The Danish Government, 2004

Waste Strategy 2005-08

Contents

Foreword

A healthy and sustainable environment is the overarching framework of all the government's environmental initiatives. We will therefore not accept unnecessary impacts on the environment from our waste. This is the clear message in Waste Strategy 2005-08 – the Government's waste policy for the next four years.

The way ahead in waste management is to reduce the loss of resources and the environmental impact from waste.

It is vital that waste be managed in the way that represents the best value – both in terms of the environment and economics. As a completely new initiative, this Strategy provides the first calculations for a number of waste indicators that show how much waste is impacting on the environment. If we combine these waste indicators with economic analyses, we will obtain a better and more thorough basis for evaluating whether waste is being managed correctly.

Waste Strategy 2005-08 sets clear goals for what we hope to achieve in waste management over the next four years. One goal is to make the environmental improvements resulting from the money invested visible. And we will work towards making the waste management sector as efficient as possible. Another great challenge is to decouple growth in the volume of waste from economic growth in society.

We are currently already recycling large volumes of waste. And that is a good thing. But there remain areas where we could do better. In particular, waste from industry and the service sector will be closely examined – as there is still more waste that could be constructively recycled in these areas.

This Strategy will equip Denmark to make a positive contribution to future waste management initiatives in the EU.

I see Waste Strategy 2005-08 as marking the beginning of a Danish waste policy that focuses on the environment, efficiency and economics, to the benefit of sustainable development. Let me encourage everyone to participate actively in implementing the Government's policy. We all have a responsibility to create the best conditions for a healthy and sustainable environment. And the way to achieve this is by having a constructive waste policy, as this Strategy describes.

Hans Christian Schmidt
Minister for the Environment

Guide to the Plan

Chapters 1 to 3 contain a general description of the Strategy and initiatives of the plan.

CHAPTER 1 presents the main elements of the waste management plan. CHAPTER 2 shows the development in the volume of waste up until 2001, and introduces the new focus on prevention of the loss of resources and environmental impact from waste. New initiatives to prevent waste are also discussed. CHAPTER 3 summarises all the planned initiatives relating to waste prevention, increased recycling, reduced resource consumption, improved quality of recycling/treatment, and reduced landfilling. These initiatives will be implemented in the years 2005-2008. Initiatives are presented for all waste sectors, and specific fractions are mentioned for the most relevant sectors.

These chapters are followed by five appendices examining the individual issues. The Waste Management Plan - and especially the appendices - have been designed to be used for reference. As a result, some material may be repeated.

APPENDIX A, on waste regulation, contains a review of the Danish instruments used in the area of waste management. EU waste regulation is also discussed.

APPENDIX B discusses the statistics for waste volumes and technological development. New initiatives to improve statistics in the area of waste management and the need for technological development are presented. The costs and environmental effects of waste management, and experience from other countries with waste prevention are also discussed.

APPENDIX C, on capacity, contains a review of capacity at waste incineration plants, landfill sites, and treatment plants for hazardous waste.

In APPENDICES D and E, each sector and fraction is reviewed: Status for 2001, aims for 2008, initiatives to meet goals, current regulation in the area, environmental and economic evaluation of initiatives, and the plan's implications for national and municipal waste authorities. Treatment capacity for each fraction is also discussed.

1 Waste Strategy 2005-2008, focus areas

Purpose of Waste Strategy 2005-2008

The purpose of Waste Strategy 2005-08 is to outline guidelines for the Government's waste policy. It is the foundation stone for the national authorities' future waste management initiatives, and defines the framework for local municipal waste planning when they prepare the next generation of municipal waste plans for 2005-08. This Waste Strategy follows on from Waste 21 (1998-2004), and implements the national waste management initiatives that are compulsory for Member States in relation to the EU.

It is the aim of the Government to reduce our consumption of resources and decouple the increase in the volume of waste from economic growth. It is important that we reduce the environmental impacts arising from the generation and treatment of waste. Authorities, people and enterprises all have a joint responsibility in this task.

The Waste Strategy is an important element in the Government's overall strategy for sustainable development[1], which aims to help decouple economic growth from resource consumption. Focus on resource optimisation in production in the form of more resource-efficient products with long lifetimes, reduction in resource losses associated with waste treatment, waste prevention, and an increase in recycling can all contribute to sustainable development.

The Waste Strategy is one strategic element that works in synergy with the Government's other environment policy strategies, such as the chemical strategy – important for efforts to reduce the levels of xenobiotic substances in waste, the product-oriented environment strategy – with respect to the prevention of waste, the "Environment and health are closely related" strategy, and the strategy of making the market work for the environment.

The Government's waste policy for 2005-2008 builds upon three fundamental elements:

- We must prevent the loss of resources and environmental impact from waste.
- We must decouple growth in waste from economic growth.
- We must ensure the improved cost-effectiveness of environmental policies through:
- improved quality in waste treatment, and
- an efficient waste management sector.

These fundamental elements will be realised using a number of different instruments that take into account both the environment and economics. We will ensure that waste is treated in an environmentally responsible manner and at a reasonable price. It is therefore important that the quality of waste

[1] See "A shared future - balanced development", Denmark's National Strategy for Sustainable Development, the Danish Government, 2002.

treatment is improved and that the basis for making decisions in the area of waste management is enhanced. We will establish new waste indicators that incorporate the most important environmental factors, such as resource consumption and environmental impacts. And we will also carry out cost-benefit analyses in several waste management areas. In order to achieve more efficient waste management, we need to look at how the entire sector is organised.

1.1 Loss of resources and environmental impacts from waste must be reduced

Resource consumption must be reduced

Waste represents resources. A central element in future initiatives will be to limit the loss of these resources as far as possible. Furthermore, the individual flows of materials will be prioritised. Not all materials are equally welcome in the flow of waste, and initial efforts must be directed towards substances with the greatest health and environmental impacts. Other materials are known to generate large volumes of waste or other pollution during their life cycle. These materials will also be given high priority in future initiatives. Prevention of waste is therefore an important element in the total efforts to move towards greater resource efficiency and more sustainable development.

Danish environment policy largely aims to promote the responsible use of resources. But even under the existing policy, it is still necessary to work for better utilisation of resources. In order to pursue this aim, an element of the Strategy will be to focus on generating data and developing methods that can evaluate the total resource usage and environmental impact of products and materials.

The Strategy will provide a basis for evaluating which combination of instruments best ensures resource efficiency and waste prevention. Special focus will be given to market-based mechanisms, in preference to prohibitions and orders.

1.2 Growth in waste must be decoupled from economic growth

Decoupling economic growth and waste

In the strategic effort to decouple growth in waste from economic growth, it is essential that the factors responsible for the generation of waste be identified. Economic growth has a large impact on the volume of waste. The greater the disposable income of the population, the more waste is generated. Activity in the construction industry is a good example of how the generation of waste is closely linked to economic conditions.

Our consumption and production patterns also play a role. Genuine preventative initiatives must build upon enterprises and people having the opportunity and the willingness to contribute to:

- producing and consuming less resource-intensive products that are durable and environmentally friendly,
- environmentally friendly products gaining greater market share,
- securing an opportunity to choose consumption patterns that benefit the environment.

1.3 Improved cost-effectiveness of environmental policies – improved quality in waste management

Quality must be improved

We must ensure improved quality in waste management. To date, waste management has been based around the waste hierarchy, and it should continue to be. This tool is a useful instrument for initially determining which treatment waste should receive. The waste hierarchy dictates that waste fractions must be moved up in the hierarchy. This means that the prevention and recycling of waste must be given priority over incineration. Ultimate priority must be given to avoiding landfilling of waste. However, there needs to be a balanced evaluation. In general, we should follow the waste hierarchy when it is both environmentally justified and cost-effective.

We must strive to develop and use the treatment that is best for the environment. At the same time, we must watch and demand that the price we pay for treatment of waste is the most cost-effective solution for society. The environmental quality achieved for the money spent needs to be clear. However, an important question is whether we are always able to assess whether a given treatment is optimal.

The waste hierarchy on its own is not sufficient for choosing the best treatment for the waste of the future. We need a more solid basis for making the right decisions. In other words, the waste hierarchy is an imprecise a tool to base future choices about the treatment of waste upon. It is necessary to be able to document the environmental benefits we gain from the money spent on a specific form of treatment. In the future, there must therefore be greater focus on the connection between economics and environmental impact in the waste management choices we make.

In order to promote better quality in waste management, there are three central focus areas in particular that require improvement over the next few years.

- Firstly, we must develop a method that makes it possible to assess the quality of waste treatment and to evaluate whether waste is being treated at the right price.
- Secondly, we need more stringent requirements governing the treatment chosen for waste.
- Finally, we must work towards waste becoming less hazardous, and reducing the volume of hazardous waste.

Quality assessment

Method for assessing quality – new waste indicators

Technologies that make it possible to utilise the resources in waste – both the energy and material resources – and to eliminate problems with xenobiotic substances, are usually considered to be high-quality treatment technologies. This continues to be a good guide for what an effective technology should be able to achieve. But these parameters may also be difficult to work with in practice. It is therefore necessary to develop a method that indicates, at a more detailed and specific level, how well we are able to treat waste, and at what price. This can lead to greater transparency in decisions.

Waste indicators highlight environment effects

The first steps to develop this instrument have already been taken. Waste Strategy 2005-08 includes the first calculations of a number of waste indicators that highlight resource and energy consumption and landfilling requirements for various waste fractions. These indicators show where the greatest environmental effect can be achieved, for example, by choosing recycling instead of incineration.

To date, the focus has been on the volume of waste produced and how this waste is treated. The greater the recycling percentage, the better the waste treatment was seen to be. This is no longer adequate. It is now necessary to supplement the previously used indicators with new indicators that tell us something about the environmental impact from waste. The new waste indicators need to be refined so that they provide a total picture of resource consumption and environmental impact. These indicators must also be supplemented with an evaluation of each material's environmental and health effects.

One needs to be aware that the new indicators are associated with a certain degree of uncertainty. They require a large statistical base and complicated calculations. Therefore, initially, they will not be quite as robust as the existing indicators for the volume of waste in tonnes, and they should be interpreted with caution.

The waste indicators will be combined with cost-benefit analyses. This will provide a solid basis for assessing whether the specific waste fractions are being treated in the way that is best for the environment and at the right price.

Waste treatment requirements

Waste treatment requirements

We must ensure that recycled materials are of higher quality and that treatment has the minimum possible environmental impact. Once it has been decided that a waste fraction should be separated for the purpose of receiving special treatment, we must stipulate more stringent quality requirements for the treatment of the waste.

In the years ahead, we will probably see new requirements placed on the treatment of fractions such as PVC and impregnated wood. In addition, as a consequence of the Directive on the landfill of waste, a number of "acceptance criteria" for the landfill of waste must be developed. Overall, waste treatment requirements will lead to better quality in waste treatment.

Waste has to be less hazardous

Waste has to be less hazardous

Waste has to become less hazardous over time. Under the product-oriented environment strategy and the chemical strategy, action will be taken, in the long term, against hazardous substances in products. This will mean that waste will become less "hazardous" as these products finally end up in the flow of waste.

In the years ahead, we need to work out a strategy for hazardous waste that focuses on the degree of hazard from the waste and identifies any barriers preventing waste from being sent to the most environmental and cost-effective treatment.

We currently have criteria for determining whether waste is hazardous, but a method needs to be developed that indicates which treatment the hazardous waste should receive. New initiatives in this area will be considered throughout the term of the Strategy.

1.4 Improved cost-effectiveness of environmental policies – an efficient waste management sector

Organisation of the waste management sector
In Denmark, waste management has been organised in such a way that currently there is a smoothly operating waste management system and a high degree of environmental protection. Furthermore, the costs of waste management are extremely reasonable compared to other countries.

The municipalities have responsibility for all waste and have overseen the management of waste within a complete municipal waste system. It has not been uncommon for municipalities to also take responsibility for operational tasks in the area of waste management. The majority of all landfill sites and waste incineration plants are publicly owned and operated.

International studies have shown that Denmark has relatively low costs for the incineration and landfilling of waste. Note that this has been achieved without compromising the environment. It is worth maintaining this.

Good results have thus been achieved in the way Denmark has organised waste management, but there are also weaknesses. Some of the most significant problems are: inadequate competition within the sector, confusion of the municipalities' roles as an authority and as an operator, difficulties for waste producers in gaining exemption from municipal waste collection schemes, data reporting requirements, lack of transparency in waste fees, inexplicable differences in processing fees, and failure to implement new treatment technologies (plants) under market conditions.

At the same time, analyses have been carried out that indicate various degrees of potential to improve efficiency in the areas of incineration and landfilling.

Waste must be managed in both an environmental and cost-effective manner – this is important. We must therefore take an unprejudiced look at who is best able to carry out each task, and how it can be done most effectively. Future waste policy needs to give greater attention to economic factors in decisions, so that collection methods and forms of treatment are chosen that are environmentally and cost effective. Clearer choices and a more visible prioritisation of initiatives are goals in themselves, and are also necessary in order for people and enterprises to take more responsibility and for local waste solutions to better reflect the needs of people and enterprises.

In spring 2002, the Government appointed a work group to undertake a complete assessment of the scope and significance of the most important problems in the area of waste management, and to identify the advantages and disadvantages of deregulating the waste management sector. In 2004, this work group is due to report on proposed future solutions within the areas in which the group believes it is necessary to change waste management organisation and legislation. The results of this work are intended to contribute, in general, to a more efficient sector in which it is easier for people and enterprises to dispose of waste, and where it is clear where the money is going and what the costs of waste management are.

The work group has proposed and initiated studies into the transparency of fees and into the advantages and disadvantages of deregulating landfill and incineration activities. Studies investigating the following items are also being planned: analysis of reporting obligations, a central register of waste carriers,

simplification of the municipal waste regulations, transparency in the role of waste carriers and waste brokers, experience from an area of waste management subjected to competition (the recycling sector), separation of the roles of authority and operator, and producer responsibility for disposed products.

The work group will focus on the framework conditions for the waste management sector, including organisational, competition and economic factors for both domestic and commercial waste and for private and public players. The work of the work group will naturally influence the implementation and results of the Waste Strategy, since the aim of the work is to ensure that the waste management sector becomes more efficient.

However, the work group is not intended to examine trends in volumes of waste, initiatives to prevent increased volumes, or specific goals for specific waste fractions and forms of treatment. The aims of the Waste Strategy are based on the existing framework for the waste management sector. It is too early at this stage to say anything about the extent to which organisational changes will contribute to a more efficient waste management sector, in economic and environmental terms.

Waste Strategy 2005-08 should therefore not be considered to be an exhaustive description of the initiatives that will be implemented during the period in relation to the organisation of waste management and the use of control mechanisms. Changes to organisational factors will not be discussed further in the Strategy. The work group will conclude its work in 2004. On the basis of their findings, the Government will decide what initiatives are to be implemented from 2005 and on.

Producer responsibility in relevant areas

One goal of the Waste Strategy is to identify whether advantages can be achieved by introducing producer responsibility in relevant product areas. It needs to be evaluated whether producer responsibility can be introduced without a heavy administrative burden on manufacturers/importers and authorities. It also needs to be evaluated whether producer responsibility can lead to more environmentally friendly products. For certain products in particular, producer responsibility is expected to be very suitable.

Producer responsibility should not be chosen as a unilateral Danish solution. This mechanism must be introduced at the international level, for example in the EU. Regulations governing producer responsibility have already been introduced in the EU in areas such as end-of-life vehicles and waste from electrical and electronic equipment.

Environmental and cost-benefit assessments – a better basis for making decisions

In the area of waste management, it is important to ensure greater environmental effect from the investments made.

Many factors play a part in which solution should be chosen – available treatment and collection technologies, willingness to separate waste, and many others. In the future, waste management will presumably require more advanced technological solutions than those that exist today, and there will therefore be even greater sorting and collection requirements, etc. These technological solutions may make it necessary to make new investments in the area of waste management.

There must also be better prioritisation, based on good documentation, within the range of possible schemes that can be initiated in waste management. It will be necessary to weigh up the advantages and disadvantages achieved. In other words, for all initiatives, it will be necessary to know whether the environmental effects we achieve through a specific measure in waste management also correspond to the costs.

To ensure that the environmental effect is as great as possible, it will be necessary, in a methodical and structured way, to weigh up environmental and economic factors – and ensure that we can compare various initiatives. In this respect, environmental and cost-benefit assessments are tools which can provide part of the basis for waste policy decisions. They permit environmental effects to be compared against cost-benefit analyses, ensuring that the decisions made incorporate an economic perspective.

The strength of these analyses is that the information is structured in such a way that the decision made is well-founded and documented – and no other viable alternatives exist. Using environmental and cost-benefit analyses, it will be clearer what a given initiative costs, and what effects it has. However, cost-benefit analyses are only part of the decision basis. There may be political reasons for implementing an initiative, even though a cost-benefit analysis shows that it is not economically viable.

All this is not as easy as it sounds. Any method has strengths and weaknesses. One of the greatest weaknesses is that not all environmental effects have been thoroughly investigated, and not everything has been assigned a monetary value. There is also some uncertainty involved in placing a value on environmental effects. A responsible environmental and cost-benefit analysis is also very dependent on the data available. It is therefore important that sufficient information exists on both the environment and costs.

We must, of course, continue to prioritise the investigations we initiate. Any change in the Danish regulations that results from an EU directive has normally been evaluated in connection with the negotiations, and therefore does not necessarily need to be investigated at the same level of detail as other regulations when they need to be implemented. Within the framework of the EU directives, implementation must take place in a way that balances costs and environmental effects.

The same is true for some of the areas mentioned in the Strategy. It shows the direction the development should take; but both environmental and economic factors need to be investigated more closely to ensure a well-documented and objective decision basis. Cost-benefit analyses will be carried out when the areas have been specified in more detail and sufficient data is available.

1.5 How to achieve the Strategy aims

Aims for 2008
- *65% recycling*
- *26% incineration*
- *9% landfill*

Denmark currently recycles a large proportion of the total volume of waste. But there is still room for improvement.

The Government's aim for future initiatives in relation to the total volume of waste is to increase recycling. At the same time, the aim is to reduce the volume of landfilled waste, so as to avoid loss of resources. The recycling aim for 2008 is 65%, and the aim for landfilling is a maximum of 9%.

The monitoring activities of the local environmental authorities are an important element in achieving the future waste management aims.

The Waste Strategy contains a total of more than 100 new initiatives, covering the entire waste management spectrum. The majority of these initiatives are directed towards implementing both EU and Danish regulations, and making new knowledge available through development and elucidation projects. In addition, a number of initiatives aim to develop new tools, sub-strategies and environmental and cost-benefit assessments. Finally, the Strategy contains a small number of information activities. The Strategy cannot be implemented without financial support for the majority of these initiatives.

The aims are to be achieved through initiatives directed towards the following areas:

Cross-cutting initiatives

Knowledge-sharing is a central instrument to be used by the players in implementing the Strategy. Waste Centre Denmark has a central role in this area, and it is important that the Waste Centre can promote knowledge-sharing between players in the area of waste management. The waste centre is supported by funding in the annual Finance Act.

In order to promote the development of new, full scale, treatment technologies, it is necessary to continue to provide financial support. Efforts will also be made to ensure that regulations support the use of the new technology.

Transparency needs to be achieved in municipal fees. To this end, changes to the Environmental Protection Act will be proposed.

The possibility of simplifying enterprise registration and reporting obligations needs to be assessed. The number of municipal regulations needs to be reduced, and the contents of the regulations need to be harmonised to make it easier for enterprises to work across municipal boundaries.

A strategy for hazardous waste will be prepared. The purpose of this strategy will be to identify whether the various regulations which relate to or refer to hazardous waste represent barriers to the best economic and environmental management of waste, and to identify potential initiatives to minimise these barriers.

Building and construction

The large volume of building and construction waste that is currently recycled can be contaminated by substances with harmful environmental impacts. During the period of the coming plan, these substances will be required to be washed out so that the waste can be recycled in an environmentally responsible manner and under the same conditions as apply to the recycling of other residual products.

In addition, the use in buildings of chemicals which cause environmental and health problems will be reduced as much as possible, so that future building waste becomes cleaner. It will be investigated whether there is an environmental and health effect in connection with the use, renovation and demolition of buildings containing PCB.

Proposals will be made for specific resource and environment indicators for individual construction projects. These indicators will enable building

contractors to take responsibility for improving environmental factors in construction. Principles will also be proposed for a benchmarking system that makes it possible to evaluate and compare environmental initiatives.

Furthermore, regulations will be introduced regarding the treatment of district heating pipes containing CFC's or HCFC's, as a consequence of the EU regulation on substances that break down the ozone layer.

Households

In general, people will be better informed about municipal schemes. Evaluation will be made of whether an environmental effect can be achieved by carrying out an information campaign on consumption and waste. Many consumption and behaviour patterns become established as children. To ensure that future generations are conscious of resource and waste problems, information and teaching materials will be prepared for pre-schools, and primary and high schools.

A tool will be prepared for local evaluation of the most environmentally and economically appropriate management of organic domestic waste. This will enable municipalities to assess whether two-part collection of the organic component of domestic waste should be locally introduced, and make a decision about this. Experience has shown that the volume collected, and the costs associated with the collection of organic domestic waste, can vary significantly. However, factors associated with incineration, e.g. heat disposal or the need for pre-treatment before bio-gasification can also vary locally and have a critical impact on the environmental economic assessment.

Recycling of packaging will be increased in accordance with the goals for 2008 under the revised Packaging Directive. Municipalities will be required to increase the collection of plastic and metal packaging from households.

Municipalities will be encouraged to increase the reuse and recycling of bulky waste. They will also be encouraged to establish networks for staff at recycling centres.

Industry

Enterprises need to focus on reducing the volume of waste in the production process, and on producing more environmentally friendly products. There are often economic advantages in focusing on these areas, due to savings in raw material consumption. Assessment will be made as to whether increased use of environmental management in enterprises can be best achieved through sector agreements or whether guidelines on waste requirements need to be prepared in connection with the environmental approval of enterprises.

Industry is currently landfilling waste which it is now possible to recycle. This waste must be moved to recycling, as long as this is cost-effective.

The existing tool for analysing an enterprise's waste will be refined. It is currently being used by small and medium-sized enterprises, but the tool must be developed so that it can also be used in large enterprises and in the service sector.

The management of animal waste has to be changed as a consequence of new rules adopted in the EU in the form of the EU Regulation on animal by-products. These rules are administered by the Ministry of Food, Agriculture and Fisheries.

Industry and institutions, trade and offices

Changes in the EU's Packaging Directive require introduction of a number of initiatives in this area. The Strategy therefore contains initiatives to increase recycling of plastic transport packaging and other plastic packaging from all enterprises, and 15% recycling of wood packaging waste has to be achieved.

The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004. This entails, inter alia, manufacturers being given responsibility for waste management and having to cover the costs of this.

Retail trade

In order to strengthen initiatives in retail trade, a panel of players from the sector has been appointed. The Retail Trade Panel has been given the task of promoting the supply of cleaner products in the area of convenience goods, and helping to increase consumer interest in such products. The Retail Trade Panel will also focus on reducing the environmental impact from the sector, for example, in the area of transport and packaging.

Landfill sites

The volume of landfilled waste has declined over recent years. It is important to ensure that the operation of landfill sites is environmentally optimal. As an element in the implementation of EU legislation, during the period of the Strategy it will become a requirement that documentation be available for waste content and leaching of xenobiotic substances. The new requirements for waste characterisation are expected to contribute to a further reduction in the volume of landfilled waste. The trend is expected to be in the direction of fewer, but larger, landfill sites. This will allow better operation of the sites, both in terms of the environment and cost effectiveness.

Waste incineration plants

An action plan for the future management of flue gas cleaning products will be prepared. The plan will be prepared in cooperation with waste incineration plants. The action plan will contain deadlines for when each problem with flue gas cleaning products has to be solved.

New EU regulations

A number of new or revised directives will soon be issued by the EU. These directives typically have a short deadline for implementation in Danish legislation. The directives are: the Sludge Directive, the Directive on biological treatment of biodegradable waste for agricultural applications, the Battery Directive and the Transport Regulation.

1.6 Cost of the Strategy initiatives

The Strategy contains various types of initiatives. A number of measures have been made necessary by new or revised EU directives, and as such, implementation in Danish legislation is compulsory. The costs of these initiatives have been estimated:

- The Packaging Directive, including increased recycling of plastic, cardboard, wood and metal packaging
- The Electronics Directive, including implementation of producer responsibility
- Implementation of acceptance criteria for landfilling of waste
- Regulations on the treatment of district heating pipes containing CFC's or HCFC's, as a consequence of the Regulation on substances that break down the ozone layer

In order to achieve the goal in the revised Packaging Directive, plastic packaging must be collected from households. On the basis of environmental cost-benefit analyses carried out, the collection method with the lowest costs per tonne of plastic waste has been chosen. The total costs are estimated to be approx. DKK 2 million per annum. In order to achieve the goal in the Packaging Directive, it will also be necessary to increase the collection of plastic transport packaging from enterprises that handle large quantities. This is not expected to lead to a net increase in costs to enterprises, since the increased costs of collection will be offset by savings in treatment expenses for mixed waste for incineration. Should it become necessary to collect plastic packaging from enterprises that handle only small quantities, this will lead to an increase in costs to these enterprises.

The new material-specific goals in the Packaging Directive are only expected to lead to a limited increase in the costs of collecting metal packaging from households. A report for the Danish Folketing will be prepared in 2005 on how the goal of 55% recycling of all packaging waste can be achieved. The other initiatives will be carried out in a way that ensures improved cost-effectiveness of environmental policies.

To date, electrical and electronic products have been collected via municipal schemes financed through municipal fees. Under the new directive, producer responsibility will be introduced, with the result that waste management costs will be included in the prices of these products. Costs associated with the waste treatment of electrical and electronic products are expected to constitute 0.2 – 3.0 per cent of the products' purchase prices.

