	689	-	-	236
Raw material -69	IN	-	974	-	-	334
Raw material -70	IN	-	7 193	-	-	1 744
Raw material -71	IN	-	6 518	-	-	2 717
Raw material -72	IN	-	26	-	-	10
Raw material -73	IN	-	229	-	-	101
Raw material -74	IN	-	65	-	-	29
Raw material -75	IN	-	5 237	-	-	1 348
Raw material -76	IN	-	1 033	-	-	243
Raw material -77	IN	-	119	-	-	232
Raw material -78	IN	-	169	-	-	42
Raw material -79	IN	-	133	-	-	34
Raw material -80	IN	-	507	-	-	14
Raw material -81	IN	-	59	-	-	860
Raw material -82	IN	-	1 122	-	-	495
Raw material -83	IN	-	588	-	-	259
Raw material -84	IN	-	343	-	-	151
Raw material -85	IN	-	654	-	-	206
Raw material -86	IN	-	1 989	-	-	966
Raw material -87	IN	-	681	-	-	-
Raw material -88	IN	-	1	-	-	-
Raw material -89	IN	-	3 056	-	-	718
Raw material -90	IN	replacement with Raw material -91	-	-	-	-
Raw material -91	IN	change in amount	-	306	-	-
Raw material -92	IN	replacement with Raw material -N91 and Sales packaging -19	-	-	-	-
Raw material -93	IN	-	-	3 967	-	-
Raw material -94	IN	-	-	-	-	189
Raw material -95	IN	-	-	-	-	863
Raw material -96	IN	-	-	-	-	12
Raw material -97	IN	-	-	-	-	2
Raw material -98	IN	-	-	-	-	139
Raw material -99	IN	-	-	-	-	5 109
Raw material -100	IN	-	-	-	-	6 802
Raw material -101	IN	-	-	-	-	1 216
Raw material -102	IN	-	-	-	-	157
Raw material -103	IN	-	-	-	-	3 328
Raw material -104	IN	-	-	-	-	211
Raw material -105	IN	-	-	-	-	16
Raw material -106	IN	-	-	-	-	13
Raw material -N1	IN	new raw material	-	5 378	-	-
Raw material -N2	IN	new raw material	225	-	-	58
Raw material -N3	IN	new raw material	1 343	-	-	477

Waste component			Recyclable (fibre) waste	Recyclable (fibre) waste	Combustible waste	Mixed waste
Sales packaging or Food raw material	Disposal location[1]	Change at the harmonisation	Annual amount	Annual amount	Annual amount	Annual amount
			kg	kg	kg	kg
Total	106		461 334	9 650	0	124 662
Number of packaging items (IN)			90	3	0	102
Number of packaging items (OUT)			-	-	-	-
TOTAL (1-7)	180		545 595	9 650	7 662	124 662
Number of packaging items (IN)			163	3	44	102
Number of packaging items (OUT)			-	-	-	-
[1] IN - Packaging disposed of at the outlets						
OUT - Packaging disposed of outside the outlets						

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