The economic consequences of implementing the annex to the Directive on the landfill of waste are difficult to calculate. Before the waste is landfilled, information must be available on the composition of the waste and leaching of contaminants in the short and long-term ("characterisation"). The associated costs can only be calculated when it is known which types of waste must be characterised. The total costs to waste producers for characterisation of waste types for landfill is estimated to be of the order of DKK 100-200 million. It is expected that these costs will be incurred over approx. a two-year period (2005-2006).

In addition to the costs of characterisation, waste producers will be regularly required to document that the particular waste type characteristics are not changing over time. This documentation will be in the form of analyses (compliance tests) aimed at showing whether the composition and leaching characteristics of a waste type have changed in relation to the results from the earlier characterisation. If the characteristics are changing, the waste producer may, in the worst case, be required to perform a new characterisation of the particular waste type. The total annual costs to waste producers for carrying out compliance tests are estimated to be in the order of DKK 5-10 million.

During the 1990's, international rules were implemented regarding the phasing out of substances that deplete the ozone layer, in the Montreal Protocol and in an EC Regulation on substances that deplete the ozone layer. One study has shown that the greatest quantity of these substances is found in district heating pipes. The volume of scrapped district heating pipes that contain ozone layer depleting substances will significantly increase in the years ahead, but no information is available about how many of these scrapped pipes will be excavated. It will therefore be necessary to investigate this before

the expenses associated with separate treatment of district heating pipes containing ozone layer depleting substances can be calculated. When a specific scheme is implemented for the waste management of these waste fractions, emphasis will be given to finding the most cost-effective scheme.

In addition to the above legal instruments, the Regulation on animal by-products (Danish Ministry of Food, Agriculture and Fisheries) applies from 2003. This Regulation does not repeal the temporary ban on feeding using meat-and-bone meal that has been in force since 1 January 2001, and was decided at the EU Agriculture Council meeting in December 2000. As a result of the ban, a large quantity of meat-and-bone meal has to be treated as waste. The industry has reported that the extra expenses incurred are estimated to be of the order of DKK 200 million per annum.

Other initiatives in the Waste Strategy require further assessments of the economic consequences. No specific new initiatives will be implemented in these areas until a cost-benefit analyses has been carried out.

A number of initiatives relating to the separation of special fractions were started as a result of the previous waste plan. In these areas, a decision on the final treatment of the fractions will await investigation of environmental and economic factors. This applies to initiatives such as:

- PVC
- impregnated wood

These analyses are expected to be completed in 2003.

A number of initiatives in the Waste Strategy indicate the direction the Government wishes to work towards. Measures under these initiatives will not be economically evaluated before the Strategy comes into force. However, the environmental and economic consequences will be evaluated before decisions are made about starting specific, binding initiatives. This may be relevant within initiatives such as:

- Increased recycling of industrial waste.
- Initiatives for increased recycling of bulky waste.
- A strategy for hazardous waste.
- Changes to the Statutory Order on residual products, including requirements relating to the content of organic contaminants, and extension of the Order to include building and construction waste.
- Investigation of the options for introducing producer responsibility for relevant products

In addition, a number of initiatives will require that elucidation projects be carried out with government funding.

A number of new or revised directives will soon be issued by the EU. These directives typically have a short deadline for implementation in Danish legislation. The following rules are coming soon:

- Directive on packaging and packaging waste
- The Sludge Directive
- Directive on biological treatment of biodegradable waste for agricultural applications

- The Battery Directive
- The Regulation on the shipment of waste

The Packaging Directive

The Packaging Directive is being revised. In October 2002, a common position was adopted, in which goals were set for 2008 for the utilisation and recycling of various packaging materials and the total quantities of packaging. The revised directive is expected to be finally adopted in 2003. The national goals for the recycling of packaging waste in 2008 in this Waste Strategy have been matched to the expected objectives in the EU's revised Packaging Directive.

The Sludge Directive

The Sludge Directive from 1986 is being revised, and the Commission's proposal is expected to be ready in 2003. The Directive is expected to continue to be a minimum requirements directive, and preliminary announcements suggest that the Directive's limit values will be brought closer to Danish limits, which are significantly lower than the existing minimum requirements. Denmark will work towards a reduction in these limit values and the introduction of requirements on organic xenobiotic substances, with the aim of bringing these requirements closer to existing Danish levels.

Biowaste Directive

The Commission plans to present a Directive on biological treatment of biodegradable waste for agricultural applications in 2004. From preliminary work on the Directive it is apparent that the Commission is considering compulsory source separation of organic domestic waste throughout the EU. The Commission is also considering whether the Directive should be a minimum requirements directive or whether Member States will have to use the limit values in the Directive. Denmark does not believe that requirements for the collection of organic domestic waste should be regulated at the EU level, but believes it is important that minimum standards are set for the content of hazardous substances in treated waste. Denmark will therefore work towards the Directive being a minimum requirements directive, and the requirement for source separation being excluded.

The Battery Directive

It is expected that the EU will revise the current Battery Directive during the term of the Waste Strategy. It is expected that the change will be to the effect that all batteries should be collected and recycled. No timetable for the revision has been set.

The Waste Shipment Regulation

The Regulation on shipment of waste is being revised, but the timetable for completion is not known. The primary purpose of the revision is to integrate the OECD decision of 14 June 200 C (2001) 107/FINAL in the regulation. This decision entails a mandatory harmonisation of lists and other requirements in the Basel Convention on the shipment and disposal of hazardous waste.

The change also aims to simplify procedures and specify clearer and more uniform requirements for notification, shipping documents, information, provision of financial security, etc., throughout the entire community.

It is also expected that written consent will have to be obtained prior to the shipment of both orange and red waste, instead of only for red waste, as is the case today.

2 Focus on preventing loss of resources and environmental impact from waste

Waste represents resources that are on their way to being lost. The challenge ahead is to limit the loss of resources as far as possible, in an efficient manner, taking into account both the environment and economics. Preventing the loss of resources is not an easy task and it is vital that people and enterprises be actively involved. Information must make it clear to people and enterprises where they can make a difference. Local solutions will be given focus, and the benefit must be clear for the relevant players. There must be no doubt about when and where it is worth saving resources.

For example, people must know which products are worth buying if they wish to contribute to reducing environmental impacts. And they must have the opportunity to choose to repair their products and hence avoid throwing goods away if it is not necessary.

Enterprises should be aware that sensible management of their raw materials has economic benefits. The less waste, the greater the earnings will often be. For many enterprises, environmental management is a good instrument for gaining a good overview of where waste arises in the process. It needs to be easier for enterprises to act in the interests of both their own financial situation and the environment. However, this must not entail a deterioration in enterprises' competitiveness, and it will be necessary to ensure that the initiatives take place on as uniform a basis as possible.

We can prevent loss of resources and environmental impact in several different ways. Firstly, we can work towards waste simply not being generated. We will immediately see an effect from our efforts in this area in the volumes of waste calculated each year. We must ensure that we use our resources efficiently, so that they are not wasted.

We can also recycle waste and hence reduce the consumption of virgin raw materials. When a decision has to be made about waste management, it is important that it is built upon a solid and well-founded basis. We must recognise that even though waste is recycled, some resources will be lost in this area also. Furthermore, recycling cannot take place without a certain level of impact on the environment.

Finally, we also need to look at how hazardous waste is, in order to help prevent environmental impacts. Over time, waste needs to become less hazardous, and high-quality waste management needs to ensure that many environmental problems related to future treatment can be avoided.

New and better foundation

To date, our environmental initiatives have been measured in terms of the volume of waste. Denmark has been one of the few countries in the EU that has been able to calculate society's total annual waste production in tonnes,

and summarise how this waste has been managed. A high level of recycling has typically been a goal for any good initiative.

In the future, we must continue to focus on the volume of waste, but initiatives must be based on an improved decision basis that links environmental problems to the tonnes of waste being produced at any given time.

Denmark has therefore developed and calculated a number of new indicators that tell something about the impact on resources and the environment from waste. These indicators calculate resource and energy consumption and the need for landfilling associated with a number of different forms of treatment. Initially these indicators have been calculated for 22 materials found in waste.

The purpose of the new indicators is to gain a better foundation for making decisions about waste treatment. The new indicators will enable us to prioritise and calculate whether it is better, in terms of the environment and resources, to recycle a particular waste fraction instead of incinerating it. Unfortunately, the existing statistical base does not permit us to work out the magnitude of the environmental benefit that would result from focusing efforts on completely avoiding waste by waste prevention. Thestatistical base is still insufficient for this purpose.

We will continue to use the volume of waste as an indicator for how well we are doing in the area of waste management. It is a simple indicator to use. What is new, is that this indicator will no longer stand alone. It will be supplemented by calculations of how many resources are lost in waste – from the time the raw materials are recovered and the products are produced through to when the waste is recycled, incinerated or landfilled.

The first generation of the new indicators will be published together with Waste Strategy 2005-2008. However, we will only reap the full benefits from the new indicators once a series of indicators is available, calculated over a number of years.

It will take time before we have a fully developed prioritisation tool. During the term of the Strategy, we must therefore work to develop several new indicators and calculate them over several years. The new waste indicators must thus be refined so that they provide a total picture of resource consumption and environmental impact. These indicators cannot stand alone. They must be supplemented with an assessment of the materials' environmental and health effects.

The new waste indicators will be combined with cost-benefit analyses. This will provide a solid basis for assessing whether the specific waste fractions are being treated in the way that is best for the environment and at the right price.

2.1 Volumes of waste and economic development

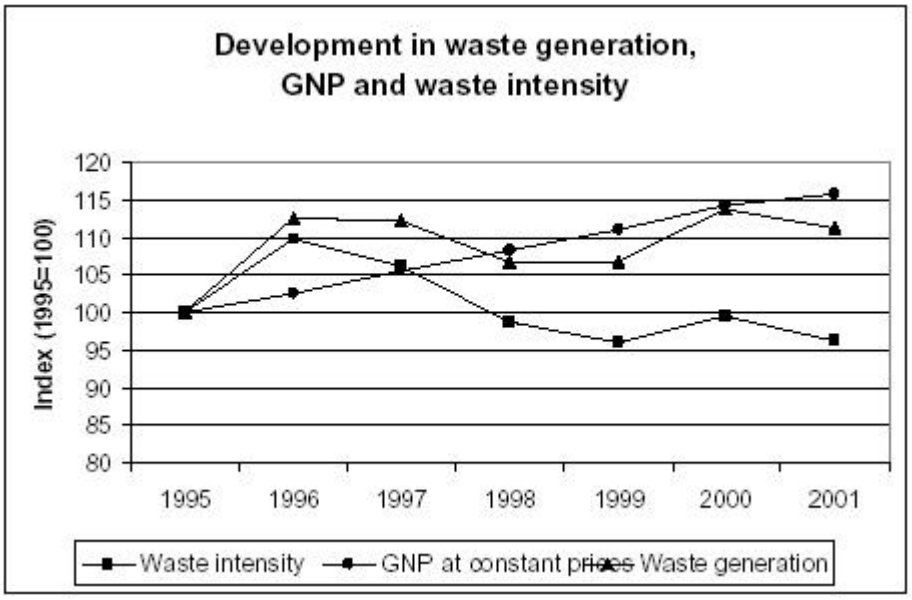
Increasing volumes of waste are closely linked to increasing resource consumption. Prevention of waste[2] therefore continues to be an important element in sustainable development. Sustainable development[3] means that economic growth must not be linked to a corresponding growth in resource and energy consumption, and increased pollution, including waste.

It has been shown that the economy is responsible for 80% of the increase in the volume of waste. The greater the disposable income of the population, the more waste is generated. But the economy does not play an equal role for all fractions. The remaining part of the increase in the volume of waste is caused by other factors such as changes in legislation and production patterns.

The challenge is to decouple the increase in the volume of waste from general economic growth. Responsibility for solving the problem of increasing volumes of waste is shared by all sectors of society. Our initial goal is thus to ensure that increases in the volumes of waste do not occur at the same rate as the increase in economic development.

The figure below shows that the total volume of waste increased faster than economic growth in the period 1995 to 1996. This was followed by a decline in the volume of waste, and another increase during 1999 to 2000. However, this is only the picture for the total volume of waste. Appendix D shows the development in volumes of waste for each sector.

Waste generation is the result of all activities in society. If total waste generation is shown in proportion to gross national product (GNP), it provides an indication of the waste intensity in society.



[2] **Waste prevention** covers all activities that lead to a reduction in the volume of waste that is recycled, incinerated and landfilled. Direct re-use, where a product is used again in its original form and for its original purpose (e.g. a refillable bottle), prevents waste.

[3] As described in Denmark's National Strategy for Sustainable Development, the Danish Government, June 2001.

The graph shows the relative changes in gross national product at constant prices[4] (GNP), waste generation and waste intensity, which is the relationship between the relative change in waste generation and the relative change in GNP. As can be seen in the figure, waste intensity declined until 1999 (decoupling) and has subsequently been relatively constant. This means that growth in the volume of waste since 1999 has largely corresponded to growth in GNP. Thus this trend does not point in the direction of decoupling, but rather an approximately constant relationship between growth in the volume of waste and economic growth, as measured by GNP.

Since the volume of waste in a number of sectors is increasing, it is important to continue to work towards reducing the volume of waste. Forecasts for future volumes of waste show that these volumes will rise, unless active efforts are made to reduce them. This can be seen, for example, in the European Environment Agency's report, "Environment in EU at the turn of the century".

2.2 Prevention of waste

There are many barriers that need to be overcome in order to prevent waste generation. It is important for each party to evaluate whether their behaviour is appropriate. We must also find and choose the right instruments to ensure that we act on a sensible basis. It is important to evaluate whether the existing instruments, in reality, counteract resource savings, leading to the generation of even more waste. The legislation needs to support preventative initiatives, and there needs to be sufficient knowledge and development in this area. Last but not least, communication efforts must be targeted.

In this Waste Strategy, it has been decided to take action initially where the barriers are small and where results can be achieved in the short term at relatively low cost.

In the long term, the use of resources and each product's real environmental impact must be reflected in its price. All proposed legislation is currently subject to environmental assessment, and in the future, these assessments should pay greater attention to resource consumption and waste generation. When future market initiatives are being developed, there should be greater focus on waste prevention.

In November 2000, a conference was held on the prevention of waste, at which many players participated.

The outcome of the conference was that these players indicated which preventative initiatives they would like to see implemented in the years ahead. Everyone was agreed on working to reduce the volume of waste, but there was not agreement on which instruments should be used to reach the goals.

The table below contains an overview of the Waste Strategy initiatives for waste prevention. Each initiative is described in more detail for each sector in Appendix D.

[4] Constant prices are prices for the year adjusted for inflation, and are thus an indicator of real growth.

Sector	Waste prevention initiative
Households	- Information campaigns with specific recommendations for waste prevention - Educational material on resource consumption and waste prevention for schools and child-care centres - Establish or improve municipal re-use schemes
Trade and service	- Motivate the trade and repair sectors to make greater use of reusable transport packaging - Continue the work in the product panel for retail trade
Industry	- Re-use large plastic containers - Limit consumer production waste due to inappropriate packaging - Guidelines on using the conditions on prevention of waste. These guidelines must be based, in particular, on the European Commission's BAT notes (see Appendix D5) - Tools to use in connection with the analysis and reduction of an enterprise's waste generation and management
Building and construction	- Guide on waste prevention for use during property renovation

It is currently very difficult to calculate the environmental effect of these preventative initiatives, as no empirical data is available for changes in the behaviour of the population and trade and industry. However, an attempt will be made to evaluate the environmental effects and the total socio-economic consequences of these preventative initiatives.

2.3 New indicators for loss of resources and environmental impact

New waste indicators have been developed and calculated for loss of resources and landfill requirements for 22 materials present in waste. These indicators express the environmental benefit associated with moving a particular waste fraction from landfill to recycling or incineration. This means that for each material type, the loss of resources and energy associated with landfilling the entire fraction is calculated, and compared with a new treatment situation in which a realistic quantity is either recycled or incinerated[5]. These indicators are calculated on the basis of the volume of waste in 2000, and no forecasts have been made for the future volume of waste.

These indicators can be used to prioritise environmentally initiatives within each fraction, since they tell us whether anything can be gained in terms of resources or the environment from recycling or incinerating the waste. In this way, the new indicators can be used to select where we achieve the minimum environmental impact. And as mentioned in chapter 1, the indicators provide an important foundation when we have to calculate the quality of waste treatment.

Armed with these new indicators, we will be able to select specific areas upon which to focus our future initiatives. We have now calculated these indicators for the first time, and this information can provide a basis for new initiatives. But it is important to mention that before these specific initiatives are

[5] In other words, these indicators reveal what is saved by using each form of treatment, compared to 100% landfilling of the particular waste fraction.

implemented, a more thorough environmental and economic analysis of the measures will be carried out.

The new indicators require a very large LCA statistical base, analysis of material flows and complicated calculations, and are therefore associated with a certain degree of uncertainty. The method and statistical base have been critically reviewed and it has been concluded that the indicators undoubtedly provide a more accurate picture of the real environmental impacts than is the case for existing indicators, based exclusively on the volume of waste. However, the indicator for landfill requirements is extremely uncertain.

Due to a lack of LCA data, it has not been possible to calculate the indicators for all waste fractions. Neither do the indicators include calculations of toxic effects, since statistics in this area do not exist. It is therefore vital that the indicators are supplemented with a qualitative assessment of hazardous emissions from the processes in each material's life cycle before the final decisions about new initiatives are made.

New treatment methods have been developed for the environmentally harmful PVC and impregnated wood fractions. However, LCA data is not available for these processes, so these methods have not been included in the calculation of the indicators.

2.3.1 Definitions

For each of the selected materials, three indicators have been calculated:

1. Resource consumption
2. Energy consumption
3. Landfilling requirements

Resource consumption is expressed in *person-reserves*. A person-reserve is the amount of the resource available per person. (For non-renewable resources, the available amount is calculated per world citizen, but for renewable resources, the available amount is calculated per person in the region).

Energy consumption is calculated in *person equivalents*. A person equivalent corresponds to the amount of energy (primary energy) a Danish resident uses in a year.

Landfilling requirements are also expressed in *person equivalents*. In this context, a person equivalent is the amount of landfill generated per Danish resident, per annum.

2.3.2 Materials and forms of treatment

The indicators are based on the volume of waste from 2000, and the treatment being employed that year. The volume of waste that was landfilled, incinerated, recycled and re-used (if any) is shown in figure 2.a.

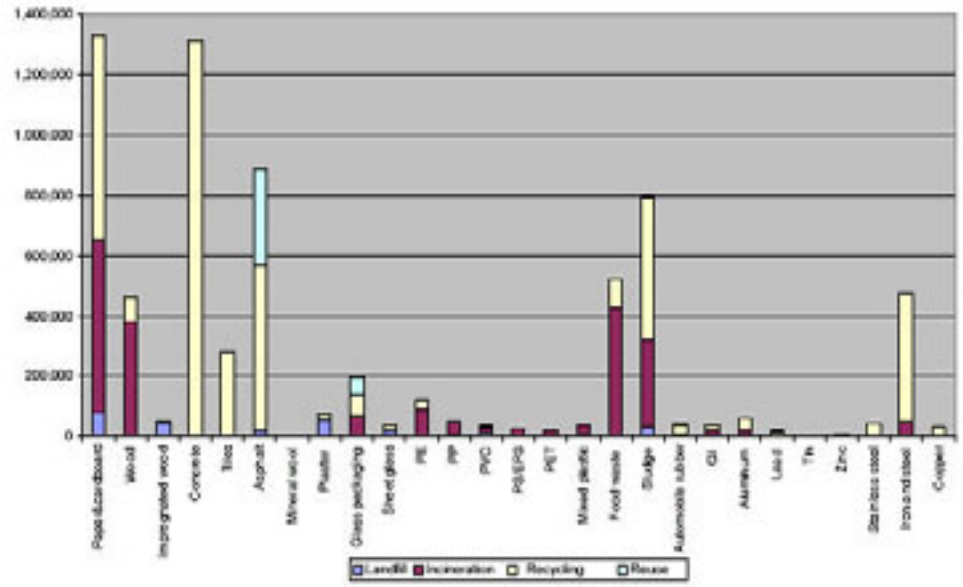


Figure 2.a. The volumes of material treated, divided by form of treatment and material (tonnes).
Sludge is specified as 20% dry matter content.

As the figure shows, we landfill quite large quantities of paper and cardboard, impregnated wood and plaster. Paper and cardboard, wood, organic domestic waste and the many contributions from various plastic materials comprise the largest quantities incinerated. The largest quantities being recycled are concrete, tiles, asphalt (incl. re-use), paper and cardboard, and iron and steel.

2.3.3 Indicators for resource savings

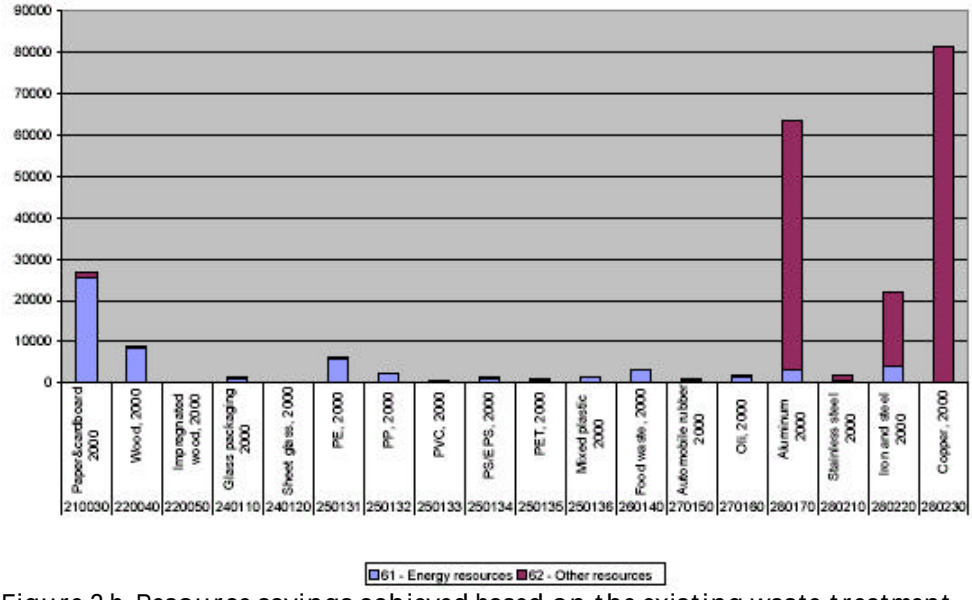


Figure 2.b. Resource savings achieved based on the existing waste treatment for the various materials, calculated in PR (person-reserves).

Figure 2.b. shows how many resources we have saved based on the existing treatment of waste, compared to the situation if all waste was landfilled. These resource savings are divided into energy resources and other resources.

In particular, recycling metals has led to the greatest contribution to the resource savings already achieved.

Lead, tin and zinc are not shown in the figures, since the necessary LCA data is not available to calculate these indicators. But it is estimated that the resource savings for lead, zinc, and tin would be at the same level as those for the other metals, since these resources have a relatively short supply horizon.

Paper, wood, and the six plastic fractions contribute particularly to energy resource savings, since incineration of these replaces energy raw materials used for electricity and heat production.

The building materials – concrete, tiles and asphalt – are not shown on the figure, since no significant resource savings are achieved through recycling. This is because concrete, tiles and asphalt replace resources that exist in abundant quantities.

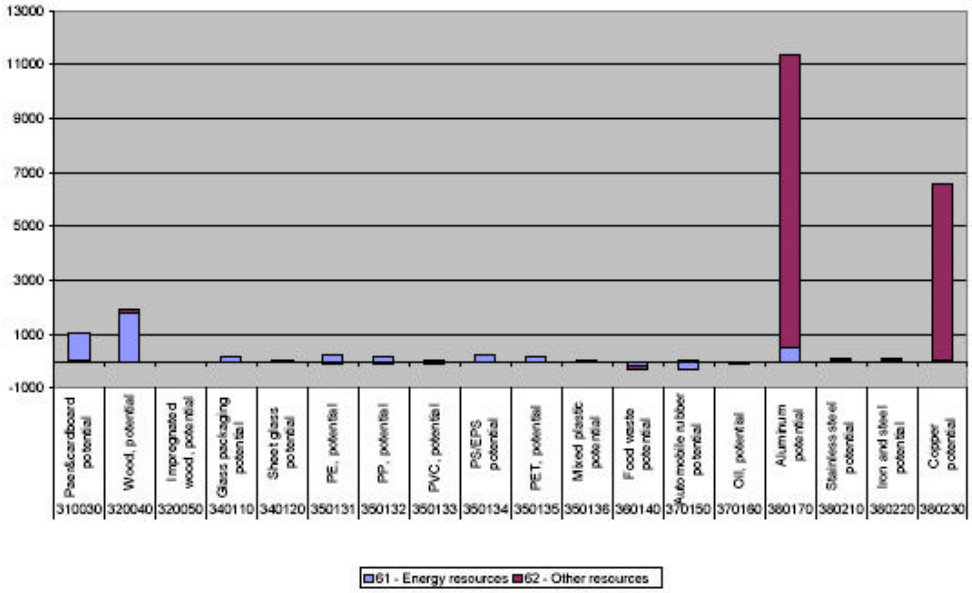


Figure 2.c. Potential for further savings in resource consumption for the various materials, calculated in PR (person-reserves).

Figure 2.c shows how much room there is for improvement, for example, if we were able to recycle a large proportion of a fraction which is currently being incinerated or landfilled. Thus we have an indicator value that shows how many more resources can be saved by improving the existing treatment.

A positive value indicates that an environmental benefit can be achieved if we can save resources by moving from the existing waste treatment to an "optimised waste treatment" with increased recycling. As part of the calculation, an assessment was made as to how much more it would be realistic to recycle.

For paper, plastic (excluding PVC), aluminium and copper, figure 2.c shows that there is the potential for significant resource savings by increasing recycling. For wood, resource savings can be achieved by increasing incineration in waste incineration plants.

The figure also shows that we cannot save further resources by recycling greater quantities of organic domestic waste, automobile rubber and oil than is currently the case.

For PVC, it is assumed that a larger proportion of PVC waste will be landfilled for environmental reasons, leading to negative savings in energy resources.

2.3.4 Indicators for resource savings

Figure 2.d shows how much energy we have saved based on the existing treatment of waste, compared to the situation if all waste were landfilled.

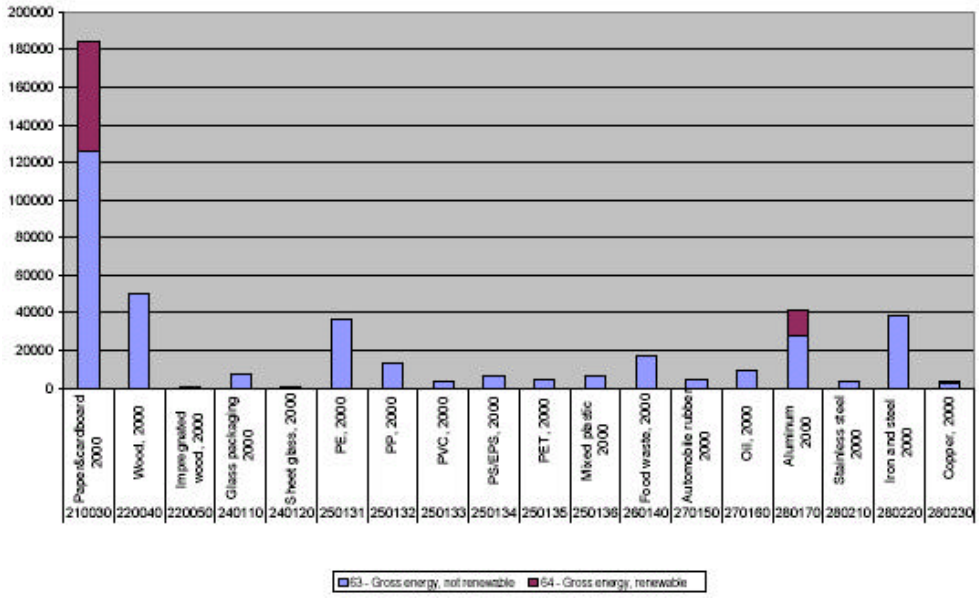


Figure 2.d. Energy savings achieved based on the existing waste treatment for the various materials, calculated in PE (person equivalents).

This figure shows that we have already saved a significant amount of energy through treatment of most of the materials suitable for incineration. This reflects the fact that incineration with energy recovery is a significant element in existing waste management. In particular, the last ten years of expansion using power generating waste incineration plants has contributed significantly to the energy savings achieved. Generating power at waste incineration plants replaces natural gas and other fossil fuels with waste.

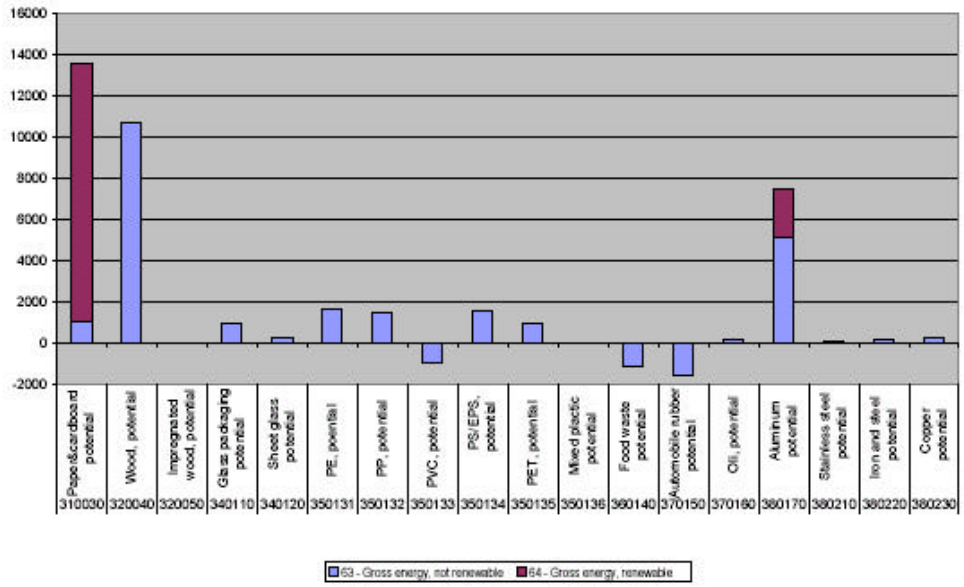


Figure 2.e. Potential for further savings in energy consumption for the various materials, calculated in PE (person equivalents).

Figure 2.e shows how much more energy we can save, for example, if we were able to recycle a large proportion of a fraction which is currently incinerated or landfilled. Thus we have an indicator value that shows how much more energy consumption can be saved by improving the existing treatment.

Figure 2.e shows that further energy resources can be derived from our waste. In other words, we can save energy resources by increasing recycling of waste fractions compared to current levels. However, this is not the case for organic domestic waste, PVC and automobile rubber.

If we are to save more energy resources, we must focus on increasing the recycling of aluminium and paper. For most plastic materials and for glass packaging, modest energy savings can be achieved by increasing recycling as opposed to incineration. The big potential for further energy savings for wood is due to the assumption of an increase in incineration as opposed to landfill.

2.3.5 Indicators for landfill requirements

The indicator values for landfill requirements are extremely uncertain.

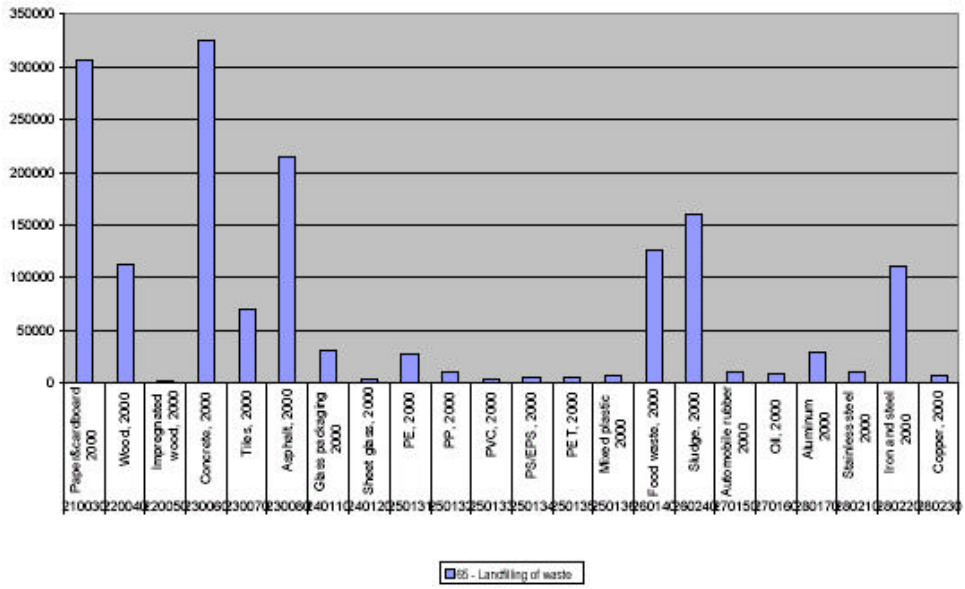


Figure 2.f. Savings in landfill requirements achieved based on the existing waste treatment for the various materials, calculated in 10PE (person equivalents).

Figure 2.f shows how much we have reduced our landfill requirements based on the treatment of waste in 2000, compared to the situation if all waste was landfilled.

The indicator values for saved landfill requirements show that the existing waste management is ensuring that large quantities of waste are not ending up at landfill sites.

The indicator also incorporates the "hidden material flows", wherever this has been possible. The hidden material flows are included in data for coal extraction, and partially in data for metal extraction. Landfilled waste will thus be included in connection with the extraction of new materials or energy to replace materials lost through landfilling or incineration.

For most metals, there are significant landfill requirements in connection with the extraction of ore. However, due to the lack of data for these hidden streams, they are generally not included in the calculations. If the hidden streams were incorporated everywhere, increased recycling would lead to significant savings in landfill requirements for most metals.

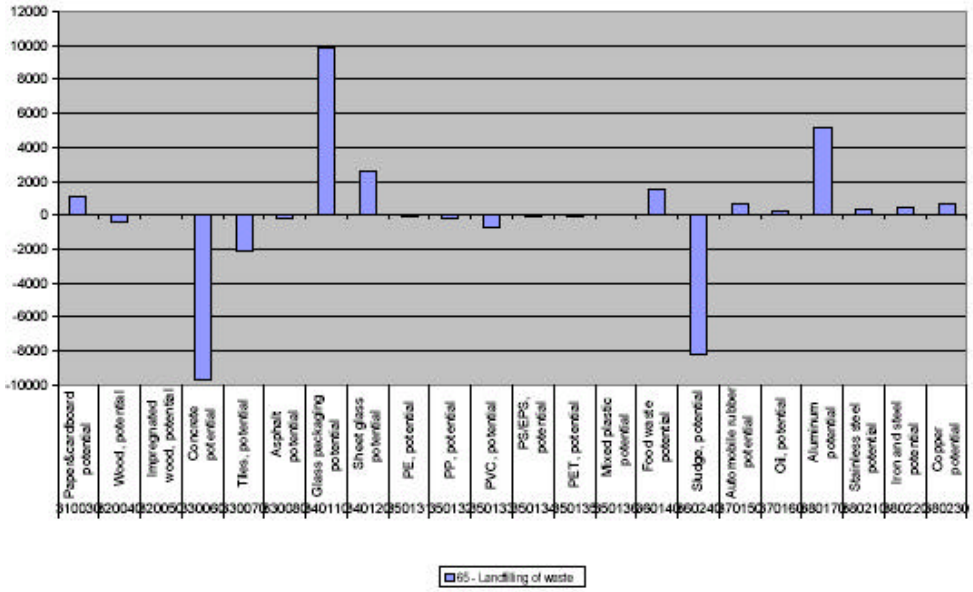


Figure 2.g. Potential for further savings in landfill requirements for the various materials, calculated in 10PE (person equivalents).

Figure 2.g shows how much more we can save in landfill requirements, for example, if we were able to recycle a larger proportion of a fraction which is currently incinerated or landfilled. Thus we have an indicator value that shows how much more can be saved in landfill requirements by improving the existing treatment.

For glass and aluminium, there is a significant potential to save landfilling as glass that is not recycled is incinerated, generating slag requiring landfill. Similarly, aluminium does not burn in the thicknesses that are typically found in household waste, and hence contributes to the slag volume.

For several materials, an increase in landfill requirements can be seen. For concrete, tiles and PVC, the increased landfill volumes are due to allowance for requirements for increased sorting of contaminated materials for landfill, compared to the situation in 2000. There has been a shift here from recycling to landfilling.

The results must be interpreted with care, as the indicators are derived from many different types of waste, without weighing up the degree of environmental hazard associated with these types of waste.

2.3.6 Summary of the new indicators

With the existing waste management, involving 66% recycling, 24% incineration, and 10% landfilling, significant savings in resource consumption have been achieved for waste from paper and cardboard, wood, and these metals: aluminium, iron and steel, and copper. Significant energy savings have been achieved through the existing waste treatment of paper and cardboard, wood, PE plastic, aluminium, and iron and steel. There have been savings in landfill requirements under the existing waste management for the majority of waste fractions, except for impregnated wood, PVC and plane glass.

The most important potential for further savings in both resource consumption and energy consumption is found in the metals, paper, and

plastic – excluding PVC. The greatest potential for further savings in landfill requirements is found for glass packaging and aluminium.

2.3.7 Conclusion

The development and calculation of the new indicators has marked the beginning of a valuable process. We are gaining greater and more detailed knowledge about the environmental impact of waste. These indicators are contributing to providing a better foundation for making the right decisions in waste management.

We are only at the beginning of this process, and it will be many years before we have a well-developed and complete tool to use in prioritising initiatives. But we have taken the first step in developing the right tool to ensure that we achieve better quality in our waste management. If we use the indicators and the other knowledge in this area together with cost-benefit calculations, we will be well on the way to having a tool that tells us where we can gain improved cost-effectiveness from environmental policies.

During the years ahead we need to develop new indicators for further environmental effects, and to improve our statistical base. We must regularly update the indicators we have already calculated to get an overview of whether we are sending waste to the treatment process that is most beneficial for the environment.

3 Initiatives

The Danish Waste Strategy focuses on prevention of resource consumption and environmental impacts from waste.

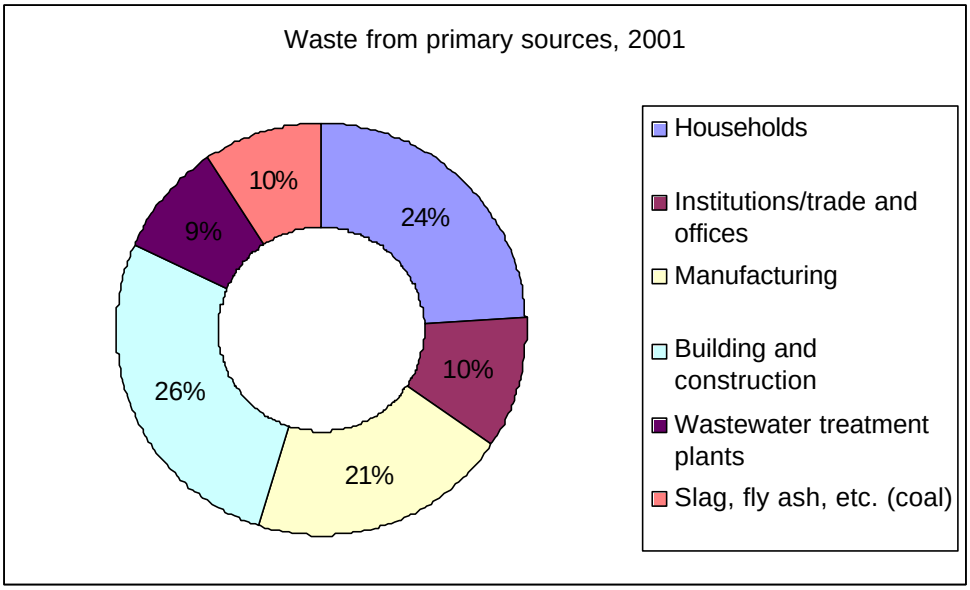
Future initiatives will not be based purely on the volume of waste alone. The total resource consumption and environmental impact from waste treatment will be central elements in the evaluation of future initiatives.

Waste prevention, increased recycling, reduced landfilling and improvements to the quality of waste treatment will continue to be important areas, and initiatives to tackle xenobiotic substances in waste must continue to be enhanced.

For Waste Strategy 2005-2008 to succeed, a number of initiatives must be commenced at various levels. Some initiatives are of a more general nature, while others will be adapted to different sectors or directed at the waste fraction in question.

The Strategy contains more than 100 new initiatives, covering the entire waste management spectrum. The majority of these initiatives are directed towards implementing EU and Danish regulations, and making new knowledge available through development and elucidation projects. The Strategy also contains a number of initiatives that aim to develop new tools, sub-strategies, environmental and cost-benefit assessments, and a small number of information activities.

Waste can be divided according to the source (sector) generating it. These sectors are waste incineration plants, building and construction, households, industry, institutions, trade and offices, power plants, and wastewater treatment plants. Landfill sites are also considered to be a sector. The total volume of waste is distributed as follows: the building and construction sector 26%, households 24%, industry 21%, institutions/trade and offices 10%, and power plants 10%. Wastewater treatment plants contribute 9% of waste. Residues from waste incineration plants are not included in the total volume of waste in the figure, as they would otherwise be counted twice.



The Waste Strategy initiatives are described briefly below. The first initiatives are of a more general nature, followed by a number of initiatives divided according to the various waste source sectors. A more detailed description of initiatives is given in Appendices A to E.

For each sector, total aims have been calculated for recycling, incineration and landfilling arising as a consequence of the initiatives taken in relation to each waste fraction.

3.1 General focus areas

Statistical base
There is a need to continue the systematic collection of comparable data on waste generation and treatment in a way that permits both enterprises, and local and national authorities, to use it. It is also important to measure the effect of future initiatives in the area of waste management. Initiatives to improve the statistical base for the entire waste sector are described in Appendix B on waste data.

In 2002, the Minister for the Environment appointed a work group to examine the organisation of waste management. One of the group's tasks was to look at registration and reporting requirements, with the aim of simplifying these. Early in the plan period, a model for a central register for waste carriers will be developed.

Indicators for resource consumption, energy consumption and landfill requirements
The new waste indicators for resource consumption, energy consumption, and landfill requirements must be refined, and attempts must be made to obtain further life-cycle analysis data (LCA data) for the calculations. In order to be able to monitor the trends, the waste indicators should be recalculated regularly, every two or three years. There is a great need in the future to supplement the LCA databases with data for recycling processes, and

especially for human and ecotoxic effects. Further LCA-based indicators should be developed, if the statistical base allows this. The waste indicators will provide an improved foundation for selecting the best environmental initiatives in the future.

The final choice of treatment methods will be based on the indicators, together with other knowledge about the environmental impacts of waste, and cost-benefit analyses. Together, these initiatives provide a good prioritisation tool for selecting specific treatment methods for the individual waste fractions.

Knowledge-sharing
Knowledge-sharing is a central instrument to be used by the players in implementing the Strategy. Information can support and contribute to fulfilling the various elements of the Waste Strategy. Relevant information must be made available to the players via the Internet and other media. Waste Centre Denmark has a central role in this area.

Waste prevention
In Waste Strategy 2005-08, it has been decided to implement waste prevention measures initially where the barriers are small and where results can be achieved in the short term. Initiatives will be commenced in four sectors: households, the service sector, industry, and building and construction.

Technology development
Better quality in waste treatment requires the development of new technologies. There are several barriers that prevent this development taking place automatically. An example of a barrier is the fact that there is no security that the necessary volumes of waste will be supplied to the treatment plants (see Appendix B on technological development).

If technologies adapted to future waste are to be developed at a general level, it is necessary to continue to support the development of new technologies. Furthermore, central requirements must be placed on waste treatment when technologies exist. This can contribute to treatment plants being established and operated under market conditions.

Transparency in municipal fees
Transparency needs to be achieved in municipal fees. Changes to the legal basis for fees in the Environmental Protection Act will be proposed during parliamentary session 2004-05. In addition to transparency, the following factors will be considered when selecting the formulation of the legal basis for fees: the municipalities' need for flexibility in waste management, the rule of law, the polluter pays principle, and environmental, economic and legal efficiency.

Organisation of waste management
In spring 2002, the Government appointed a work group to undertake a complete assessment of the scope and significance of the most important problems in the area of waste management. At the end of 2004, the work group will offer proposals for future solutions within areas where it considers that changes to organisation and legislation have been found to be necessary.

The Waste Strategy should therefore not be considered to be an exhaustive description of the initiatives that will be implemented during the period in

relation to the organisation of waste management and the use of control mechanisms. Rather, the Strategy will be supplemented by new initiatives when the Government has evaluated the recommendations of the work group.

Municipal regulations
The number of municipal regulations must be reduced, and the contents of regulations must be harmonised to make it easier to work out which rules apply in each municipality and to compare municipalities.

Taxes
Investigation will be made into whether waste tax rates support environmental priorities in the area of waste management. At the same time, assessment should be made of whether the waste tax can be used as a more precise control instrument, for example, in connection with the industrial use of residues from sludge incineration and shredder waste. A change in the waste tax will not lead to a total increase in yield from the tax.

Capacity, general
In most areas, the market generates the necessary capacity for the treatment of waste. This is especially true for waste recycling. One of the areas where it has not yet been possible to establish the necessary capacity is sites for landfilling acidic flue gas cleaning products.

Incineration and landfilling are special areas where deregulation is being discussed. Currently, the capacity of incineration plants and landfill sites is largely controlled by the national and municipal authorities. If these parts of the waste management sector were deregulated, government control of this capacity will disappear. The advantages and disadvantages of potential deregulation of the waste management sector are being considered by the work group on the organisation of the waste sector. This group is considering how the necessary capacity can be ensured.

Capacity at waste incineration plants
Currently, challenges relating to changes in capacity requirements, overall energy policy, and stricter environmental requirements are solved in close co-operation between municipalities, counties and national authorities.

It is believed that the planned expansions will provide sufficient capacity to meet incineration requirements in 2008.

The objective is to match incineration capacity to actual requirements and locate it in areas where the best possible energy utilisation and greatest possible CO_2 mitigation are obtained, taking into consideration the principle of regional self-sufficiency.

Much incineration capacity is currently based purely on hot water generation. It is estimated that after 2004 there will still be a need to utilise capacity in several of these incinerators. However, these incinerators are being gradually phased out as new incinerators are built, and in 2008, approx. 95% of waste for incineration is expected to be processed in CHP incinerators that produce both heat and power.

Landfill capacity
Up until 2008, landfill capacity will be sufficient at the national level, but there are large regional differences due to varying degrees of difficulty in finding suitable sites for placing landfill. In addition, experience has shown that

planning should be carried out with a 12-year horizon. Capacity planning should therefore look further ahead than the four years that are typical practice in planning, and should be carried out in cooperation between counties and municipalities.

Hazardous waste
A strategy for hazardous waste will be prepared. The purpose of this strategy will be to identify whether the various regulations relating to hazardous waste represent barriers to the best economic and environmental management of waste, and to identify potential initiatives to minimise these barriers.

3.2 Sectors and fractions

Initiatives for each sector are described below. Each sector description will contain details of how individual objectives will be achieved, including which fractions will be the focus of initiatives (see also Appendix D on sectors, and Appendix E on fractions).

The table below contains an overview of actual waste treatment in 2001, based on the latest waste statistics, and an overview of the Waste Strategy's aims for 2008.

	Actual waste treatment 2001			Waste Strategy – aims for 2008		
	Recycling	Incineration	Landfilling	Recycling	Incineration	Landfilling
Household waste	29%	61%	8%	33%	60%	7%
Domestic waste	16%	81%	3%	20%	80%	0%
Bulky waste	18%	49%	26%	25%	50%	25%
Garden waste	99%	0%	1%	95%	5%	0%
Waste from institutions, trade and offices	36%	49%	12%	50%	45%	5%
Industry	65%	12%	22%	65%	20%	15%
Building and construction	90%	2%	8%	90%	2%	8%
Sewage works	67%	27%	6%	50%	45%	5%
Power plants	99%	0%	1%	90%	-	10%
Total	63%	25%	10%	65%	26%	9%

Where the sum of recycling, incineration and landfilling components does not amount to 100% in the table, this is because a small proportion of waste is put in temporary storage.

3.3 Waste incineration plants

Aims for 2008

- *85 % recycling of slag from incineration plants*
- *a Danish solution for the management of flue gas cleaning products*

In 2001, approx. 540,000 tonnes of residues (slag and flue gas cleaning waste) were generated at waste incineration plants[6]. It is expected that increasing amounts of waste will be incinerated in the years ahead, leading to increasing amounts of residues being generated.

In future, fractions that can be recycled or that cause environmental problems must be prevented from reaching waste incineration plants.

Residue quality must be improved. Residue recycling and landfilling must also give maximum consideration to the protection of groundwater resources. This will require new treatment methods to be developed, for example, for flue gas cleaning waste.

Waste incineration plants, initiatives

Electrical and electronic products	The EU Directive on waste electrical and electronic equipment has to be implemented by the end of 2004
Flue gas cleaning waste	An action plan for a permanent solution for the management of flue gas cleaning products generated in Denmark will be prepared.
Slag	The Statutory Order on the Recycling of Residues and Soil for building and construction purposes will be extended to contain limit values for organic substances Leaching of xenobiotic substances from slag must be reduced. Investigation will be made into whether there should be a requirement to sort fractions with particularly high heavy metal content from the remaining slag.

Electrical and electronic products must be collected separately and managed in a more environmentally sound manner. Requirements for their management were laid down in a Statutory Order issued in 1998. The new EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment.

Flue gas cleaning waste is classified as hazardous waste[7]. This waste used to be landfilled temporarily or exported, as no suitable methods to stabilise it were available. On the basis of an environmental and cost-benefit analysis, and in cooperation with waste incineration plants, an action plan will be prepared for the future management of flue gas cleaning products generated in Denmark. This action plan will contain deadlines for when each problem with flue gas cleaning products has to be solved. Once environmentally responsible reprocessing methods have been established, specific rules will be laid down for the management of flue gas cleaning products from waste incineration plants.

[6] Residues from waste incineration plants are not included in statements of total waste amounts, as they would otherwise be counted twice.
[7] In 2001, 73,800 tonnes of flue gas cleaning waste were generated.

In 2001, 87% of *slag*[8] was recycled. Future recycling of slag must continue to give maximum consideration to the protection of groundwater resources. The Statutory Order on the recycling of residues and soil for building and construction purposes will be extended to contain limit values for organic substances.

Recycling of slag from waste incineration must be increased by reducing the leaching of xenobiotic substances from the slag. This can be achieved by improved source separation of waste going to incineration or by sorting fractions with particularly high heavy metal content from the remaining slag.

3.4 Building and construction

Aims for 2008

- *90% recycling of building and construction waste*
- *recycling of building and construction waste gives maximum consideration to groundwater resources*
- *recycling of residues in the building and construction sector gives maximum consideration to groundwater resources*
- *indicators are used that make it possible to evaluate environmental initiatives in construction*

The building and construction sector is characterised by a very high recycling rate for the waste generated. This high rate will be maintained, as waste recycling saves important resources.

The aim for 2008 is to maintain this high recycling rate. It must also be ensured that building and construction waste recycling gives consideration to the protection of groundwater resources.

In 2001, building and construction waste amounted to approx. 3.4 million tonnes. The volume of building and construction waste has been increasing over the last ten years.

Using funding from the Danish Environmental Council for Cleaner Products, a Construction Panel has been appointed which has prepared an action plan for sustainable construction.

Cross-cutting initiatives

During the next few years, a guide to waste prevention will be prepared. During the renovation of older properties, it is constructive to re-use previously used building elements. The guide will describe the activities that should be carried out during demolition to ensure the optimal re-use of building components. Renovation is an alternative to new construction, and the scope of property renovation compared to demolition therefore needs to be analysed.

Such high levels of contaminants have been recorded in building and construction waste that a nationwide investigation needs to be carried out to determine which contaminants are present and in what concentrations. The sources of these contaminants must also be identified.

An investigation will be carried out to describe the normal procedure for managing building and construction waste in the municipalities. For example, this investigation will clarify whether the individual fractions are mixed together before they are recycled, and whether the mixed fractions are recycled with the necessary Section 19 permission or Chapter 5 environmental approval under the Environmental Protection Act.

It will be investigated whether there are environmental and health effects in connection with the use, renovation and demolition of buildings containing PCB.

[8] In 2001, 465,600 tonnes of slag were generated.

Building and construction waste has sometimes been found to contain contaminants and should be treated like other residues. Consideration will be given to whether the recycling of building and construction waste should be regulated under the Statutory Order on residues and soil for building and construction purposes, in the long term. The necessary basis for revising the Statutory Order to also cover building and construction waste needs to be provided. It is expected that the Statutory Order will be extended to include fractions containing organic contaminants.

A proposal will be made for specific resource and environment indicators for individual construction projects. These indicators will enable building contractors to take responsibility for improving environmental factors in construction. Principles will also be proposed for a benchmarking system that makes it possible to evaluate environmental initiatives.

A project will be initiated to provide an overview of where environmental considerations should be incorporated into the existing legal and regulatory base. The existing requirements need to be assessed to determine whether they support the environment goals presented in the Construction Panel's action plan.

Focus needs to be given to the use of chemicals in buildings and building products. An investigation will therefore be initiated with the aim of developing a simple tool to evaluate and prioritise the use of chemicals in the building sector.

Building and construction sector, initiatives

Cross-cutting	A guide to the prevention of building and construction waste will be prepared An analysis of contaminants in building and construction waste will be carried out An investigation will be carried out that describes the procedure for managing building and construction waste The environmental and health effects of PCB in buildings will be investigated The Statutory Order on residues and soil for building and construction purposes will be extended to also cover building and construction waste and organic contaminants Proposals will be made for specific indicators for individual construction projects An overview will be provided of where environmental considerations should be incorporated into the existing legal and regulatory base. Focus needs to be given to the use of chemicals in buildings and building products
Asphalt	Asphalt recycling must be done in a responsible manner, taking into account environmental and health impacts.

Concrete	There must continue to be a high rate of concrete recycling, in an environmentally responsible manner.
Electrical and electronic products	The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004
Hazardous waste	A strategy for hazardous waste will be prepared Criteria for environmental hazards will be implemented New treatment methods for hazardous waste fractions will be developed Information on hazardous waste regulations will be communicated
Mineral wool	The potential for recycling mineral wool will be investigated, including the development of recycling methods and of the market for recyclable mineral wool
Impregnated wood	Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as non-incinerable waste, and landfilled. Once better treatment methods have been developed, impregnated wood will be collected separately, if this is assessed to be environmentally and cost-effective.
Ozone layer depleting substances in waste fractions	Under the EU Regulation on ozone layer depleting substances, regulations must be implemented regarding the separate treatment, wherever possible, of products containing ozone layer depleting substances. This will apply to pre-insulated district heating pipes in particular
Plastic packaging	Under the Packaging Directive, 22.5% of plastic packaging must be recycled in 2008
PVC	PVC waste must continue to be separated, either for recycling or landfilling. Once better treatment methods have been developed, PVC will be collected separately, if this is assessed to be environmentally and cost-effective
PCB and PCT	Evaluation will be made as to whether health impacts arise in connection with the use, renovation or demolition of buildings containing PCB
Residues from power plants, waste incineration plants and soil	Guidelines on the recycling and relocation of soil and residues will be prepared The Statutory Order on recycling of residues and soil for building and construction purposes will be revised to also cover soil contaminated with organic compounds
Tiles	Efforts will be made to ensure that tiles are recycled in an environmentally responsible manner
Wooden packaging	Under the Packaging Directive, 15% of wooden packaging must be recycled in 2008

Asphalt recycling must be done in a responsible manner, taking into account environmental and health impacts. The first step is to ensure that the health risk associated with laying crushed asphalt is minimised. This can be achieved by requiring asphalt to be compressed or compacted after laying, to limit dust emission. In the longer term, asphalt recycling will be covered by the Statutory Order on recycling of residues and soil for building and construction purposes.

There must continue to be a high rate of *concrete* recycling, in an environmentally responsible manner. In the longer term, regulations governing the management of concrete will be covered by the Statutory Order on recycling of residues and soil for building and construction purposes.

Electrical and electronic products must be collected separately and managed in a more environmentally sound manner. Requirements for their management were laid down in a Statutory Order issued in 1998. The new EU Directive on waste electrical and electronic equipment has to be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment.

A strategy for *hazardous waste* will be prepared. The purpose of this strategy will be to identify whether the various regulations related to hazardous waste represent barriers to the best economic and environmental management, and to identify potential initiatives to minimise these barriers. Understanding of how to use the hazardous waste criteria needs to be continually disseminated. New treatment methods for hazardous waste will be developed. Efforts will be made to ensure that criteria for environmental hazards are implemented in Danish regulations.

Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as non-incinerable waste, and landfilled. When better treatment methods have been developed, these types of impregnated wood will be collected separately. Requirements for the management of certain types of impregnated wood will be introduced on the basis of an environmental and cost-benefit assessment.

Mineral wool, as waste, represents a health problem. It is hazardous due to its local irritation and carcinogenic effects. Mineral wool produced after 2000 is less hazardous, as it is considered to only cause local irritation. The potential for recycling mineral wool must be investigated, including the development of recycling methods and of the market for recyclable mineral wool.

District heating pipes can contain *ozone layer depleting* substances, such as CFC's and HCFC's. Regulations for separate treatment of pre-insulated district heating pipes will be laid down. An investigation will also be carried out into the potential for separate treatment of other waste fractions containing ozone layer depleting substances.

Under new EU regulations, Denmark has to recycle 22.5% of *plastic packaging* in 2008. Greater quantities of plastic packaging must therefore be collected from the construction sector.

PVC waste will be separated. PVC construction waste contains a large fraction of hard PVC that can currently be recycled. Recyclable hard PVC

construction waste will therefore be assigned to recycling. Non-recyclable PVC waste will be landfilled. When suitable treatment methods have been developed, new requirements for special management of such waste will be laid down, if this is considered to be environmentally and cost-effective.

PCB is used in sealing compounds and to seal insulating glass. A project will be initiated to investigate the health impacts associated with the use, renovation or demolition of buildings containing PCB. The project will focus on an evaluation of the PCB contribution from building dust, indoor air and soil close to buildings.

Residues from power plants, waste incineration and soil are widely recycled in building and construction works. Guidelines on the recycling and relocation of soil and residues will be prepared. Statutory Order no. 655 of 27 June 2000 on recycling of residues and soil for building and construction purposes will be revised to also cover soil contaminated with organic compounds.

Tiles represent approx. 5% of building and construction waste. In the longer term, regulations governing the management of tiles will be covered by the Statutory Order on recycling of residues and soil for building and construction purposes.

Under new EU regulations, Denmark has to recycle 15% of *wooden packaging* and 55% of all packaging waste in 2008. In order to achieve this goal, an analysis will initially be completed of the volume of wooden packaging waste, and potential buyers. Wooden packaging will also be included in the transport packaging agreement, and requirements for the separation of wooden transport packaging will be laid down.

3.5 Landfill sites

Aims in 2008

- *all transition plans are expected to be considered before the end of 2004 – all outdated landfill sites are required to close by 16 July 2009*
- *reduce the volume of landfilled waste*
- *ensure optimal environmental operation of landfill sites (sustainable landfill)*
- *anyone carrying out landfill activities at landfill sites must be in possession of an A certificate (operations manager) or a B certificate (other staff)*

In 2001, 1.3 million tonnes waste were landfilled. Over the last 15 years, attempts to reduce the volume of landfilled waste have been successful.

The design and operation of landfill sites must conform to the requirements in the Statutory Order on landfill sites.

As a consequence of Denmark's implementation of the EU Directive on the landfill of waste, the number of landfill sites in Denmark is expected to be further reduced.

Cross-cutting initiatives
The potential to recycle/utilise waste must constantly be investigated so that in the future, waste will only be landfilled when it is environmentally appropriate and responsible to do so.

Requirements will be laid down governing the design and operation of landfill sites and limit values for the leaching characteristics of waste. These will aim to ensure, as far as possible, that the consequences of a failure in the environmental protection systems does not lead to irreversible damage to nature and/or the environment surrounding a landfill site.

As a result of the implementation of the EU Directive on the landfill of waste (including annex harmonisations) the contents of the landfill guidelines from 1997 have become obsolete in a number of areas. The landfill guidelines

therefore need to be updated, giving special attention to a description of the future Danish waste characterisation requirements aimed at ensuring "sustainable landfilling".

Training plans, training material and various tests will be prepared with the aim of ensuring that employees at landfill sites can attain the certificates required under the Statutory Order on training[9].

Landfill sites, initiatives

Cross-cutting	In the future, waste should only be landfilled where it is environmentally appropriate and responsible to do so Requirements will be laid down for the design and operation of landfill sites, and criteria and limit values for the leaching characteristics of waste As a result of the implementation of the EU Directive on the landfill of waste (including annex harmonisation) the landfill guidelines from 1997 will be updated Training plans, training materials and various tests will be prepared for employees
Seabed sediment	Preparation of a new administration basis for managing seabed sediment Other possible relevant initiatives

The Minister for the Environment, together with representatives from Danish Regions, Local Government Denmark (LGDK) and the Association of Danish Ports, is considering a new administration basis for managing seabed sediment. This is expected to be available in autumn 2003 at the earliest.

Further potential relevant initiatives are awaiting the contents of the proposal for a new administration basis.

3.6 Households

Aims for 2008

- *ensure that consumers have the opportunity to choose products that help prevent waste*
- *increased information about collection of hazardous waste from households*
- *33% recycling of household waste*
- *60% incineration of household waste*
- *7% landfilling of household waste*

Household waste consists of domestic waste (including paper, glass and food waste collected separately), bulky waste, and garden waste. A small proportion of household waste is hazardous.

From 1995 to 2001, there has been an increase in the volume of household waste. The major part of this increase can be attributed to garden waste in particular. The increase should also be considered in the context of increased purchasing power and private consumption in the nation.

Focus must be given to consumption, and the resulting volumes of waste.

[9] Statutory Order no 647 of 29 June 2001 on training of operations managers and personnel employed at landfill sites.

Cross-cutting	Efforts to communicate information about the municipal schemes will be increased An information campaign will be run on the link between consumption and waste volumes Information and teaching materials on resource consumption and waste prevention will be prepared for pre-schools, and primary and high schools.

Cross-cutting initiatives

In order to meet the aims for domestic waste, garden waste and bulky waste, it will be necessary to involve the public in the various collection schemes. This will require increased communication activities within each municipality in order to create the greatest possible awareness of the specific waste collection schemes, including schemes for hazardous waste.

Another purpose of information activities is to increase people's interest in purchasing products that have a lower environmental impact throughout their entire life cycle, and generate as little waste as possible. The Ministry of the Environment will conduct an information campaign on the link between consumption and waste volumes, with specific recommendations regarding, for example, quality/durable products, products made from recycled materials, reusable packaging and packaged goods, etc.

Many consumption and behaviour patterns become established as children. To ensure that future generations are conscious of resource and waste problems, information and teaching materials will be prepared for pre-schools, and primary and secondary schools. This material will highlight the link between increased consumption and environmental problems related to resource consumption and waste generation. Similarly, all children's day-care centres and educational institutions should be encouraged to sort their own waste.

3.6.1 Domestic waste

Aims for 2008

- *20 % recycling of domestic waste*
- *80 % incineration*

Recycling of domestic waste can be increased, and in the years ahead, focus will be given to increased separation and collection of plastic and metal packaging, due to our obligations under the EU Packaging Directive.

Domestic waste, initiatives

Organic domestic waste	The Ministry of the Environment will develop a tool to be used to evaluate locally the environmentally and economically most appropriate management This will enable municipalities to assess whether two-part collection of the organic component of domestic waste should be locally introduced, and make a decision about this Focus on cheaper collection systems and the development of pre-processing technologies Initiate investigations into central sorting of the combined domestic waste, with the aim of recycling the organic component
Plastic packaging	Mandatory schemes for the collection of plastic containers and bottles must be introduced as a consequence of the EU Packaging Directive
Metal packaging	Increased recycling of metal packaging as a consequence of the EU Packaging Directive

A tool will be developed to help municipalities evaluate whether incineration, biogasification or composting of the *organic component of domestic waste* is best. This will enable municipalities to assess which treatment for organic domestic waste is environmentally and economically most effective and make decisions accordingly.

Previous studies have shown that the two-part collection and pre-treatment of waste is particularly expensive and has a critical impact on whether it is economically viable to recycle organic waste. The aim is therefore to reduce collection costs and develop pre-processing technology. As an alternative, the possibility of sorting the combined domestic waste centrally in order to recycle the organic component is being investigated, taking into account both environmental and working environment factors.

From 2005, municipalities will be required to give people the opportunity to separate the relevant *plastic packaging* and deliver it for recycling, for example at recycling centres.

Requirements will be laid down for increased collection of *iron and metal packaging* from households, for example, via recycling centres or under existing bulky waste schemes.

3.6.2 Bulky waste

Aims for 2008
- *25 % recycling*
- *50 % incineration*
- *25 % landfilling*

Recycling of bulky waste can be increased by reorganising or improving existing schemes. In recent years, many municipalities have set up manned recycling centres, often supplemented by collection schemes.

Bulky waste is an area that requires local solutions and where there are advantages in building networks.

Cross-cutting initiatives

The Ministry of the Environment will encourage municipalities to participate in establishing or improving existing re-use schemes for bulky waste. Well-developed schemes to ensure that reusable products do not end up in the waste system should be spread to more municipalities, possibly in cooperation with charities.

Municipalities will also be encouraged to extend the municipal bulky waste schemes to cover many more recyclable waste fractions, so that the volumes collected in the incinerable and non-incinerable fractions can be reduced.

It is not feasible to calculate the environmental and socio-economic effects of alternative forms of treatment for the many hundreds of different products that end up in bulky waste. Municipalities will therefore have to base their evaluations of which types of products should be directed to recycling on the waste indicators for the various material types and on the potential markets for the various fractions.

Municipalities will be encouraged to establish networks for staff at recycling centres and involved in collection schemes for bulky waste, to allow them to share practical experience, including knowledge of potential markets for the many material fractions and products in bulky waste.

The Ministry of the Environment will also encourage building associations and other apartment buildings to establish bulky waste schemes to ensure that re-usable items do not end up in the waste system (exchange centres), and that recyclable waste fractions are separated for recycling.

Waste collection staff and property administrators should be in close contact with residents to inform them about correct separation of their waste, with the particular aim of increasing the re-use and recycling of bulky waste. Municipalities will therefore need to take the initiative to train and instruct janitors, caretakers, waste collection staff and staff at recycling centres, to equip them to give better advice to people about waste separation.

Bulky waste, initiatives

Cross-cutting	Municipalities will be encouraged to participate in establishing or improving existing re-use schemes for bulky waste Municipalities will be encouraged to extend municipal bulky waste schemes to cover many more recyclable waste fractions Municipalities will be encouraged to establish networks for staff at recycling centres, etc. Building associations and other apartment buildings will be encouraged to establish bulky waste schemes for re-usable and recyclable items Municipalities should take the initiative to train and instruct janitors, caretakers, waste collection staff and staff at recycling centres, to equip them to give better advice to people about waste separation.
Electrical and electronic products and refrigeration equipment	The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004, including regulations for the management of refrigeration equipment
Impregnated wood	Efforts will be made to ensure that only wood impregnated with chromium, copper, and arsenic-containing substances is treated as waste not suitable for incineration.
PVC	New requirements for the management of PVC waste will be prepared

Electrical and electronic products will be collected separately and managed in a more environmentally sound manner. Requirements for their management were laid down in a Statutory Order issued in 1998. The new EU Directive on waste electrical and electronic equipment has to be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment, including refrigeration equipment. The directive is based on producer responsibility.

Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as waste not suitable for incineration, and landfilled. When better treatment methods have been developed, these types of impregnated wood will be collected separately. Requirements for the management of certain types of impregnated wood will be introduced on the basis of an environmental and cost-benefit assessment.

Efforts will be made to ensure that *PVC waste* is managed in an environmentally responsible and cost-effective manner. This can be achieved by drafting requirements for the collection and management of PVC waste.

3.6.3 Garden waste

Aims for 2008
- *95% recycling*

Municipalities have voluntarily established schemes and facilities for composting garden waste. It is not expected that recycling of garden waste can be increased further[10].

Existing initiatives will be maintained, and no new initiatives are expected in this area.

3.7 Industry

The recycling goal for industrial waste for 2004 has almost been reached, but too much waste is being landfilled. Concerted efforts will therefore be made to reduce the volume of landfilled waste, while maintaining the recycling rate of 65%.

Aims for 2008
- *65% recycling*
- *maximum 15 % landfilling*
- *improved collection of hazardous waste*

The aim for 2008 is to reduce the volume of landfilled waste to a maximum of 15%. A study has shown that shredder waste and foundry waste account for 27% of industrial waste landfilled in 1997, corresponding to approx. 190,000 tonnes[11].

Other fractions will be separated to increase recycling, if environmental cost-benefit analyses indicate a benefit from doing so. These fractions are described below.

Cross-cutting initiatives
Measures will be initiated to prevent waste. Information on volumes of waste, composition, and potential for recycling will be improved in future preparation of environmental approvals, green accounts, and in the establishment of environmental management in enterprises.

Environmental approvals will be improved in the area of waste management. With the implementation of the IPPC Directive[12] in Statutory Order no. 807 of 25 October 1999, as most recently amended by Statutory Order no. 606 of 15 July 2001, on approval for specially polluting activities, the waste component has been given high priority. Section 13(2), no. 4 of the Statutory Order states that the enterprise must take the necessary steps to avoid waste generation, and where this is not possible, to exploit the potential for recycling and recirculation.

Assessment will be made as to whether increased use of environmental management in enterprises can be best achieved through sector agreements or whether guidelines on conditions for waste reduction need to be prepared for enterprises subject to approval and not requiring approval. These guidelines could also describe BAT's (Best Available Techniques) to help reduce waste, etc., for a number of waste-intensive enterprises, and the significance of BAT's in relation to the maximum waste volumes.

[10] In 2001, recycling amounted to 99%, and only 1% of garden waste was landfilled.In 2001, the volume of garden waste was 458,000 tonnes.
[11] The total volume of industrial waste in 2001 was 2,616,000 tonnes. Approx. 22% of this waste was landfilled and 65% recycled.
[12] Industrial Prevention Pollution Control Directive no. 96/61/EC, 24 September 1996.

The existing waste analysis model will be refined so that it can also be used in large enterprises. The model can identify fractions for which internal recycling of the enterprise's waste can be increased.

Product wastage at the consumer due to inappropriate packaging that is impossible or difficult to completely empty could be significantly reduced if packaging designers and manufacturers developed packaging that it was possible to empty. Packaging manufacturers and producers who fill packaging will therefore be encouraged to develop and use better packaging that reduces wastage.

Based on both an environmental and economic assessment, efforts should be made to ensure that large plastic containers (over 20 litres) from industrial enterprises are re-used. It is expected that regulations will be implemented, requiring large containers to be separated for re-use or recycling.

In general, too much industrial waste is landfilled. Specific initiatives will be carried out, targeting individual fractions and sectors.

Industry, initiatives

Cross-cutting	Measures will be initiated to prevent waste Information on volumes of waste, composition, and potential for recycling will be improved Environmental approvals will be improved in the area of waste management as a result of implementation of the IPPC Directive[13] The existing waste analysis model will be refined so that it can also be used in large enterprises Product wastage at the consumer due to inappropriate packaging that is impossible or difficult to completely empty can be significantly reduced It is expected that regulations will be implemented, requiring large plastic containers to be separated for re-use or recycling Guidelines on conditions for waste reduction for enterprises subject to approval and not requiring approval will be prepared, or sector agreements to this end will be established Specific initiatives will be carried out, targeting individual fractions and sectors to reduce landfilling
Animal waste	Investigate the possibility of supplying animal waste to biogasification plants, especially abattoir waste Investigate the possibility of recovering phosphor from slag from incinerated meat-and-bone meal
Vehicle waste	Requirements will be laid down for increased recycling of plastic components Recycling of waste from end-of-life vehicles will be increased as a result of an EU directive

[13]Industrial Prevention Pollution Control Directive no. 96/61/EC, 24 September 1996.

Electrical and electronic products	The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004 Better resource utilisation through the development of new technologies for reprocessing products.
Tyres	Information campaign to limit damage during fitting, and promote the sale of retreaded tyres
Hazardous waste	A strategy for hazardous waste will be prepared The criteria for environmental hazards will be implemented New treatment methods for hazardous waste fractions will be developed Information on hazardous waste regulations will be communicated
Refrigeration equipment	Regulations for the management of refrigeration equipment will be included in a revised Statutory Order on management of waste electrical and electronic equipment
Plastic	A greater percentage of plastic film transport packaging must be recycled under the EU Packaging Directive
Metal	Increased recycling of metal packaging as a consequence of the EU Packaging Directive
Wooden packaging	Under the Packaging Directive, 15% of wooden packaging must be recycled in 2008
Impregnated wood	Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as non-incinerable waste, and landfilled. Once better treatment methods have been developed, impregnated wood will be collected separately, if this is assessed to be environmentally and cost-effective
Glass	Initiation of development activities aimed at developing alternative recycling processes for glass fragments
PVC	The volumes of PVC marketed and potential waste volumes will be determined Draft requirements for the management of PVC waste will be prepared Criteria for exemption from the PVC tax will be prepared Chemical treatment plants will be exempted from waste tax to promote recycling of new technologies PVC products that end up in waste incineration plants will be replaced Efforts will be made to ensure that PVC products containing lead and cadmium are separated, either for chemical treatment or landfilling

Shredder waste	Development of new treatment methods for extracting heavy metals
Foundry waste	The development of recycling methods will be promoted

The EU Animal By-Products Regulation, administered by the Danish Ministry of Food, Agriculture and Fisheries, has led the Ministry of the Environment to issue new regulations for the recycling and disposal of *animal waste*, including industrial kitchen waste, in the Statutory Order on sludge. The aim of these regulations is to ensure optimal treatment of animal waste, based on environmental considerations. Investigations will be carried out into the possibility of recycling increased volumes of animal waste for agricultural purposes through biogasification. Trials will be carried out on the recovery of phosphor from slag from incinerated meat-and-bone meal.

Requirements for increased recycling of plastic components resulting from an EU directive will be laid down through an amendment to the Statutory Order on management of *waste in the form of motor vehicles and derived waste fractions.* Initiatives supporting the development of new separation technologies aimed at recycling plastic and exploiting other organic fractions will be promoted as far as possible. Analyses of treatment technologies have been carried out. This work will continue with the aim of establishing plant to exploit shredder waste derived from end-of-life vehicles and a number of other composite products.

Electrical and electronic products will be collected separately and managed in a more environmentally sound manner. Requirements for their management were laid down in a Statutory Order issued in 1998. The new EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment. The directive is based on producer responsibility.

Regulations on the waste treatment of *refrigeration equipment* will be incorporated in a revised Statutory Order on management of waste electrical and electronic equipment, expected to be issued in 2004.

Further to the action plan for environmentally aware public procurement officers, guidelines have been prepared for public procurement officers on a number of items of electronic office equipment, and eco-labelling criteria will be prepared for several products. The development of new technologies for reprocessing electrical and electronic equipment will be evaluated regularly. Amendments to regulations to promote the use of best available technology will be made as the need arises.

Under the agreement with the Danish Tyre Trade Environmental Foundation, information campaigns will be conducted, aimed at minimising the volume of waste and promoting the use of *retreaded tyres.*

A strategy for *hazardous waste* will be prepared. The purpose of this strategy will be to identify whether the various regulations related to hazardous waste represent barriers to the best economic and environmental management, and to identify potential initiatives to minimise these barriers. Understanding of how to use the hazardous waste criteria needs to be continually disseminated. New treatment methods for hazardous waste will be developed. Efforts will be

made to ensure that criteria for environmental hazards are implemented in Danish regulations.

Separation of *plastic film transport packaging* from industry must be increased under the EU Packaging Directive. Municipalities will have to give priority to monitoring that plastic transport packaging is collected for recycling. Waste producers will have to participate more actively in the organisation of effective schemes. It needs to be easier for sector associations that represent waste producers/retail chains to establish nationwide collection schemes. The legislative changes necessary to support this will be investigated with the aim of amending the legislation in 2004, so that the new schemes can function from 2005. Increased focus will also be given to enterprises that produce large volumes of plastic film waste. Finally, it may be necessary to extend the requirements on collection to cover smaller enterprises.

Separation of other *plastic packaging* from industry must also be increased. The potential for recycling and re-using plastic containers from trade and industry has been investigated. Environmental and economic factors will also be investigated. When the project has been completed in the middle of 2003, a decision will be made on which types of packaging need to be separated.

Iron and metal packaging must be referred to recycling.

Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as waste not suitable for incineration, and landfilled. When a plant has been established, these types of impregnated wood will be collected separately. Requirements for the management of certain types of impregnated wood will be introduced on the basis of an environmental and cost-benefit assessment.

Under new EU regulations, Denmark must recycle 15% of *wooden packaging* and 55% of all packaging waste in 2008. In order to achieve this goal, an analysis will initially be completed of the volume of wooden packaging waste, and potential buyers. Wooden packaging will also be included in the transport packaging agreement, and requirements for the separation of wooden transport packaging will be laid down.

A project was initiated in 2002 to find alternative uses for *glass packaging*. This project will determine volumes and evaluate the potential for using glass in cement, tiles and road construction. There will be a need for further development and trials of other methods for alternative uses for glass.

A work group will be set up to determine the marketed volumes of *PVC* and propose a model for calculating the expected volume of waste. The volume of waste will be estimated through to 2020.

Efforts will be made to ensure that *PVC waste* is managed in an environmental and cost-effective manner. This can be achieved by drawing up requirements for the collection and management of PVC waste, and providing tax exemption for products that are managed in an environmentally responsible manner. Efforts will be made when drafting future regulations for the management of PVC waste to ensure that products containing lead and cadmium are separated, either for chemical treatment or landfilling. If exemptions are granted for the sale of products containing lead, guidelines will be prepared on how recycling of the regenerated PVC material containing

lead can be carried out. In order to promote the use of new technology for processing PVC waste, an amendment to the Act on taxes on waste and raw materials will be sought, such that new plants are exempted from paying waste tax.

It is not possible to keep waste incineration plants completely free of *PVC waste*. The Environmental Protection Agency has evaluated alternative products for soft PVC building products. Other areas will be continually evaluated to examine the potential for promoting the use of alternatives to the products that end up at waste incineration plants.

It is expected that a decision can be made during 2003-2004 on which treatment should be used for *shredder waste*. Initiatives that monitor and support the development of better treatment methods that can utilise the resources contained in shredder waste will be promoted as much as possible. Once the treatment technique is ready, regulations for the future management of shredder waste will be prepared, based on a cost-benefit analysis.

It is currently technically possible for a large proportion of *waste from foundries* to be recycled. Efforts will be made to ensure that all foundries in Denmark work towards recycling this waste, if this is found to be environmentally and cost-effective.

3.8 Institutions, trade and offices

Aims for 2008
- *50 % recycling*
- *45 % incineration*
- *5 % landfilling*

Recycling of waste from institutions, trade and offices[14] is far below the goal of 50% for 2004. Over the next few years, focus will therefore be given to separation of a number of waste fractions for recycling or special treatment.

The aim for 2008 is to achieve a recycling rate of 50%. This will primarily be achieved through source separation of a number of fractions for recycling. A number of these initiatives are aimed at ensuring compliance with targets in the relevant EU directives. Other initiatives will only be carried out if environmental cost-benefit analyses show them to be beneficial.

Cross-cutting initiatives
The existing waste analysis model will be refined so that it can also be used by service enterprises. The model can identify fractions for which internal recycling of the enterprise's waste can be increased.

The trade and repair sectors need to be encouraged to extend, improve and optimise the use of returnable transport packaging and make greater use of reusable transport packaging in general.

The Danish Environmental Council for Cleaner Products appointed a Retail Trade Panel in 2002. The aim of the panel is to generate activities to change attitudes and behaviour, with the aim of reducing the total environmental impact from the retail trade. The panel also aims to promote the range of and market for cleaner products in the area of convenience goods. In the area of waste management, the panel will initiate activities relating to organic waste, packaging waste, shop personnel training and packaging systems.

[14] The recycling percentage was 36% in 2001.

Institutions, trade and offices, initiatives

Cross-cutting	The existing waste analysis model will be refined so that it can also be used by service enterprises The trade and repair sectors will be encouraged to make greater use of reusable transport packaging The Retail Trade Panel will initiate activities relating to organic waste, packaging waste, shop personnel training and packaging systems
Animal waste (food waste from industrial kitchens and organic waste from the retail trade)	The best way of managing organic waste from the trade of convenience goods and ways of making it easier for retail chains to organise nationwide collection of organic waste need to be identified
Vehicle waste	Requirements will be laid down for increased recycling of plastic components Recycling of waste from end-of-life vehicles will be increased in accordance with an EU directive
Electrical and electronic equipment	The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004. Preparation of environmental guidelines for public procurement officers of a number of electrical and electronic products and eco-labelling criteria for several products.
Refrigeration equipment	Regulations for the management of refrigeration equipment will be included in a revised Statutory Order on management of waste electrical and electronic equipment
Tyres	Information campaign to limit damage during fitting, and promote the sale of retreaded tyres
Hazardous waste	A strategy for hazardous waste will be prepared The criteria for environmental hazards will be implemented New treatment methods for hazardous waste fractions will be developed Information on hazardous waste regulations will be communicated

Plastic	A greater percentage of plastic film transport packaging and other plastic packaging must be recycled under the Packaging Directive
PVC	Draft requirements for the management of PVC waste will be prepared Criteria for exemption from the PVC tax will be prepared Efforts will be made to ensure that PVC products containing lead and cadmium are separated, either for chemical treatment or landfilling
Wooden packaging	Under the Packaging Directive, 15% of wooden packaging must be recycled in 2008

As of 1 August 2003, in the Statutory Order on sludge, new regulations for the recycling and disposal of *animal waste*, including *industrial kitchen waste*, have been drawn up in cooperation with the Ministry of Food, Agriculture and Fisheries. The scheme for food waste from industrial kitchens has been evaluated and discontinued against the background of the prohibition against use in pig food.

There are large quantities of *organic waste in grocery stores.* The best way of managing organic waste from consumer goods is to be determined in cooperation with the Retail Trade Panel and the food authorities. Ways of making it easier for retail chains to organise nationwide collection of organic waste will also be investigated.

Requirements for increased recycling of plastic components resulting from an EU directive will be stipulated in an amendment to the Statutory Order on management of waste in the form of motor vehicles and derived waste fractions, during the term of the plan. Initiatives supporting the development of new separation technologies aimed at recycling plastic and exploiting other organic fractions will be promoted as far as possible.

Electrical and electronic equipment will be collected separately and managed in a more environmentally sound manner. Requirements for their management were laid down in a Statutory Order issued in 1998. The new EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment. The directive is based on producer responsibility.

Further to the action plan for environmentally aware public procurement officers, guidelines have been prepared for public procurement officers on a number of items of electronic office equipment, and eco-labelling criteria will be prepared for several products. Development of new technologies for reprocessing waste electrical and electronic equipment will be evaluated regularly. Amendments to regulations to promote the use of best available technology will be made as the need arises.

Regulations on the waste treatment of *refrigeration equipment* will be incorporated in a revised Statutory Order on management of waste electrical and electronic equipment, expected to be issued in 2004.

Under the agreement with the Danish Tyre Trade Environmental Foundation, information campaigns will be conducted, aimed at minimising the volume of waste and promoting the use of *retreaded tyres.*

A strategy for *hazardous waste* will be prepared. The purpose of this strategy will be to identify whether the various regulations related to hazardous waste represent barriers to the best economic and environmental management, and to identify potential initiatives to minimise these barriers. Understanding of how to use the hazardous waste criteria needs to be continually disseminated. New treatment methods for hazardous waste will be developed. Efforts will be made to ensure that criteria for environmental hazards are implemented in Danish regulations.

Separation of *plastic film transport packaging* from trade, etc., must be increased under the Packaging Directive. Municipalities will have to give priority to monitoring that plastic transport packaging is collected for recycling. Waste producers will have to participate more actively in the organisation of effective schemes. It needs to be easier for sector associations representing waste producers/retail chains to establish nationwide collection schemes. The legislative changes necessary to support this will be investigated with the aim of amending the legislation in 2004, so that the new schemes can function from 2005. Increased focus will also be given to enterprises that produce large volumes of plastic film waste. Finally, it may be necessary to extend the requirements on collection to cover smaller enterprises.

Separation of other *plastic packaging* from trade, etc., must also be increased. The potential for recycling and re-using plastic containers from trade and industry has been investigated. Environmental and economic factors will also be investigated. When the project has been completed in the middle of 2003, a decision will be made on which types of packaging need to be separated.

Efforts will be made to ensure that *PVC waste* is managed in an environmental and cost-effective manner. This can be achieved by drawing up requirements for the collection and management of PVC waste, and providing tax exemption for products that are managed in an environmentally responsible manner. Efforts will be made when drafting future regulations for the management of PVC waste to ensure that products containing lead and cadmium are separated, either for chemical treatment or landfilling. If exemptions are granted for the sale of products containing lead, guidelines will be prepared on how recycling of the regenerated PVC material containing lead can be carried out.

It is not possible to keep waste incineration plants completely free of *PVC waste*. The Environmental Protection Agency will continually evaluate other areas to examine the potential for promoting the use of alternatives to the products that end up at waste incineration plants.

Under new EU regulations, Denmark must recycle 15% of *wooden packaging* and 55% of all packaging waste in 2008. In order to achieve this goal, an analysis will initially be completed of the volume of wooden packaging waste, and potential buyers. Wooden packaging will also be included in the transport

packaging agreement, and requirements for the separation of wooden transport packaging will be laid down.

3.9 Power plants

Aims for 2008
- *recycling of 90% of residues from coal-fired power plants*
- *reduction in coal-based energy generation*
- *environmentally responsible recycling of bioash*

The Plan of Action for Energy - Energy 21 - will result in coal-based energy generation being almost completely phased out within 30 years. This will have a decisive impact on the volume of residues from coal-fired power plants, leading to a significant decline. The volumes still being generated in the years ahead will continue to be recycled, giving maximum consideration to the protection of groundwater resources.

Under Energy 21, wood and energy crops will in future represent an increasing element of fuel, and recycling of the ash generated will have high priority.

Power plants, initiatives

Residues from biofuel	Re-evaluation of current regulations for the recycling of bioash for agricultural purposes

The Statutory Order on bioash will be revised to incorporate the latest knowledge on the availability of nutrients in hardened bioash.

3.10 Public wastewater treatment plants

Aims for 2008
- *50% recycling of sludge for agricultural purposes*
- *25% incineration of sludge with recycling of the ash in industrial processes*
- *20% incineration*
- *5% landfilling*
- *influence the EU's revision of the Sludge Directive*

Recycled waste from municipal wastewater treatment plants represented 67% of the total volume (wet weight) in 2001[15].

Both the fertiliser and energy content in sewage sludge are to be utilised, but due to more stringent requirements concerning the content of certain organic chemicals in sludge, the current extensive application of sludge to farmland is expected to decrease. The aim is therefore to maintain 50% recycling in 2008.

Wastewater treatment plants, initiatives

Sludge	The use of xenobiotic substances will be reduced Denmark will strive to influence the EU's revision of the Sludge Directive

In the long term, it is expected that the quality of sludge and its recycling potential will be improved through the general policy of phasing-out xenobiotic substances. The levels of these substances in sludge are thus expected to be further reduced.

The Ministry of the Environment hopes to influence the revision of the EU Sludge Directive so that it ends up containing more stringent requirements for heavy metal contents, in line with existing Danish requirements, and introduces requirements relating to certain organic xenobiotic substances.

[15]In 2001, a total of 1,123,000 tonnes of sludge, sand and screenings were generated at wastewater treatment plants.Under Waste 21, the goal was to recycle 50% of the sludge.

Appendix A

Regulation

A.1 Instruments used in the Danish waste system

Legal basis

Danish waste legislation is characterised by a close interplay between EU regulation and national regulations.

EU regulation outlines the overall framework and principles for waste management. The organisation of waste structures and the implementation of EU regulations in Danish legislation is a task for the Danish national authorities.

The Danish waste model is based on a combination of traditional administrative instruments (Acts, Statutory Orders, and Circulars), and various other instruments such as taxes and charges, subsidy schemes and agreements. These instruments are described below.

Section A2 contains a more detailed description of EU waste regulation, and briefly discusses the links between EU regulation and Danish legislation.

A.1.1 Administrative instruments

The legal framework laying down the obligation of local authorities to manage waste is given in the Danish Environmental Protection Act and associated Statutory Orders and Circulars. The most important Statutory Order is the Statutory Order on Waste no. 619 of 27 June 2000.

Municipalities – the competent authority in waste management issues

The Danish Environmental Protection Act contains regulations on waste in Part 6 (Sections 43-50a). The Act states that the local municipal council is in charge of waste management. Each municipality is responsible for managing the waste produced within its geographic boundaries, whether this waste is from households or trade and industry.

Duties of municipalities

Under the terms of the Danish Environmental Protection Act and the Statutory Order on Waste, municipalities have a number of duties in connection with waste management.

Every four years, each municipality must prepare a short-term waste management plan covering four years, and a long-term plan covering 12 years.

Furthermore, each municipality must prepare waste regulations detailing the schemes established within its boundaries.

Municipalities must ensure that waste management is carried out in accordance with the waste hierarchy, including recycling of certain types of waste in accordance with specific requirements laid down in the Statutory Order on Waste and various waste management Statutory Orders and

Circulars.

Each municipality must establish schemes to ensure that waste generated within the municipality is managed in an environmentally acceptable way. Such schemes may be assignment schemes or collection schemes.

The characteristic features of assignment schemes are that the municipality lays down in a waste regulation that given waste types must be assigned to a given form of management. The waste producer is responsible for managing the waste in compliance with the provisions in the regulation.

For collection schemes, the municipality is responsible for ensuring that collection, transportation and management of a given waste fraction is in compliance with the regulation.

For domestic waste, including glass and paper from private households, for domestic -like waste from enterprises, and for hazardous waste, the Statutory Order on Waste stipulates that municipalities must establish a collection scheme. Furthermore, the Statutory Order on food waste from catering centres laid down requirements for the establishment of a collection scheme. This Statutory Order was repealed on 1 August 2003.

Each municipality collects and registers information on waste amounts and waste treatment plants, etc.

Finally, each municipality makes decisions according to the Danish Environmental Protection Act and the Statutory Order on Waste, for example concerning classification of waste and notification of orders and prohibitions, and supervises compliance with regulations.

Obligation to use schemes

Where a municipal scheme has been established, citizens, property owners, and enterprises are generally under an obligation to use the scheme under the Statutory Order. There are, however, various possibilities of exemption from this obligation.

According to the Danish Environmental Protection Act, competing collection schemes are also prohibited from being introduced where a municipal collection scheme has been established.

Organisation

A municipality is not permitted to assign its tasks as an authority. I.e it cannot assign the part of municipal administration that involves regulating legal conditions for residents, such as, fee setting, preparing regulations and supervision – in the area of waste management. However, for waste plans, section 47(4) of the Environmental Protection Act grants them authority to do so. This authority is exploited in section 11 of the Statutory Order on Waste, allowing the competence to plan waste management to be assigned to an inter-municipal company.

In terms of the actual administration of waste management (operational tasks), municipalities can choose to coordinate these tasks themselves, assign them to an inter-municipal company (i.e. a union of municipalities), or delegate them to private enterprises.

Collection schemes for household waste are operated by both municipalities and private waste companies, whereas the management of industrial and commercial waste is normally carried out by private companies alone.

Environmental approvals

Enterprises and plants that treat, reprocess or crush waste, etc., must have environmental approval. As of 1 January 1992, landfills may normally only be owned by public authorities.

The municipalities are not responsible for managing certain specific waste fractions covered by special regulations. This is the case for the Statutory Order on recycling of residual products and soil in building and construction work, the Statutory Order on biomass waste, the Statutory Order on treatment of end-of-life vehicles, the Statutory Order on application of waste products for agricultural purposes, and the Statutory Order on deposit and collection etc. of packaging for beer and certain soft drinks.

A 1.1.1 Future initiatives

Measures

- *possible changes to the legislation based on proposals from the work group*
- *harmonisation and reduction in the number of regulations*

In 2002, the Government appointed a work group to examine the organisation of waste management.

This work group has been charged with assessing the scope and significance of a number of problems in the area of waste management. The following significant problems have been identified and provide a basis for the work of the work group: lack of transparency in setting charges, unclear lines of competence due to the confusion of the roles of authority and operator, potential to improve efficiency in incineration and landfilling, advantages and disadvantages of deregulating the waste management sector, experience from an area of waste treatment subject to competition (the recycling sector), lack of development and exploitation of treatment technologies, data reporting – transport registration, producer responsibility, and lack of transparency in the roles of waste carrier and waste broker.

The work group will make proposals for solutions within the areas in which the group believes the problems are of such a magnitude and significance as to warrant changes to the existing organisation and legislation.

The work of the work group is expected to be completed in 2004. On the basis of the work group's conclusions, the Minister for the Environment will decide whether changes should be made to the waste management legislation. These changes might have significance for the municipalities' organisation of waste management, and the wording of municipal waste regulations.

There is already a clear need to reduce the number of municipal regulations. The content of regulations also needs to be harmonised to make it easier for enterprises to work across municipal boundaries.

A.1.2 Other instruments

In addition to the above traditional regulation by Acts, Statutory Orders and Circulars, waste management is regulated by a number of different instruments such as taxes and charges, subsidies and agreements.

Waste tax

The waste tax, which came into effect on 1 January 1987, is one of the instruments established to achieve the objectives of the Plan of Action for waste and recycling. The waste tax is differentiated so that it is most expensive to landfill waste, cheaper to incinerate it, and tax exempt to recycle it. No tax is levied on hazardous waste, contaminated soil or waste that is covered under the Statutory Order on biomass waste.

The objective is for the waste tax rate and the differentiation to provide an incentive for waste generated to be directly recycled or exploited by incineration with energy recovery, instead of being landfilled.

The waste tax is described in more detail in A 1.3.

Packaging taxes

Packaging taxes are levied on a number of products. Since 1978 a volume-based tax on packaging for most beverages has been in effect. The tax is levied on new packaging and thereby provides an incentive to use refillable packaging.

In addition, effective from 1 January 1999, a weight-based tax was introduced for 13 types of material and packaging. This tax is levied on packaging for a number of products, including soap and detergents, lubricants, perfume and margarine. Non-carbonated soft drinks, vinegar and edible oils also began to be covered under the weight-based tax as of 1 January 1999.

The weight-based tax promotes the reduction of packaging consumption and hence reduces the volume of waste. The tax was adjusted as of 1 April 2001 to reflect the environmental impact from each material. A number of environment indices have been worked out on the basis of “cradle to grave” (life cycle) assessments.

As of 1 January 1999, a weight-based tax has also been levied on plastic-foil foodstuff packaging manufactured from soft PVC. The purpose of this tax is to promote the use of more environmentally friendly packaging foils.

Finally, since 1994, a weight-based tax on paper and plastic carrier bags has been in effect, and since 1988 a tax on disposable tableware. Both taxes provide an incentive to increase re-use and hence reduce the volume of waste.

Tax on PVC and phthalates

In December 1999, a tax was introduced on PVC and phthalates. The Act came into effect on 1 July 2000. In the comments on the bill it is stated that the Act will be reconsidered after two years.

The reason for introducing the tax was that the disposal of PVC causes problems. During the incineration of PVC, hydrochloric acid is formed and must subsequently be neutralised. Cleaning the hydrochloric acid from the smoke generates a flue gas cleaning product. This product is classified as hazardous waste and has to be specially landfilled. In addition, some

phthalates are suspected to have undesirable effects on the aquatic environment, and some reduce reproductive capacity and cause damage to foetuses in animal trials.

The aim of the tax is to reduce the volume of PVC incinerated or landfilled and to reduce the use of phthalates.

The tax is based on a rate of DKK 2/kg of PVC and DKK 7/kg of phthalate. The tax is levied on both locally produced and imported goods. The tax is reimbursed for export items. The tax generated revenue of approx. DKK 65 million in 2001.

Specific taxes

As a supplement to the general waste tax, more specific taxes have been introduced aimed at products that either require special treatment after use or where consumption should be limited or shifted to more environmentally friendly products. Examples are the tax on nickel-cadmium batteries[1] and the environment premium on vehicles. Revenues from these taxes are used to cover the costs of reimbursement schemes for the collection of nickel-cadmium batteries and for vehicle owners that deliver end-of-life vehicles for scrapping at registered scrapping enterprises.

General fee or tax financing of municipal schemes

Municipalities are permitted to finance their actual expenses associated with the management of household waste using fees or taxes. Municipalities must finance their actual expenses associated with the management of waste from trade and industry using fees.

These fees may cover costs for establishment, operation, administration, investment, planning, and collection of information, etc.

In compliance with general local government rules, fees must be calculated based on a cost-coverage principle, i.e. the rate of the fees must be fixed so that over time there is a balance between revenues (fees) and the costs of waste management schemes. Schemes must therefore be based on the non-profit cost-coverage principle.

Municipalities are permitted to set an overall fee for schemes established in the municipality. This overall fee must correspond reasonably to the service provided to each resident.

Where waste management is financed using fees, the municipality must lay down regulations governing waste fees, including any waste schemes and user circles covered, in the municipal waste regulations. Provisions governing fee charges and collection methods may also be laid down.

Specific taxes and fees

In addition to the waste management fee financing municipal waste management schemes, taxes, charges and fees are increasingly being used to finance initiatives such as take-back schemes for certain waste fractions (tyres and lead accumulators). In these contexts, fee revenue is used to cover the expenses of subsidy schemes for the collection and recycling of the products subject to these fees.

[1] Act no. 414 of 14 January 1995, as amended by Act no. 397 of 22 May 1996 on taxes on nickel-cadmium batteries.

Agreements

Agreements are another control instrument used to achieve environmental objectives in waste management. For example, an agreement has been entered into with the Danish Contractors' Association on selective demolition of building materials. Other examples of agreements are: an agreement with municipalities on refrigerators containing CFCs, an agreement on recycling transport packaging (the transport packaging agreement) with the Confederation of Danish Industries, the Danish Plastics Federation and the Packaging Industry, an agreement between the Minister for the Environment and industry on collection of discarded lead accumulators, and an agreement with the Danish Motor Trade Association, the Association of Danish Recycling Industries and municipal associations on a take-back scheme for discarded tyres.

Subsidy schemes to promote cleaner products and recycling

Under the subsidy programme, "Programme for cleaner products, etc.", from 1999 to 2002, funds were set aside for projects relating to the recycling and development of treatment technologies and other waste management. The Environmental Council for Cleaner Products is in charge of the overall prioritisation of funds, while the Danish Environmental Protection Agency is in charge of the administration of grants to specific projects.

Subsidies are granted to activities that reduce environmental impacts in connection with the development, manufacture, sale or use of products, or in connection with the management of waste generated throughout the entire life cycle of products, either by promoting cleaner products or recycling. Subsidies may also be granted to projects aimed at mitigating problems related to waste disposal. This may be in the form of demonstration, surveying, or information projects, etc., or for the development of processes, methods, production equipment or products within the area of waste management. Investments in plant cannot currently be subsidised.

A 1.2.1 Future initiatives

In its motion for the adjournment from 12 December 1996, the Danish Folketing laid down requirements for transparency in municipal charges. Most recently in environment project no. 717 from 2002 on "Transparency in the municipal waste collection fees", it was concluded that no such transparency exists.

Measures

- *change the legal basis for fees to increase transparency in fee setting*
- *update the environment index for the weight-based packaging tax and revise the tax*
- *extend the agreement on transport packaging to cover more materials and packaging types for trade and industry*
- *implement producer responsibility for passenger vehicles and commercial vans and for electrical and electronic products*

Changes to the legal basis for charges in section 48 of the Environmental Protection Act will be proposed during parliamentary session 2004-05. The reason for this is primarily the desire for greater transparency – both in the way each municipality sets fees, and between municipalities. In addition to transparency, the following factors will be considered when selecting the formulation of the legal basis for charges: the municipalities' need for flexibility in waste management, the rule of law, the polluter pays principle, and environmental, economic and legal efficiency.

When the weight-based packaging tax was amended in April 2001, the Danish Environmental Protection Agency made a commitment to perform new calculations relating to the environment-based index when the EDIP database had been updated. It is expected that the environment index can be updated and the weight-based packaging tax revised in 2004. The

environment-based index is also going to be reviewed by an external expert at this time.

The agreement on transport packaging covers cardboard, paper and plastic transport packaging. A status report for 1999 and 2000 shows that the agreement's goal for the combined recycling of cardboard and paper has been reached in 2000. The agreement's goal for plastic recycling in 2001 has not been reached in 1999 and 2000. This goal is linked to the goal in the EU Packaging Directive – a minimum of 15% in 2001.

The Packaging Directive is being revised. In October 2002, a common attitude was adopted, in which goals were set for 2008. Further measures will be necessary if the future higher recycling goals for packaging are to be achieved. The agreement on transport packaging therefore needs to be extended to cover more materials and types of packaging for trade and industry.

Under the Directive on end-of-life vehicles and the Directive on waste electrical and electronic equipment, producer responsibility is to be implemented for passenger and commercial vehicles and electrical and electronic products. This will mean that manufacturers will have to ensure effective collection schemes exist, that end-of-life products are collected and waste treated, and that this waste treatment is financed by the manufacturers.

A.1.3 The waste tax

Aims for 2008

- *ensure that the waste tax leads to waste prevention and increased recycling*

A 1.3.1 Status

The waste tax was introduced in 1987. The purpose of the waste tax is to direct waste away from landfilling and incineration towards recycling. The tax is therefore differentiated such that it is most expensive to landfill waste, cheaper to incinerate it with energy recovery, and tax exempt to recycle waste.

The waste tax provides a financial incentive to shift waste from incineration and landfilling to recycling. It has worked well for large, homogeneous waste fractions, but up until 1997, the tax rate has not been high enough to ensure satisfactory recycling of the types of industrial waste which traditionally have not been earmarked for recycling.

A 1.3.2 Future initiatives

Measures:

- *analyse whether the waste tax rates support environmental priorities*
- *evaluate whether the waste tax can be used as a more precise control instrument, for example in connection with sludge and shredder waste*

The waste tax rates will be analysed to see whether they support environmental priorities, including whether differentiation between incineration and landfilling is appropriate, and whether the incineration rate provides sufficient incentive to ensure that waste is recycled in the instances where this is best for the environment and cost-effective. The aim is thus to illustrate whether the tax rate levels ensure "optimal" waste disposal.

The waste tax has been revised in connection with simplification of the regulations. However, there are other recommendations not covered by the process of regulation simplification. These relate to a change to the tax basis for composted and mineralised sludge and for shredder waste. Consideration

needs to be given to whether the waste tax should be brought into closer alignment with the environmental priorities for these waste fractions. A change to the waste tax will not lead to an increase in total revenue from the tax.

A 1.3.3 Regulation

The waste tax is authorised by the Act on taxes on waste and raw materials. Revenue from the tax is included as income in the annual budget. The tax is administered by local customs and tax regions, and is levied at registered treatment plants. This ensures that all waste treated is taxed and that the tax is passed on fully to the waste producer. The latest changes to the waste tax were made on 1 January 2003.

The waste tax is differentiated such that the rates are currently DKK 375 per tonne for all landfilled waste and DKK 330 per tonne for incinerated waste. Recycled waste is not taxed.

In general, all waste is covered by the waste tax, but there are isolated exemptions. The most important exemptions are for hazardous waste, contaminated soil and waste fractions covered by the Statutory Order on biomass waste.

A 1.3.4 Environmental assessment

An adjusted waste tax will lead to reduced loss of resources and improved waste treatment, both contributing to reduced environmental impact. The waste tax also contributes to reducing environmental impact in the most cost-effective manner possible.

A 1.3.5 Implications for the national authorities

It may be necessary to amend the Act on taxes, depending on the results of ongoing studies and any specific problems that arise.

A 1.3.6 Implications for municipal authorities

Municipalities must constantly be aware of the effects of the waste tax, both in connection with waste classification, and the type of treatment waste is referred to.

A.2 EU waste regulation

Close interplay between EU and national regulations

Danish legislation on waste management is characterised by a close interplay between EU regulation and national regulations.

EU regulation outlines the overall framework and principles for waste management. The organisation of waste structures and the implementation of EU regulations in Danish legislation is a task for the Danish national authorities.

The formulation of EU waste strategy and legislation takes place in close co-operation between EU institutions and Member States.

EU objectives

EU objectives for waste management are primarily concentrated on prevention, promotion of recycling and other forms of recovery, and minimisation of final disposal.

The present Community strategy for waste management, in particular its objectives and measures, is described in the Communication from the Commission on the Community strategy for waste management, adopted on 30 July 1996.

The waste management policy has resulted in the adoption of a number of legal instruments setting up obligations for Member States in waste management.

Member States are required to draw up one or more plans for the management of waste in order to achieve the objectives for waste management laid down in Directives.

The central legislative instrument is Council Directive 75/442/EEC as amended by Council Directive 91/156/EEC, also known as the "framework" Directive on waste. In addition, the Directive on hazardous waste (91/689/EEC) contains general rules on hazardous waste. These directives are supplemented by a number of directives regulating particular types of waste. There are also other regulations in the form of a number of directives on waste treatment: the Directive on waste incineration, and the Directive on landfilling of waste.

The objectives and requirements for waste management laid down in the waste-related directives are described below, including the requirements to draw up waste management plans.

Regulations on transboundary movements of waste and the Regulation on waste statistics are also described.

A.2.1 General requirements in the framework Directive on waste and the Directive on hazardous waste

Definition of waste

The Directive on waste[2] (framework Directive on waste) provides a number of basic waste definitions and principles for environmentally sound management of waste. The scope of the Directive covers all waste that is not regulated separately in other EU legal instruments. The framework Directive on waste is supplemented by general regulations in the Directive on hazardous waste[3] (Hazardous Waste Directive), which similarly covers all hazardous waste not regulated separately in other EU legal instruments.

List of waste

The framework Directive on waste defines what is meant by the term 'waste' (the definition of waste) and the Directive on hazardous waste defines what is meant by the term 'hazardous waste'. To clarify the definition of waste (including the definition of hazardous waste) and provide examples, a list of waste[4] has been prepared in which the types of waste that are seen as hazardous are marked as such.

A 2.1.1. The framework Directive on waste

Waste hierarchy

- *waste prevention*
- *recycling*
- *incineration with energy recovery*
- *landfilling*

The framework Directive on waste defines forms of treatment of relevance in waste management. It distinguishes between recovery (forms of treatment ensuring resource utilisation of waste, such as recycling and incineration with energy recovery) and disposal (forms of treatment where resources in waste are not utilised, including landfilling).

The framework Directive on waste lays down the treatment hierarchy discussed above. That is, waste prevention is the highest priority. Then comes recycling and other utilisation, including incineration with energy recovery. Finally, waste which cannot be treated in any other ways is landfilled.

Principles of proximity and self-sufficiency

Under the terms of the Directive, Member States are required to establish an integrated and adequate network of disposal installations, enabling both the Community as a whole, and Member States individually, to dispose of waste generated within their territory.

Environmentally sound management of waste

Member States are required to ensure that waste is managed without endangering human health and the environment. The Directive prohibits the abandonment, dumping or uncontrolled disposal of waste and stipulates that all treatment plants must obtain a permit, and be subject to periodic inspections.

Further to this requirement, the Directive requires establishments or undertakings that carry out waste treatment to keep a record of various information on waste treated.

Finally, the Directive lays down the "polluter-pays principle", i.e. the cost of disposing of waste must be borne by the holders and/or the previous holders or the producer of the product from which the waste came.

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[2] Council Directive 75/442/EEC, as amended by Council Directive 91/156/EEC.
[3] Directive 91/689/EEC.
[4] Council decision 2000/532/EC, as amended by Council decision 2001/118/EC, European Commission decision 2001/119/EC and Council decision 2001/573/EC.

Drawing up plans to attain the objectives

In order to realise the objectives of the Directive, Member States are required to draw up waste management plans. Member States may prohibit movements of waste which are not in accordance with their waste management plans.

The Directive lists a number of specific requirements for the contents of such plans relating to the type, quantity and origin of waste, technical requirements, management of particular wastes and suitable disposal sites or installations.

Implementation in Denmark

The framework Directive on waste has been implemented in Denmark in, for example, the Danish Environmental Protection Act and the Statutory Order on Waste.

A. 2.1.2. Directive on hazardous waste

Approvals Monitoring

The requirements of the Directive correspond to requirements laid down in the framework Directive on waste: permits for establishments or undertakings carrying out storage, treatment or disposal of hazardous waste, and periodic inspections of establishments or undertakings transporting such waste.

Prohibition to mix waste

The Directive on hazardous waste also prohibits mixing of hazardous waste of different categories or mixing hazardous waste with non-hazardous waste.

The Directive requires Member States to ensure that hazardous waste is labelled and packaged in connection with collection, transportation, and temporary storage.

The Directive stipulates that producers, carriers, and disposal plants for hazardous waste must keep a record of waste treated.

Plans

This Directive also establishes the requirement to draw up management plans for hazardous waste.

Implementation in Denmark

The Directive is implemented in Danish legislation through a number of provisions in the Statutory Order on Waste.

The Directive on hazardous waste is supplemented by a number of individual Directives regulating particular types of hazardous waste. The basic principles contained in the framework Directive on waste and the Directive on hazardous waste on, for example, permits for enterprises storing, treating or disposing of hazardous waste, periodic inspections of enterprises transporting such waste, as well as plans for management of hazardous waste also apply to these individual Directives.

A.2.2 Requirements for particular waste fractions

A 2.2.1 Directive on waste oils

Requirements for special management

The Council Directive on the disposal of waste oils[5] prohibits any discharge or treatment of waste oils that might cause pollution. If such discharges and treatment forms cannot be avoided, Member States must take the necessary measures to ensure safe collection and disposal of waste oils.

[5] Council Directive 75/439/EEC, as amended by Council Directive 87/101/EEC.

The Directive stipulates that waste oils should primarily be treated by regeneration and/or incineration with energy recovery.

The Directive gives emission values in connection with incineration of waste oils.

In addition, the Directive requires that establishments or undertakings collecting waste oils are registered and inspected by competent authorities. Establishments or undertakings carrying out disposal of waste oils must also obtain a permit.

Implementation in Denmark

The Directive is implemented in Danish legislation through a number of provisions in the Statutory Order on Waste.

A 2.2.2 Directive on batteries and accumulators

The Council Directive on batteries and accumulators containing certain dangerous substances[6] aims at harmonising national measures on the management of spent batteries and accumulators containing mercury, cadmium or lead.

Requirements for collection

The Directive requires Member States to establish collection schemes for spent batteries and accumulators containing mercury, cadmium or lead, and to ensure separate treatment and disposal.

The Directive prohibits the marketing of alkaline manganese batteries and the incorporation of accumulators in appliances, if batteries or accumulators exceed the limits fixed in the Directive.

The Directive is supplemented by a Commission Directive on a marking system for batteries and accumulators[7]. The marking must support the provisions of the Directive on batteries and accumulators on the collection and recovery of batteries and accumulators.

The Directive also lays down provisions on the use of economic instruments such as deposit and return systems, charges or taxes.

Plans

The Directive requires Member States to draw up plans for attaining the objectives of the Directive. Plans must comprise initiatives to promote marketing of "green" batteries and ensure that heavy metal-containing batteries are separated from household waste.

Implementation in Denmark

The Directive has been implemented by the Statutory Order on certain batteries and accumulators containing dangerous substances, the Statutory Order on Waste, the Statutory Order on a fee on lead accumulators and the Act on remuneration for the collection of lead accumulators etc.

[6] Directive 91/157/EEC, Act on taxes on lead accumulators and hermetically sealed nickel-cadmium batteries, and the Statutory Order on collection of hermetically sealed nickel-cadmium accumulators (closed nickel-cadmium batteries) and remuneration for collection and disposal for recycling.
[7] Commission Directive 93/86/EEC.

It is expected that the EU will revise the current Battery Directive during the term of the waste strategy. However, no timetable for the revision has been tabled.

A 2.2.3 Directive on end-of-life vehicles

The purpose of the Directive on end-of-life vehicles is to harmonise the waste treatment of end-of-life passenger and commercial vehicles in the Member States.

Special collection and treatment requirements

Under the Directive, Member States are required to establish collection schemes for end-of-life vehicles and separate treatment and recovery, in particular, including re-use and recycling of waste from vehicles.

The Directive contains provisions prohibiting the use of lead, mercury, cadmium and hexavalent chromium in new vehicles being brought onto the market.

Producer responsibility

The Directive also contains provisions stipulating that the last owner of a vehicle must be able to deliver the vehicle for waste treatment without expense, and that a significant proportion of the expenses for waste treatment must be met by the manufacturer. Producer responsibility for vehicles must be implemented by 1 January 2007.

The Directive also stipulates that certificates of destruction must be issued when end-of-life vehicles are delivered.

In addition, the Directive requires that establishments or undertakings that waste treat end-of-life vehicles are registered and inspected by competent authorities. These establishments or undertakings must also obtain a permit.

Implementation in Denmark

The Directive has been implemented in Danish legislation in the Statutory Order on management of waste in the form of motor vehicles and derived waste fractions[8] and the Consolidated Act on environment premiums and reimbursement in connection with dismantling and scrapping of vehicles[9].

A 2.2.4 The Directive on waste electrical and electronic equipment

The purpose of this directive is to prevent the generation of waste from electrical and electronic equipment and increase re-use, recycling and other forms of recovery for waste from electrical and electronic equipment.

Special collection and treatment requirements

The Directive requires Member States to lay down regulations for the collection of waste from electrical and electronic equipment, and for separate treatment and recovery, in particular, the re-use and recycling of such waste.

Producer responsibility

The directive also contains provisions on producer responsibility for waste treatment of electrical and electronic waste. These stipulate that waste management from private households has to be financed by Danish manufacturers and importers who bring electrical and electronic equipment onto the market. Electrical and electronic waste from users who are not

[8] Statutory Order no. 480 of 19 June 2002
[9] Statutory Order no. 782 of 17 September 2002

private households must also be financed by either the manufacturers or the final user.

Implementation in Denmark

The Directive has to be implemented in Danish legislation before the end of 2004. This will be achieved through amendments to the Statutory Order on management of waste from electrical and electronic products[10].

A 2.2.5 The Directive on PCBs and PCTs

Special requirements for disposal

The Council Directive on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)[11] regulates the disposal of PCBs/PCTs and the replacement or disposal of equipment containing PCBs as well as the disposal of used PCBs. The Directive prohibits re-use of PCBs.

The purpose of the Directive is to ensure environmentally responsible disposal of PCBs and PCTs. For large PCB volumes (more than 5 dm^3), decontamination and/or disposal must take place by the end of 2010. For equipment with contents of less than 5 dm^3, disposal must be ensured no later than at the end of the product's useful life.

Member States must ensure that inventories are compiled for equipment with PCB volumes of more than 5 dm^3.

The Directive must be seen in connection with the Directive on reduced marketing and use of certain dangerous substances and preparations, partly prohibiting the use of PCBs/PCTs[12], the Directive on waste oils[13] and the Directive on the incineration of waste.

Plans

Plans for the replacement, collection and disposal of PCBs must be drawn up.

Implementation in Denmark

The Directive on PCB/PCT was implemented in Danish legislation in December 1998[14].

A 2.2.6 The Sludge Directive

The Sludge Directive[15] lays down regulations for the recycling of sludge and is implemented in the Statutory Order on sludge[16]. The Directive is a minimum requirements directive and the Statutory Order on sludge has implemented significantly more stringent limit values. A proposed revision of the Sludge Directive is expected to be presented in 2003, containing even more stringent limit values.

[10] Statutory Order no. 1067 of 22 December 1998
[11] Directive 96/59/EC
[12] Directive 85/467/EEC
[13] Directive 75/439/EEC
[14] Statutory Order no. 925 of 13 December 1998 on PCBs, PCTs and substitute substances.
[15] Council directive 86/278/EEC of 12 June 1986 on protection of the environment and soil in particular in connection with the use of sludge from wastewater treatment plants in agriculture
[16] Statutory Order no. 49 of 20 January 2000 on recycling waste products for agricultural purposes.

A 2.2.7 Directive on biological treatment of biodegradable waste for agricultural applications

The European Commission is working on a Directive on biological treatment of biodegradable waste for agricultural applications. The Directive proposal is expected to be presented in 2004. This area is already being regulated in Denmark under the Statutory Order on sludge. The Directive will regulate source separation and biological treatment of organic domestic waste.

A 2.2.8 Animal By-products Regulation

In October 2002, the Animal By-products Regulation[17] was adopted. Under the Regulation, large volumes of animal waste that were previously processed into meat-and-bone meal and used in feed, must in future be incinerated or recycled in biogas plants, prior to use in agricultural applications.

The Regulation has led to a revision of the Statutory Order on sludge in spring 2003.

A 2.2.9 Special requirements for packaging and packaging waste

The Directive on packaging and packaging waste[18] should be seen in connection with the framework Directive on waste and the Community strategy for waste management. The Directive on packaging and packaging waste is the first example of a Directive fully based on the waste hierarchy.

The Directive includes provisions on prevention of packaging waste, including the promotion of re-use systems for packaging. It also sets up a number of quantitative objectives for the recycling of packaging waste.

Quantitative treatment requirements

The Directive stipulates that between 50% and 65% of total packaging waste must be recovered no later than 2001. Of this, between 25% and 45% of total packaging waste must be recycled. For the specific materials, a minimum of 15% of each material must be recycled before 2001.

The Packaging Directive is being revised. In October 2002, a common attitude was adopted, in which goals were set for 2008. The goal for the recovery of packaging waste is 60% in 2008. Between 55% and 80% of the total volume of packaging must be recycled. For the individual materials, the goal for recycling is 60% for cardboard/paper, 60% for glass, 50% for metal, 22.5% for plastic, and 15% for wood. Appendix E, Section E5, describes how Denmark will ensure compliance with these requirements.

Requirements for packaging

To support the objectives of the Directive for treatment of packaging waste, the Directive sets up requirements for design of packaging. These requirements are directed at manufacturers (or importers) of packaging.

The purpose of these requirements is to reduce amounts of and environmental impact from packaging and packaging waste. The Directive sets up concentration levels of heavy metals in packaging and so-called essential requirements on the composition and nature of packaging.

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[17] Regulation (EC) no. 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption.
[18] Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.

Since mid-1999, Denmark has had to annually submit documentation to the Commission on recycling and recovery of packaging waste.

In common with other Directives relating to waste, this Directive contains various provisions for marking systems, return, collection and recovery systems, waste management plans, information systems, and economic instruments.

National programmes for prevention and re-use

Finally, the Directive opens the possibility for Member States to launch specific national programmes or actions to ensure prevention and re-use of packaging waste. Danish initiatives are described below.

In addition to ensuring that specific requirements of the Directive are complied with, each Member State must implement other measures to prevent packaging waste (Article 4).

In 2000, the Folketing adopted a restructuring of the existing weight-based packaging tax such that from 2001, taxes were levied on packaging for certain products on the basis of the packaging material's environmental impact and weight. It is expected that the tax will, to some extent, provide an incentive to reduce the use of materials with a big environmental impact.

In addition, Denmark has introduced a subsidy scheme for cleaner products etc., which is expected to have a waste preventive effect in the longer term. At the end of 2002, the Danish Environmental Council for Cleaner Products supported an industry initiative for packaging with funding of DKK 1.7 million. The aim of the initiative is to develop tools for documenting material optimisation of packaging in relation to the Packaging Directive, and to develop methods for incorporating environmental considerations into the packaging design phase.

Apart from the possibility of creating incentives for manufacturers to develop new, material-saving or other environmentally friendly technologies through economic instruments such as taxes, Member States do not have much room to independently implement waste-preventive measures at the manufacturing level. This is because the Directive's requirements for packaging production and composition demand that all packaging must be optimised in relation to prevention as far as possible.

As a consequence, Denmark has chosen to primarily focus on waste management in relation to national initiatives for prevention. The re-use of packaging is a logical and efficient way of preventing waste arisings.

Special initiative for beverage packaging

Denmark has selected beverage packaging as a special area for preventive initiatives, as this packaging type potentially represents a very significant amount of packaging waste due to the large volumes.

Denmark has a scheme under which beer and carbonated soft drinks may only be marketed in refillable packaging or disposable packaging covered by a deposit and return system[19]. Refillable packaging must be returned for re-use.

[19] The scheme is laid down by the Ministry of the Environment in Statutory Order no. 713 of 24 August 2002 on deposits and collection etc. of packaging for beer and certain soft drinks.

When the refillable packaging can no longer be re-used, it must be materially recycled. Disposable packaging must also be materially recycled.

The bottle return system means that each year we avoid the disposal of approx. 325,000 tonnes of waste, compared to the total weight of an equivalent volume of disposable glass or plastic bottles.

Bottles for wine and spirits are collected in municipal collection schemes (see also Appendix E, Section E7), by retailers, and from restaurants.

Whole bottles are washed and sent for refilling either in Denmark or abroad. Cullets are sent for material recovery. Reimbursement of the packaging tax when bottles are exported for refilling contributes to supporting the re-use of wine bottles.

The schemes for bottles for wine and spirits mean that each year we avoid generating approx. 60,000 tonnes of waste.

Re-use of transport packaging

Finally, large quantities of plastic transport packaging - especially crates for beer and soft drinks, transport boxes for foodstuffs in the retail trade, and pallets - are reused.

The Directive is implemented in Danish legislation in, inter alia, the Statutory Order on Waste and the Statutory Order on certain requirements for packaging[20].

A.2.3 Directives on treatment plants

The Directive on the landfill of waste (the Landfill Directive) is one of the most important legal instruments for installations for the treatment of waste. The Directive on waste incineration is also important.

Directive on the landfill of waste

A 2.3.1 Directive on the landfill of waste

The Directive on the landfill of waste[21] is drawn up under the framework Directive on waste. The purpose of the Directive is to introduce measures, procedures, and guidelines to prevent or, as far as possible, reduce environmental impacts from landfills. This refers especially to contamination of surface water, groundwater, soil, and air, impact on the global environment, including the greenhouse effect, as well as risks from landfilling of waste to human health.

The Directive covers all new landfills, but existing landfills must also comply with the Directive requirements by 16 June 2009, or be closed down and receive post treatment in accordance with the Directive's requirements.

The Directive on the landfill of waste regulates the approval, construction, operation, closure, and post treatment of landfills. The procedure for approval is uniform, regardless of the category of waste being landfilled (hazardous, non-hazardous and inert waste). The Directive also lays down

[20] Statutory Order no. 298 of 30 April 1997 on certain requirements for packaging, as amended by Statutory Order no. 1113 of 14 December 2001.
[21] Council Directive 1999/31/EC of 26 April 1999 on landfilling of waste.

procedures for the receipt of waste for landfilling. The receiving procedures are based on waste characterisation. The criteria for waste characterisation are specified in Council decision 2003/33/EC of 19 December 2002. This decision has to be implemented in Danish legislation by 16 July 2004.

Phasing-out and requirements for treatment

In order to reduce the volume of biodegradable waste going to landfills, the Directive lays down goals for amounts of this type of waste that Member States may landfill.

Furthermore, it is required - with some exceptions – that all waste is pre-treated before landfilling.

Economic instruments

The Directive requires that the price of landfilling must reflect all costs of establishment and operation of the landfill site. As far as possible, this also covers the costs of financial security, costs of closure, and post treatment for a period of at least 30 years.

Implementation in Denmark

The Directive has been implemented in Danish legislation, inter alia, through amendments to the Environmental Protection Act and Statutory Order on Waste, and by issuing the Statutory Order on landfills and Statutory Order on training of operations managers and personnel employed at landfill sites.

A 2.3.2 The Incineration Directive

Directive 2000/76/EC on waste incineration relates to the framework Directive on waste and stipulates minimum regulations for waste incineration. The Directive states that these regulations are not sufficient to comply with the IPPC Directive (no. 96/61/EC). The Directive covers any type of waste incineration, except for a number of vegetable waste types from agriculture and forestry, including the production of virgin pulp in the paper industry, wood waste, with certain exceptions, and animal bodies and waste originating from offshore industry.

Approvals etc.

The Incineration Directive regulates the approval, construction, equipping, and operation of facilities for incinerating waste.

Emission limit values

The Directive stipulates limit values for emissions of dust, certain heavy metals, hydrogen chloride, hydrogen fluoride, SO_2, NO_x, and dioxins and furans.

The Directive lays down requirements for measurements, inspection, and reporting from plants.

A.2.4 Transboundary movements of waste

The Regulation on the shipment of waste

The Council Regulation on shipments of waste[22] was adopted, in part, to implement the Basel Convention of 22 March 1989 on the control of transboundary movements of hazardous wastes and their disposal (see below), and an OECD Council Decision on the control of transboundary movements of waste destined for recovery operations.

[22] Council Regulation no. 259/93 on the supervision and control of shipments of waste within, into and out of the European Community, as amended by Council Regulation no. 120/97 of 20 January 1997.

A 2.4.1 The Regulation on the shipment of waste

Regulations apply directly and are thereby binding for authorities and citizens. Unlike Directives, Regulations do not have to be implemented in national legislation.

However, the Regulation on shipments of waste is supplemented in Danish legislation by a Statutory Order on import and export of waste[23], containing provisions on sanctions and inspection.

Basic principles

The Regulation lays down a number of procedures to be followed in connection with transboundary movements of waste, building on the principle of prior notification and authorisation, and provision of financial guarantees. The Regulation also regulates in which cases competent authorities may prohibit shipments of waste.

The Regulation distinguishes between waste destined for disposal and waste destined for recovery. Waste for recovery is divided into three main categories - green, amber and red.

Reasoned objections for competent authorities to prohibit shipments of waste vary depending on whether waste is destined for disposal or recovery.

Shipments of waste for disposal

The Regulation requires that all shipments of waste for disposal are notified and authorised.

The Regulation lists a number of reasoned objections to shipments of waste for disposal. A Member State may, partially or completely, prohibit shipments of waste into and out of its territory. Such a partial or general ban must be justified by the fact that the waste in question may be disposed of in a plant closer to its origin (proximity principle), or that the waste in question should be subject to recovery instead of disposal (priority for recovery), or that the Community as a whole should become self-sufficient in waste disposal and that Member States should move towards that aim individually, so that the waste problem is not solved by exportation of waste (principle of self-sufficiency). Denmark has made use of this authorisation to introduce Danish regulations that, in general, prohibit both the import and export of waste for disposal.

It is also possible to make objections to individual shipments of waste for disposal, if such shipments conflict with the principle of self-sufficiency, the proximity principle, waste management plans or national environmental legislation.

Shipments of waste for recovery

Under the Regulation, waste for recovery is divided into three main categories: green, amber, and red waste, and different rules apply to transboundary movements of waste depending on the category. Waste which does not feature on any of the three lists (unlisted waste) must follow the procedure for red waste.

[23] Statutory Order no. 971 of 19 November 1996, as amended by Statutory Order 246 of 3 April 2000.

Green waste is not covered by the provisions of the Regulation as to notification, but in order to enable waste tracking, the shipment must be accompanied by various information on, for example, the identity of the consignee of the waste and the holder of the waste.

Amber waste is covered by the requirement for notification. If no objections to the shipment have been raised within a given period of time, the shipment may take place without written authorisation.

Red waste follows the same procedure of notification as amber waste, but shipment can only take place after receipt of written authorisation from the competent authorities.

However, in practice, shipments of waste subject to notification requirements do not take place before written consent has been received from the competent authorities.

Grounds for objection to shipments of waste for recovery are more limited than for waste for disposal. Since green waste is exempt from the notification provisions, the Regulation provides no direct possibility of raising objections to such shipments. For amber and red waste, the most important objections are waste management plans and/or national legislation.

It is also possible to raise objections if the ratio of the recoverable and non-recoverable waste does not justify the recovery based on economic and environmental considerations (fictive recovery).

Revision of the Regulation on waste shipments

The Regulation on shipments of waste is being revised, but the timetable for completion is not known. The primary purpose of the revision is to integrate the OECD decision of 14 June 200 C (2001) 107/FINAL in the regulation. This decision entails a mandatory harmonisation between OECD and Basel regarding lists and other requirements on the shipment and disposal of hazardous waste.

The change also aims to simplify procedures and specify clearer and more uniform requirements for notification, shipping documents, information, provision of financial security, etc., throughout the entire community.

It is also expected that written consent will have to be received prior to shipment for both amber and red waste.

A 2.4.2 The Basel Convention

The Basel Convention on the control of transboundary movements of hazardous wastes and their disposal was adopted in the UNEP in Basel in 1989 and took effect in May 1992.

One of the main purposes of the Convention is to reduce the number of movements of hazardous waste. The Convention also defines a number of procedures in connection with movements – for example, requirements for notification and authorisation of movements.

Together with the other EU Member States, Denmark has implemented the Basel Convention in the Regulation on shipments of waste, regulating transboundary movements of waste, including hazardous waste.

In March 1994, in part at the initiative of Denmark, the parties to the Convention adopted an immediate ban on the movement of hazardous waste destined for final landfilling, and a ban on exports of waste for recycling from OECD countries to non-OECD countries, to be effective from 1 January 1998.

Due to non-ratification, the ban has not yet taken effect formally. Despite this, the EU has amended the Regulation on shipments of waste to the effect that the ban covers all EU Member States.

In order to ensure an operational ban, two lists have been prepared and adopted in parallel to the ban: a list of hazardous waste and a list of non-hazardous waste. These two lists provide the technical basis for determining whether waste is hazardous or non-hazardous and thereby whether a given movement is covered by the ban. The two lists have been incorporated in Annex V to the Regulation.

A.2.5 Regulation on waste statistics

The Regulation on waste statistics[24] provides the legal basis for the collection of statistical data on the generation and treatment of waste from households and trade and industry in the EU. The Regulation contains definitions for various waste sector terms and stipulates quality criteria for the collected data. The Regulation will thus ensure the procurement of statistical data with a greater degree of comparability than has previously been available. The information must be reported every two years to the EU statistics office, EUROSTAT.

These measures aim to permit trends in waste generation and waste treatment to be monitored in order to ensure compliance with the targets in EU waste policy.

Statistics Regulation

In Denmark, this statistical data will be obtained via the Environmental Protection Agency's existing Information System for Waste and Recycling (ISAG). ISAG has been implemented in the Statutory Order on Waste, including the most recent amendments to the Order. This means that the Regulation will have no further consequences for Denmark, since Denmark already fulfils the regulations.

[24] Regulation (EC) no. 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics.

Volumes of waste and statistical base

B.1 Developments in volumes of waste

B.1.1 Status

Aims for 2008

- *decouple volume of waste from economic growth*

In Denmark, 12.8 million tonnes of waste were generated in 2001 (see Table 1). This represents a 2 per cent fall in waste generation compared to the previous year. This fall is primarily due to the fact that sludge for mineralisation began to be reported using a dry matter content of 20 per cent in 2001. In previous years, the dry matter content has been 1.5 per cent. Part of the fall is also attributable to the fact that the volume from production enterprises has fallen by 11 per cent compared to 2000. A large proportion of this fall is due to a reduction of over 200,000 tonnes in the volume of iron and metal scrap, compared to 2000.

The volume of waste from the service sector has risen by 17 per cent compared to 2000. There has been a general rise in all waste fractions within the service sector.

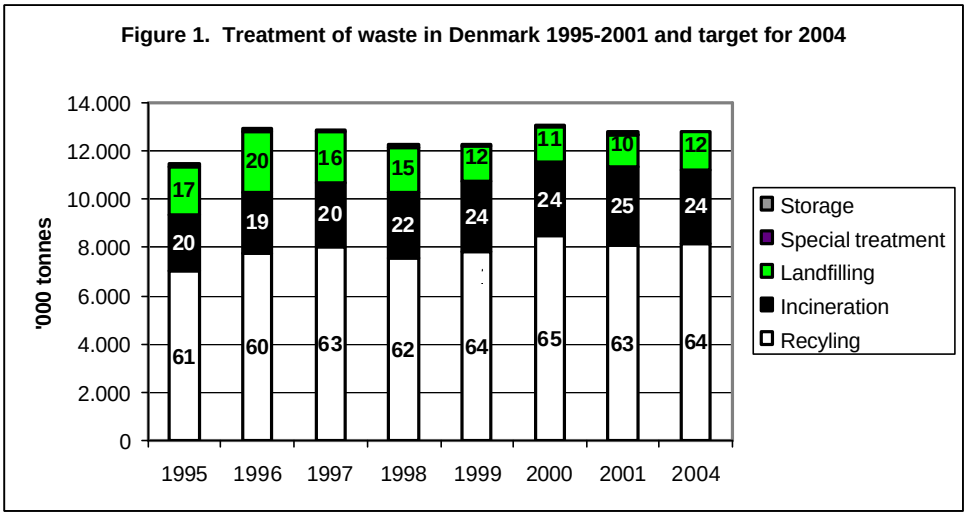
It is important to realise that changes were made to the categorisation of sectors in the Environmental Protection Agency's ISAG system[1] in 2001. These changes have led to a significant break in the data in 2001, in relation to the previous years. Comparisons at the sector level between volumes of waste for 2001 and previous years must therefore be made with a degree of caution.

Table1 Waste generation in Denmark	'000							Development % 2000-
	199	199	199	199	199	200	200	
Household	2.61	2.76	2.77	2.79	2.96	3.08	3.08	0
Domestic waste	1.62	1.65	1.62	1.70	1.66	1.67	1.70	1
Bulky waste	61	63	58	57	67	73	68	-7
Garden waste	32	40	44	43	46	51	45	-
Packaging waste							10	
Other	3	7	12	8	16	15	13	-
Institutions/trade and	83	85	86	95	95	1.11	1.30	1
Manufacturing industries	2.56	2.63	2.73	2.78	2.65	2.94	2.61	-
Building and	2.55	3.08	3.42	2.96	2.96	3.22	3.39	5
Wastewater treatment	1.19	1.21	1.24	1.25	1.37	1.47	1.12	-
Slag, fly ash etc.	1.69	2.33	1.77	1.46	1.29	1.17	1.21	3
Othe	6	3	3	1	1	5	3	60
Tota	11.46	12.91	12.85	12.23	12.23	13.03	12.76	-

Table 1 specifies the distribution of waste generation for 1995-2001 by source. Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

Figure 1 shows the treatment of waste in Denmark, compared with the goals in Waste 21. In 2001, 8,101,000 tonnes (63 per cent of the total volume of waste) was recycled.

[1] ISAG – Information System for Waste and Recycling.



The storage figure refers to waste suitable for incineration that is temporarily stored until the necessary incineration capacity is available.
Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

The volume of waste incinerated in 2001 was 3,221,000 tonnes or 26 per cent of the total volume. The landfilled volume of waste in 2001 was 1,317,000 tonnes (equivalent to 10 per cent of the total volume of waste). In 2001, 1 per cent of waste was given special treatment.

It is primarily the high recycling rate for construction and demolition waste and residues from coal-fired power plants that has contributed to the high overall recycling rate.

B.1.2 Developments in volumes of waste

The development in volumes of waste from 1995 to 2001 is shown in table 2. From 1995 to 2001, the total volume of waste rose by 11 per cent. The volumes of waste rose throughout the period for all sectors, except for slag, fly ash, etc. from coal-fired power plants and sludge for mineralisation from wastewater treatment plants.

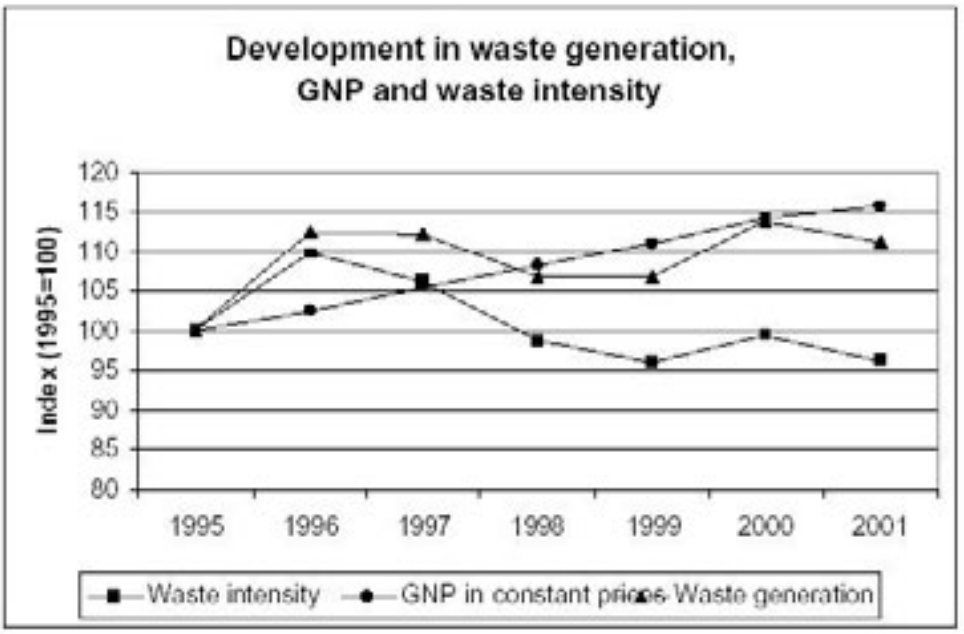
The volume of residues from coal-fired power plants has fallen as a result of the goal in Energy 21 to continue to shift from the use of coal and coke as fuel to natural gas and renewable energy. The volume of residues from coal-fired power plants depends not only on energy consumption in Denmark but also on electricity exports to Sweden and Norway.

Table 2. Total waste production in Denmark.	'000 tonnes							Development %
	1995	1996	1997	1998	1999	2000	2001	1995-2001
Households	2.610	2.767	2.776	2.796	2.963	3.084	3.083	18
Domestic waste	1.628	1.655	1.621	1.702	1.865	1.676	1.701	4
Bulky waste	618	639	588	572	672	730	680	10
Garden waste	326	401	443	438	464	519	458	41
Packaging waste							107	
Other	38	72	125	83	163	158	136	259
Institutions/trade and offices	834	851	861	955	955	1.119	1.307	57
Manufacturing etc.	2.563	2.632	2.736	2.783	2.653	2.948	2.616	2
Building and construction	2.559	3.088	3.427	2.962	2.958	3.223	3.391	33
Wastewater treatment plants	1.195	1.212	1.248	1.251	1.379	1.476	1.123	-6
Slag, fly ash etc. (coal)	1.699	2.332	1.775	1.469	1.299	1.176	1.211	-29
Other	6	30	34	18	15	5	37	481
Total	11.468	12.912	12.857	12.233	12.233	13.031	12.768	11

Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

The figure below shows that the total volume of waste increased more rapidly than economic growth in the period 1995 to 1996. This was followed by a decline in the volume of waste, and another increase during 1999 to 2001. However, this is only the picture for the total volume of waste. Appendix D shows the development in volumes of waste for each sector.

Waste generation is the result of all activities in society. If total waste generation is shown in proportion to gross national product (GNP), it provides an indication of the waste intensity in society.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003, Statistics Denmark.

The graph shows the relative changes in gross national product in constant prices[2] (GNP), waste generation and waste intensity, which is the relationship between the relative change in waste generation and the relative change in GNP. As can be seen in the figure, waste intensity declined until 1999 (decoupling) and has subsequently been relatively constant. This means that growth in the volume of waste during this period has largely corresponded to growth in GNP. Thus this trend does not point in the direction of decoupling, but rather an approximately constant relationship between growth in the volume of waste and growth in GNP.

B 1.2.1 Forecast 2000 – 2020

A forecast has been prepared for volumes of waste through to 2020 using the Risø model. This forecast is based on the Financial Statement and Budget Report 2001, the Danish Energy Authority's latest forecast from March 2001, and an adjustment of the model to ISAG data for 2000.

[2] Constant prices are prices for the year, adjusted for inflation, and are thus an indicator of real growth

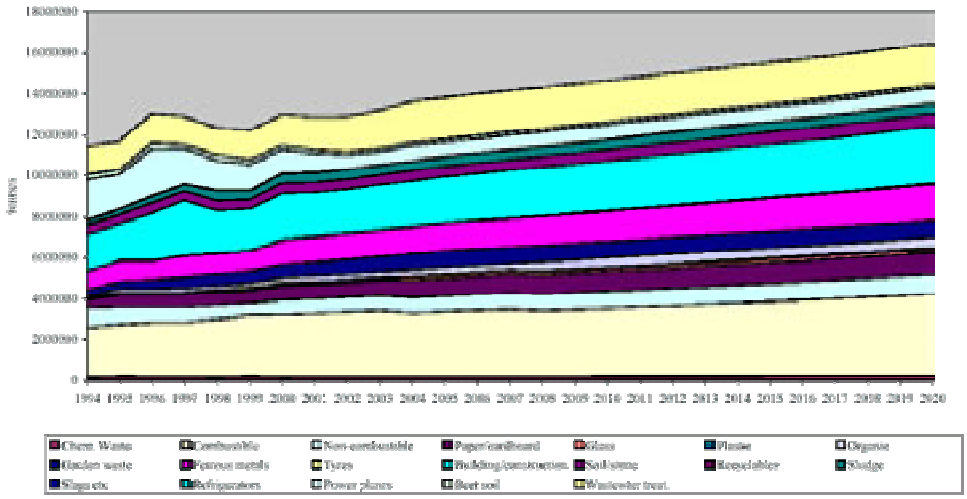
Waste 21 sets out a number of objectives for waste treatment through to 2004. Many of the initiatives in Waste 21 involve increased sorting for certain waste fractions with the aim of moving waste from incineration to recycling. But an equally important goal in Waste 21 is to stabilise the total volume of waste.

The forecast is based on the assumption that the initiatives in Waste 21 relating to increased separation and recycling of paper and cardboard, glass, plastic and organic waste will be implemented between 2000 and 2004. No further assumptions have been made about increased separation for the period 2004 –2020. This period is thus purely based on the models own forecasting ability. This means that the initiatives in this Strategy have not been included in the forecasts.

Note that the Waste 21 initiative relating to the recycling of organic domestic waste has not been implemented, with the result that the forecast for recycling has been set too high.

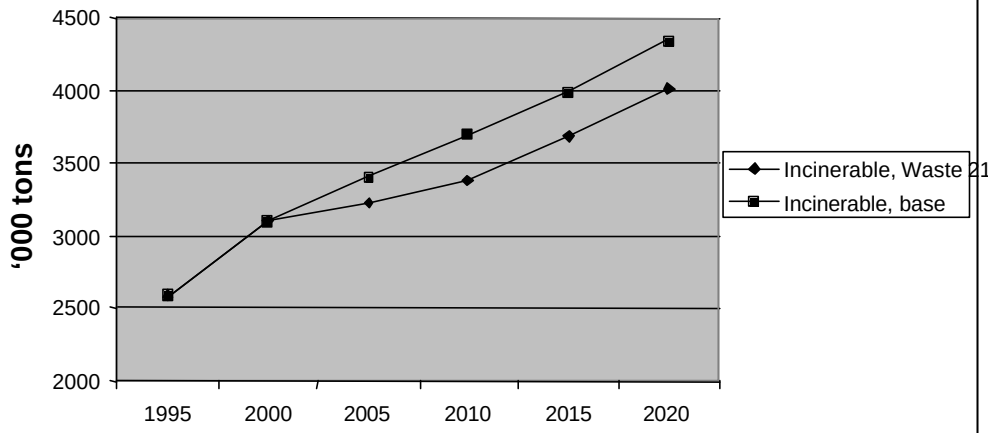
A quite large increase in the volumes of waste is predicted because animal waste (approx. 200,000 tonnes of meat-and-bone meal) from industry will be shifted to waste incineration plants. Future volumes of waste will also contain ocean floor sediment. These waste fractions have not previously been recorded in waste statistics and have therefore not been included in the forecasts.

Figure 3. Developments in waste generation, historical data 1994-2000, projections 2001-2020. Waste 21.

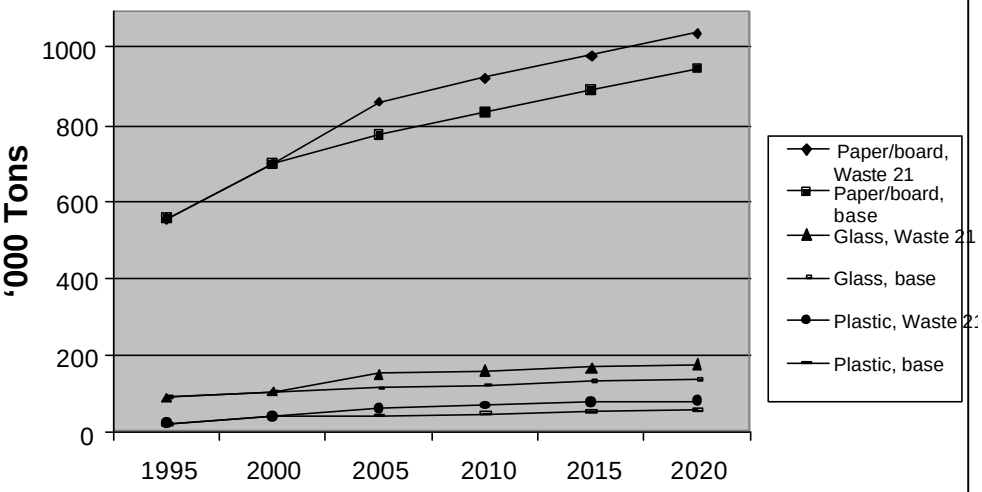


The figures below compare the forecasts, with and without the consequences of the Waste 21 initiatives. They primarily show a reduction in the volume of the mixed fraction “waste suitable for incineration, and an increase in the volume of the recycled fractions, paper and cardboard, glass, and plastic, cf. figure 4 and 5.

Figur 4. Development in the volume of incinerable waste
Base volume vs. Waste 21 scenario



Figur 5. Development in selected separated fractions.
Base volume vs. Waste 21 scenario

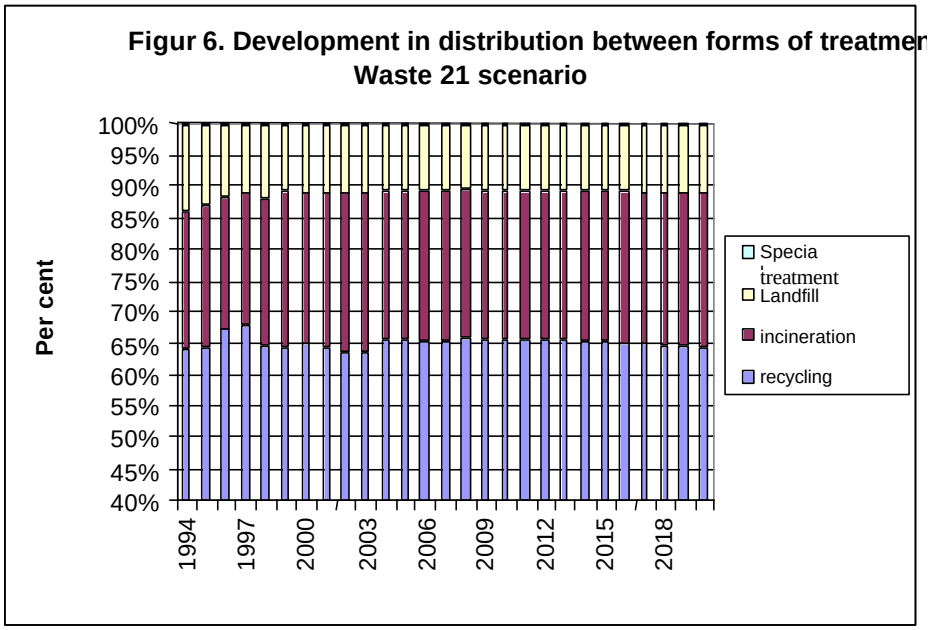


If no further initiatives are introduced to influence the development in volumes of waste after 2004[3], the Waste 21 corrections for 2000 – 2004 mean that the proportion of waste that will be incinerated in 2020 is reduced from 26.4 per cent to 24.6 per cent, while the volume of waste that will be recycled is increased from 62.5 per cent to 64.4 per cent.

In other words, Waste 21 ensures that the proportion of recyclable fractions is the same in 2000 and 2020, such that the distribution between forms of treatment will basically be the same in 2000 and 2020, cf. figure 6.

Without the initiatives from Waste 21 there would be a decreasing proportion of fractions recycled.

[3] The initiatives in this Strategy are not included in the forecast.


Figur 6. Development in distribution between forms of treatmer
Waste 21 scenario
Per cent
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
1994
1997
2000
2003
2006
2009
2012
2015
2018
Specia
treatment
Landfill
incineration
recycling

B.2 Statistical base

B.2.1 Status

Aims for 2008

- *avoid unnecessary double reporting of waste data to authorities*
- *measure effects of future efforts in waste management*
- *be able to monitor developments in the waste indicators by regularly calculating resource, energy and landfill indicators every 2-3 years*
- *develop more LCA-based indicators*

There is a need to continue the systematic collection of comparable data on waste generation and treatment at a detailed level and in a way that enables both enterprises and local and national authorities to use this data. This need will increase in future, as more and more waste fractions become subject to special treatment.

A central data reporting system exists (Information System for Waste and Recycling - ISAG) which each year provides a good picture of the waste generated in Denmark and how it is treated. ISAG was launched in 1993. Waste managers report waste data to the ISAG database[4] each year. This database is administered by the Danish Environmental Protection Agency.

The aim of ISAG is to provide a statistical basis for analysis and planning purposes. ISAG extracts are sent to the municipalities every year to be used in the preparation of municipal waste plans, and are also used by the Danish Environmental Protection Agency in preparing action plans and waste management initiatives. ISAG data is also used to fulfil Denmark's international reporting obligations.

ISAG is continually being extended. The latest change to the system involves expansion with more detailed information on plant capacity, operational data, treatment prices, geographic sources of recyclable waste, further detail for the trade and industry source, extended information on hazardous waste and waste carriers. ISAG provides a good overview of the development in volumes of waste, but cannot be used to monitor individual flows of waste at a detailed level.

ISAG data is not sufficiently detailed to be used for reporting to the EU. In parallel with ISAG, more detailed knowledge on various waste fractions is therefore regularly collected in the form of material flow analyses[5], etc. Investigation is currently being made into what correlations exist between these material flow analyses and ISAG data, and whether ISAG data reports can replace some of the data collected for material flow analyses.

Under the Statutory Order on Waste, Waste carriers are required to keep a register containing information about waste shipments. The aim of the register is to function as an inspection tool, and the data must be reported to the municipalities as required. No uniform requirements have been laid down for the form of this registration by the carriers. Each municipality lays down requirements for the form and content of the register in regulations. This

[4] In accordance with the Statutory Order on Waste, no. 619 of 27 June 2000.
[5] Annual material flow analyses are carried out for cardboard, paper, plastic packaging, glass packaging, metal packaging, and organic waste.

means that carriers may have to report data in different ways to different municipalities.

Under the Statutory Order on Waste, waste generating enterprises must keep a register of the waste they generate so that they are able to prepare source cards and report this information to the authorities (national, county and municipal) upon request.

This registration of waste data at each stage serves various purposes. Registrations at the producer and carrier stage primarily serve an inspection purpose while the ISAG registrations at waste treatment facilities provide more general information between the three stages. There are differences between the types of information and the volume and level of detail.

There will continue to be a need to carry out material and mass-flow analyses for selected waste fractions. This will particularly be the case for areas where the general data registration (ISAG) is not adequate.

The Danish Environmental Protection Agency has developed and calculated new waste indicators for resource consumption, energy consumption and landfill requirements for various treatments (re-use, recycling, incineration and landfill) for a number of materials in waste[6]. Energy consumption is used in this context as a combined indicator for both the greenhouse effect and acidification. Calculation of the indicators is based on life-cycle analysis data (LCA data).

When initiatives aimed at various materials in waste, such as glass or aluminium, need to be prioritised, one can compare the indicators for resource consumption, energy consumption, and landfill requirements for these materials and thereby compare the environmental factors for the various materials.

The new indicators require a very large LCA statistical base, analysis of material flows and complicated calculations. The resulting indicators are therefore subject to greater uncertainty and will not be as robust as the existing waste indicator for volume of waste in tonnes. It takes time to obtain data and calculate the new indicators. The first set of indicators for a number of waste fractions were presented at the beginning of 2003.

The indicators can only be fully utilised to illustrate waste management developments once a series of calculated indicators has been accumulated over a number of years.

However, the new indicators can already be used to guide the selection of waste fractions to be targeted by initiatives and the most suitable forms of treatment for these waste fractions. In this way, the new indicators can be used to select where we achieve the best environmental results with the resources available.

[6] The assumptions and statistical bases for calculating the new waste indicators are described in detail in the report:Danish Environmental Protection Agency 2003, “Resource savings in waste treatment in Denmark”

Initially, three indicators have been calculated:

- Resource consumption
- Energy consumption
- Landfilling requirements

These indicators have been calculated for the existing waste treatment of the various waste fractions and for optimal treatment, where it is assumed that recycling will be increased to a realistic level, taking into account both technological possibilities for increased recycling, and realistic options for collecting each particular waste fraction. *The indicators reveal what is saved by using each form of treatment, compared to 100 per cent landfilling of the particular waste fraction.*

Unfortunately, the three new indicators cannot be calculated for all waste fractions due to a lack of LCA data. For example, for the building materials (concrete, tiles and asphalt), data relating to resource and energy consumption during raw material extraction and recycling is not available. For plastic, data is only available for the recycling of PE, which has therefore been used for all plastic types. Similarly, up-to-date data and other data are not available for several metals.

There can be other significant environmental and societal factors apart from resource consumption, energy consumption, and landfill requirements. For example, nutrient salt load, and human and ecotoxic effects. Toxic effects are obviously of greatest significance for the hazardous waste fractions. Since LCA data is not available for these effects, new waste indicators have simply not been calculated for these hazardous waste fractions.

When making final decisions about and ranking new initiatives targeting individual materials in waste, it is important not to focus on the new indicators alone. At the very least, a qualitative assessment of hazardous emissions from the processes in the material's life cycle must be carried out before significant decisions are made on the basis of the indicator values.

There is a great need in the future to supplement the LCA databases with data for recycling processes, and especially for human and ecotoxic effects. Chapter 2 presents an overview of the new waste indicators for resource savings, energy savings, and savings in landfill requirements for existing waste treatment and the unexploited potential for further savings. The indicator values calculated for each material, from which the waste indicators are derived, are shown in the individual fraction sections in Appendix E.

B.2.2 Future initiatives

Measures:

- *ongoing knowledge-sharing via Waste Centre Denmark*
- *simplification of waste data registration*
- *refine the waste indicators and seek to obtain further LCA data for the calculations*
- *combine indicators and cost-benefit analyses*

Knowledge-sharing is a central instrument to be used by the players when implementing the Waste Strategy. Information can support and contribute to fulfilling the various elements of the Strategy. Relevant information must be made available to the players via the Internet and other media. Waste Centre Denmark has a central role to play in this area, and it is important that the Waste Centre can continue to promote knowledge-sharing between players in the area of waste management. The centre is supported by funding in the annual budget.

In 2002, the Minister for the Environment appointed a work group to examine the organisation of waste management. One of the group's tasks was to look at registration and reporting requirements, with the aim of simplifying these. The group was also to investigate whether reporting obligations would be streamlined if a central database was established, to which all relevant information was reported once a year.

Initiatives that support the development of methods that can measure the effect of initiatives on reducing environmental impacts in waste management, for example by measuring heavy metals in residues, will be promoted.

Mass-flow analyses will be prepared in areas were ISAG registrations are not sufficient.

More work is to be done with the new waste indicators for resource consumption, energy consumption, and landfill requirements.

If LCA data can be obtained for resource and energy consumption during both raw material extraction and recycling, the indicators will be calculated for building materials. LCA data must also be sought for all plastic types, for various metals, and for the new treatment methods for PVC and impregnated wood.

There can be other significant environmental and societal factors apart from resource consumption, energy consumption, and landfill requirements. For example, nutrient salt load, and human and ecotoxic effects. Toxic effects are obviously of greatest significance for the hazardous waste fractions. If LCA data becomes available for these effects, new waste indicators will be calculated for these hazardous waste fractions.

The waste indicators will be compared with cost-benefit analyses. This will provide a solid basis for assessing whether the specific waste fractions are being treated in the most environmentally and cost-effective manner.

B.2.3 Regulation

General information on waste is collected via the Information System for Waste and Recycling (ISAG), launched in 1993. ISAG is administered by the Danish Environmental Protection Agency. Under the Statutory Order on Waste, waste treatment facilities must report information about the waste they treat to the Environmental Protection Agency.

B.2.4 Environmental assessment

The waste indicators for resource consumption, energy consumption, and landfill requirements will provide an improved foundation for selecting the best environmental initiatives in the future.

B.2.5 Financial estimate

Calculation of the three indicators shown in Chapter 2 and Appendix E has cost DKK 1.2 million. It is estimated that it will possible to update the indicators for approx. DKK 0.5 million each time. The costs of extending the indicator system depend on the availability of data and cannot be estimated on the existing basis.

B.2.6 Implications for the national authorities

The work group will analyse the data registration and reporting obligations to investigate whether it is possible to simplify the entire data collection system.

Simplification of the registration and reporting obligations would reduce the burden on all players involved in waste management.

The Ministry of the Environment will update the indicators every two to three years.

ISAG data and material flow analyses will be used to carry out the necessary data reporting to the EU.

B.2.7 Implications for municipal authorities

Municipalities will use a central database as a basis for municipal waste management planning, and to carry out supervision of waste management in the municipality.

B.3 Technological development in waste management

B.3.1 Status

Aims for 2008

- *ensure continuous and systematic technological development for relevant fractions*
- *ensure that treatment technologies are being developed and result in the establishment of industrial plants for PVC, impregnated wood, batteries, electronic equipment, flue gas cleaning products from waste incineration plants and shredder waste.*
- *establish a knowledge centre to promote environmentally sound management of critical waste.*

The quality of waste treatment must be improved. Better quality in waste treatment requires the development of new technologies.

Denmark has been at the forefront of waste treatment technology development and continues to keep abreast of global developments. If technologies suitable for managing waste of the future are to be developed in general, an intensive effort is required to solve the task systematically. It will be necessary for the state to get involved in this work.

Municipalities are responsible for waste management. This makes them important players in the identification of new waste types for separate treatment, the establishment of new logistical systems, and the selection of technologies for the treatment of waste.

Profitable treatment of waste requires that plants have sufficient supply and a sound financial basis. The need for sufficient supply will, for example, require that small waste fractions be collected from larger areas. Cooperation across borders or within sectors with many small enterprises may be the key to creating the necessary basis for recycling these fractions. It may be necessary to establish a small number of plants for the treatment of certain waste streams. The location of such plants must be matched to supply conditions and logistics.

Technological development does not happen automatically in the waste management. This is partly because the necessary quantities of waste for treatment are not always available. For example, one waste fraction may be generated in small quantities in all municipalities. Other waste fractions may arise in large quantities in few municipalities. The supply base can therefore be uncertain. This creates barriers to innovation and the development of profitable collection systems and treatment methods. It also means there is no incentive to invest in the development of new plants and put them to commercial use.

With funding from the Council for Recycling and Cleaner Technology and the Environmental Council for Cleaner Products, a number of investigation and development projects have been carried out over the last eight years.

These projects have led to the development of technologies on a pilot or industrial scale, that can reprocess PVC and flame-retardant plastic, impregnated wood, shredder waste, flue gas cleaning products from waste incineration plants, and batteries.

However, the results have not led to the establishment of reprocessing facilities on an industrial scale.

For this reason, the Environmental Protection Agency has initiated an investigation into what initiatives are required in order to establish the technologies developed on an industrial scale.

The volumes of waste that will be available in Denmark have been investigated. The costs of reprocessing the waste fraction have been compared to the existing treatment of the waste, potential investors have been identified, and the conditions under which they would be willing to invest in future reprocessing facilities have been assessed.

The results show that investors do exist, but that national regulations, including reprocessing quality requirements, are necessary before they will be willing to inject the necessary capital.

To ensure that treatment technologies continue to be developed, the state must provide continued support for such development and lay down requirements for waste treatment once technologies exist so that plants can be established and operated under market conditions.

The EU support program, LIFE-Environment, is a possible source of funding in this area. For example, in 2001, approx. DKK 28 million was given from this source to support a Danish demonstration project for the recycling of PVC waste using thermal hydrolysis.

There is a general need to provide a boost to this area so that waste treatment is developed throughout the whole country. This initiative requires innovation, both in terms of technology and organisation, and it is necessary that improvements be nationwide.

B.3.2 Future initiatives

Measures

- *support technological development*
- *investigate other financing options*

It is expected that grants will continue to be made to development projects that contribute to the development of new treatment technologies.

Technological development within waste management will be supported. In cooperation with the players, the Environmental Protection Agency will evaluate areas where there is a need for greater efforts and how best to support these efforts.

A central area in relation to these initiatives will be to lay down reprocessing requirements for the various waste fractions on the basis of existing technology. These reprocessing requirements should be set on the basis of environmental and cost-benefit analyses.

B.3.3 Economy

Financing requirements are covered to a limited extent by funds from the Environmental Council for Cleaner Products. However, the Council is not currently able to provide grants for plant investments. There is a need to examine which other financing possibilities can be established in order to enhance technology development. The possibility of obtaining funds from private enterprises will be investigated.

B.4 Economic and environmental effects of waste treatment

B.4.1 Costs of waste management

The costs of waste management can be divided generally into treatment costs, collection costs, and waste tax to the state. These costs are often collected as a total fee from residents and smaller enterprises covered by collection schemes. In 2001, total municipal costs for waste management amounted to DKK 3.9 million. Several investigations have shown that it is impossible to compare the municipal waste collection fees.

Enterprises covered by assignment schemes cover the costs of transport themselves and hence the treatment price for assignment schemes does not include transport costs.

Municipal expenses for waste management and the finances of public treatment facilities must be based on the non-profit cost-coverage principle, such that the fees collected match the actual expenses.

Waste tax
The waste tax (see Appendix A) is differentiated depending on whether the waste goes to landfilling or incineration. For incineration, the tax is DKK 330/tonne, while for landfilling the tax is DKK 370/tonne. Recycled waste is not subject to tax. Hazardous waste, contaminated soil requiring special landfilling, and biomass waste are exempt from the waste tax. In 2001, revenue from the tax exceeded DKK 1 billion.

The total volume of waste, divided between forms of treatment, is shown in the figure below:

Volumes of waste in 2001[7]:

	Recycling	Incineration	Landfilling
2001	8,101 tonnes (63%)	3,221 tonnes (25%)	1,317 tonnes (10%)

As the figure shows, the major proportion of waste was recycled in 2001. The financial incentives provided by the waste tax are believed to be a significant reason behind the high rate of recycling. Note, however, that the data is based on the total volume of waste and not exclusively on waste subject to the tax.

Treatment charges – incineration and landfilling
In 2002, the Environmental Protection Agency commissioned an analysis of the potential to rationalise Danish incineration plants and landfill sites (the results of the analysis are discussed below[8]). As part of this analysis, an overview of the size of treatment charges was generated, i.e. the price for

[7] This excludes a small quantity subject to special treatment or placed temporarily in storage.
[8] Briefing from the Danish Environmental Protection Agency, no. 2, 2002.

delivering waste to a treatment facility, excluding waste tax and VAT. The treatment charge for incineration varied between DKK 0 and over DKK 900 per tonne, with the average treatment charge for incineration being DKK 248 per tonne, excluding waste tax and VAT[9]. The treatment charge for landfilling varied between DKK 100 and DKK 750 per tonne, with the average treatment charge being DKK 233, excluding waste tax and VAT[10].

A report from the European Environment Agency shows that compared to other European countries, the Danish treatment charges for incineration and landfilling are low. For example, the price for incineration in Germany is approx. twice as high as in Denmark[11].

Market price for treatment – recycling
There is no systematic overview of treatment prices for recycled waste. This is because recycling typically takes place in the private sector and the recycling method varies greatly depending on which waste fraction is involved. For example, recycling includes using residues from waste incineration plants in roads, or remelting metals to make new products. Finally, prices fluctuate greatly depending on specific market factors. For example, the prices of metals vary depending on the metal quality and the prices on commodity exchanges.

The prices below illustrate the range of market prices that exist for treatment of recyclable/reprocessed materials.

Fraction	**Market price for treatment, DKK/tonne. (beginning of 2003)** (a negative price means that the waste producer receives money for the waste)
Tyres	700-800
End-of-life vehicles	500-1,200
Waste from electrical and electronic equipment specially treated residue which is shredded	 3,000 0 to 1,000
Iron	-500 to -700
Metals	-1,000 (varies greatly)
Plastic	-950 to -2,700
Paper	240 to 700
Glass, cullets	-120

B.4.2 Environment economics

A number of initiatives have been commenced under Waste 21 for which the final decision about implementation of measures will depend on the investigations of environmental and economic factors currently underway. This applies to initiatives such as:

[9] 2001 figure for normal waste suitable for incineration weighted by volume
[10] 2001 figure for sorted, waste not suitable for incineration for landfilling, weighted by volume
[11] 1999 figure. European Environment Agency – Environmental assessment report No. 2.

Completed projects

Organic domestic waste

In 2002, the Danish Environmental Protection Agency prepared an analysis into increased collection of organic domestic waste for recycling, compared to incineration with energy recovery. The purpose of the analysis was to investigate both the direct environmental and economic effects and the welfare-economic consequences of increasing the proportion of organic domestic waste recycled. The results of the analysis show that the increased costs of two-part collection are very great in proportion to the environmental effects achieved.

The total increase to welfare-economic expenses from introducing the Waste 21 long-term goal of biogasification of 300,000 tonnes of collected organic domestic waste, in relation to the costs of incineration, is in the order of DKK 230 million. An equivalent expansion of composting would cost approx. DKK 270 million.

The Waste 21 goal for biogasification in 2004 of recycling 100,000 tonnes would cost of the order of DKK 70 million extra in relation to the existing treatment of organic waste, whereas an expansion using composting would cost approx DKK 80 million.

Plastic containers

The analysis compares the incineration and recycling of waste plastic bottles and containers from households. The analysis shows that separate collection and recycling is more expensive from a welfare-economic perspective than the existing treatment – incineration with energy recovery. With a low-budget collection system delivering to recycling centres, it would cost approx. DKK 300/tonne more to collect and export for recycling than to incinerate. It is even more expensive to treat plastic waste in Denmark than it is to export it for treatment abroad.

Since the analysis was completed, it has been found that it is possible to significantly reduce the costs of sorting the collected plastic containers. It is therefore planned to update the analysis's results with the latest knowledge in 2003, and it is assumed that this will change the results.

Efficiency analysis

An analysis of the potential to rationalise Danish incineration plants and landfill sites has also been carried out. This analysis showed that there was a potential to realise savings of DKK 135-155 million in the area of incineration in 2000, equivalent to 8-10 per cent of total expenses. This represents a relatively modest potential. In the area of landfill, there is a potential to realise savings of DKK 55-90 million annually, equivalent to an average of 25-40 per cent of total expenses. This represents a relative large potential as a proportion, but less in absolute terms than for incineration.

Future projects

Future projects

There are also a number of environment-economic investigations underway, the results of which are not yet available. These are described below.

Cost-benefit investigations for PVC

The Danish Environmental Protection Agency is currently in the process of carrying out an environment and cost-benefit investigation of various treatment methods for PVC. The investigation includes an analysis of the

various treatment technologies – reprocessing at various facilities, landfilling and incineration. It also includes an evaluation of whether increased separation for reprocessing of PVC waste can be justified in terms of costs and benefits.

Deregulation project
As an extension to the Efficiency Project, there is a need for closer investigation of the consequences of deregulating waste incineration and landfilling. The goal is to investigate whether it is possible to achieve greater socio-economic efficiency via deregulation of waste incineration and landfilling, without consumer and environmental protection considerations being neglected. The project is expected to be completed mid-2004.

Fees
This project aims to generate proposals for how fee regulations can be changed to achieve transparency in fees. The project is being carried out in ongoing dialogue with the work group on the organisation of the waste management sector. The project is expected to be completed mid-2003.

Dioxin investigation
The National Environmental Research Institute, Denmark (NERI) has prepared a report for the Nordic Council of Ministers' work group for products and waste (the PA group) aimed at evaluating the results of existing economic valuation investigations into the costs of impacts from waste treatment, and evaluating final treatment charges on waste in the Nordic countries. Another objective has been to extend the existing knowledge relating to valuation of the external effects of low-dose emissions from waste incineration. It was decided to focus specifically on dioxin emissions.

There are also a number of pending projects that have not yet been initiated. The following projects will be initiated this year, and their results are expected to be available within the first part of the Strategy period.

Due to the significant development in treatment technologies for PVC, impregnated wood, shredder waste, and acidic flue gas cleaning products, it is necessary to evaluate from a cost-benefit perspective whether the environmental effects resulting from reprocessing waste fractions are in line with the expenses. The analysis of impregnated wood (like the analysis underway for PVC) aims to identify the economic and environmental consequences of increased recycling and evaluate whether there are critical differences in either the environmental effects or expenses associated with establishing full-scale facilities using various technologies. The analyses for shredder waste and acidic flue gas cleaning products will exclusively evaluate the choice of treatment methods in connection with available technologies. These investigations are thus purely related to technology selection and not the magnitude of the recycling potential or the expenses linked to exploiting it. The reason for this is that there are relatively few sources with large volumes of waste.

Use of quotas
The objective of the project is to analyse the advantages and disadvantages of introducing quota systems for waste to be landfilled and incinerated in Denmark. The project aims to evaluate possible quota models and identify and assess legal and institutional barriers.

B 4.2.1 New initiatives

Continued development of environmental cost-benefit analysis methods

The numerous cost-benefit analyses in the area of waste management have shown that there is a need to develop the environment-economic method and create a more uniform base of calculation prices. Firstly, it is not currently possible to place a value on all parameters in such analyses, but often only for a few for which reliable valuation estimates exist. Secondly, there is often a not insignificant uncertainty linked to valuation of the individual parameters. Thirdly, there are a number of methodological problems associated with including effects in other countries in the traditional cost-benefit analysis.

Much of the waste generation in a product's life cycle and raw material consumption often takes place in foreign countries today, and waste treatment is increasingly taking place abroad. It has therefore been found that analyses that only include domestic effects can lead to narrow conclusions. Ongoing efforts are therefore being made to refine and develop the method. This work is partly being done in the Danish Environmental Protection Agency and the National Environmental Research Institute, Denmark, and seeks to achieve greater cohesion between environment-economic analyses and life-cycle analyses, and to provide a more uniform base of calculation prices.

Implementation of EU Directives

The Strategy contains various types of initiatives. A number of measures have been made necessary by new or revised EU directives, and as such, implementation in Danish legislation is compulsory. The costs of these initiatives has been estimated:

- The Packaging Directive, including increased recycling of plastic, cardboard, wood and metal packaging
- The Electronics Directive, including implementation of producer responsibility
- Necessary changes to waste regulation resulting from the Animal By-products Regulation
- Implementation of acceptance criteria for landfilling of waste
- Regulations on the treatment of district heating pipes containing CFC's or HCFC's, as a consequence of the Regulation on ozone depleting substances

In order to achieve the goal in the Packaging Directive, plastic packaging must be collected from households. On the basis of environmental cost-benefit analyses carried out, the collection method with the lowest costs per tonne of plastic waste has been chosen. The total costs are estimated to be approx. DKK 1.9 million per annum. In order to achieve the goal in the Packaging Directive, it will also be necessary to increase the collection of plastic transport packaging from enterprises that handle large quantities. This is not expected to lead to an increase in net expenses for enterprises.

The mew material-specific goals in the Packaging Directive are only expected to lead to a limited increase in the costs of collecting metal packaging from households. Should it become necessary to collect plastic packaging from enterprises that handle only small quantities, this will lead to an increase in costs to these enterprises. A report for the Danish Folketing will be prepared

in 2005 on how the goal of 55 per cent recycling of all packaging waste can be achieved. The other initiatives will be carried out in a way that ensures improved cost-effectiveness of environmental policies.

To date, electrical and electronic products have been collected via municipal schemes financed through municipal charges. Under the new directive, producer responsibility will be introduced, with the result that waste management costs will be included in the prices of these products. Costs associated with the waste treatment of electrical and electronic products are expected to constitute 0.2 – 3 per cent of the products' purchase prices.

The costs of treating animal waste have been estimated by industry to be approx. DKK 100 million per annum for incineration, and approx. DKK 100 million per annum for prior treatment – DKK 200 million in total. Incineration of meat-and-bone meal is exempt from waste tax. The increased costs to industry of managing the waste are due to the regulations in the Animal By-products Regulation and the resulting amendments to regulations made by the Ministry of Food, Agriculture and Fisheries.

The economic consequences of implementing the annex to the Directive on the landfill of waste are difficult to calculate. Before the waste is landfilled, information must be available on the composition of the waste and leaching of contaminants in the short and long-term ("characterisation"). The associated costs can only be calculated when it is known which types of waste must be characterised. The total costs to waste producers for characterisation of waste types for landfill are estimated to be of the order of DKK 100-200 million. It is expected that these costs will be incurred over approx. a two-year period (2004-2006).

In addition to the costs of characterisation, waste producers will be regularly required to document that the particular waste type characteristics are not changing over time. This documentation will be in the form of analyses (compliance tests) aimed at showing whether the composition and leaching characteristics of a waste type have changed in relation to the results from the earlier characterisation. If the characteristics are changing, the waste producer may, in the worst case, be required to perform a new characterisation of the particular waste type. The total annual costs to waste producers for carrying out compliance tests are estimated to be in the order of DKK 5-10 million.

In the 1990's, international rules were implemented regarding the phasing out of substances that deplete the ozone layer, in the Montreal Protocol and in an EC Regulation on substances that deplete the ozone layer. One study has shown that the greatest quantity of these substances is found in district heating pipes. The volume of decommissioned district heating pipes that contain ozone layer depleting substances will significantly increase in the years ahead, but no information is available on how many of these decommissioned pipes will be excavated. It will be necessary to investigate this before the expenses associated with separate treatment of district heating pipes containing ozone-depleting substances can be calculated. When a specific scheme is implemented for the waste management of these waste fractions, emphasis will be given to finding the most cost-effective scheme.

The table below summarises the economic consequences of the Waste Strategy 2005-08, with expenses divided between the public and private sectors:

Initiative	Municipalities	Counties	State	Consumer	Trade and Industry
	DKK million per annum	**DKK million per annum**	**DKK million per annum**	**DKK million per annum**	**DKK million per annum**
The Packaging Directive (from 2005)				1.9	No increase in net expenses
The Electronics Directive (from 2005)	0	0	0	0	0
The Animal By-products Regulation (from 2003)					200*
Acceptance criteria resulting from the Directive on the landfill of waste		One-off expense 2005-06 1		One-off expense 2005-06: 30-60	One-off expense 2005-06: 70-140
				Ongoing expenses From 2007: 1.5-3.0	Ongoing expenses From 2007: 3.5-7.0
Regulation on ozone depleting substances	0	0	0	unknown	unknown
Total – recurring expenses				**3.4-4.9**	**203.5-207**
Total – non-recurring expenses		**1**		**30-60**	**70-140**

* The DKK 200 million for implementation of the Animal By-products Regulation are the result of regulation changes by the Ministry of Food, Agriculture and Fisheries.

Use of environmental and cost-benefit analyses

Other initiatives in the Waste Strategy require further assessments of the economic consequences. No specific new initiatives will be implemented in these areas until a cost-benefit analysis has been carried out.

A number of initiatives relating to the separation of special fractions were started as a result of the previous waste plan. In these areas, a decision on the final treatment of the fractions will await investigation of environmental and economic factors. This applies to initiatives such as:

- PVC
- impregnated wood

These analyses are expected to be completed in 2003.

A number of initiatives in the Waste Strategy indicate the direction the Government wishes to work towards. Measures under these initiatives will not be economically evaluated before the Strategy comes into force. However, the environmental and economic consequences will be evaluated before decisions are made about starting specific, binding initiatives. This may be relevant within initiatives such as:

- Increased recycling of industrial waste

- Initiatives for increased recycling of bulky waste
- A strategy for hazardous waste
- Changes to the Statutory Order on residual products, including requirements relating to the content of organic contaminants, and extension of the Order to also include building and construction waste.
- Investigation of the options for introducing producer responsibility for relevant products
- Establishing networks for new treatment technologies

In addition, a number of initiatives will require that elucidation projects be carried out with funding from the Danish Environmental Council for Cleaner Products.

B.5 Experience from other countries in preventing waste

B.5.1 International waste prevention initiatives – OECD, EU and UN

Waste prevention and improved resource efficiency need to be viewed from an international perspective. The large volumes of waste produced outside of Denmark in connection with the extraction and processing of raw materials do not appear in Danish waste statistics – this waste appears in the countries producing the raw materials, typically in developing countries. The import into Denmark of products and semi-finished goods from other European countries in particular also has great significance. Any waste prevention strategy that builds upon product-oriented initiatives must therefore be implemented at EU level. Examples of EU initiatives include the Flower eco-labelling scheme and work on standardisation in the European Standardisation Committee (CEN).

Denmark is not alone in placing a high priority on waste prevention. Waste prevention has been an important element in waste policy in several OECD countries for many years. Since 1998, the OECD has targeted its waste minimisation efforts more specifically on waste prevention issues. In August 2000, the OECD published a comprehensive report on waste prevention: Strategic Waste Prevention - OECD Reference Manual. The OECD is also working on developing tools to evaluate the implementation of waste prevention, especially quantitative indicators.

The Basel Convention is the only international regulation of waste at global level. The main purpose of the Convention is to regulate transboundary transport of hazardous waste, but over the last few years the Convention has shifted focus towards waste prevention, waste minimisation, and environmentally responsible waste treatment. In December 2002, it was decided to implement a strategy focusing on these new areas. More specifically, a number of projects will be initiated with the aim of ensuring global waste prevention.

The *Community Strategy for Waste Management* states that "the key objective of any Community waste policy based on the precautionary and preventive principle must be to prevent the generation of waste. The Commission believes that in any case waste prevention must be considered preferable to any other possible solution."

The Commission aims to promote waste prevention via initiatives in the following areas: Continued promotion of the development and use of cleaner technology, improvements to the environmental aspects of technical standards, promotion of the use of economic instruments in the waste sector, promotion of environmental revision plans for economic players, and promotion of waste-saving products through eco-labelling. The Commission

also aims to promote consumer information in this area and hence contribute to changing consumption patterns.

The Council Resolution on the Community Strategy for Waste Management clearly supports giving highest priority to waste prevention and devoting greater efforts to this area.

Prevention of packaging waste formally has the highest priority in the *Packaging Directive***.** The Directive lays down a number of "essential requirements" relating to the production and composition of packaging, including the fact that packaging volume and weight must be reduced to the essential minimum. The aim is for these requirements to be clarified in harmonised European standards prepared by CEN. In 2001, the Commission published a standard on prevention.

The *Sixth Environmental Action Programme for the European Community* contains goals and priority areas for initiatives for the sustainable use and management of natural resources and waste. One goal is to achieve a significant general reduction in volumes of waste through waste preventive initiatives, better resource utilisation and a change to more sustainable production and consumption patterns.

It is therefore a high priority to prepare a thematic EU strategy for the sustainable use and management of resources. This strategy will contain analyses of material flows, and goals for resource efficiency and reduced resource consumption, development of technology and the use of market-based and economic instruments.

Waste prevention initiatives will also be developed and implemented, including the development of quantitative and qualitative goals for the reduction of all relevant waste types in 2010. According to the programme, the Commission is also going to prepare a strategy for waste recycling.

At the UN Summit on Sustainable Development in Johannesburg in 2002, a decision was made to develop a 10-year framework for programmes to support national and regional initiatives for sustainable production and consumption. Efforts should be made within the EU to link this 10-year framework to the EU strategy for the sustainable use and management of resources.

B.5.2 Waste prevention in other countries – Norway, Sweden, the Netherlands and Austria

A number of countries have set specific goals for waste prevention:

In 1999, *Norway* set a goal to the effect that developments in the generated volume of waste must be significantly lower than in economic growth. This goal is to be achieved through a number of different measures:

- appointment of a committee made up of central players from trade and industry, consumers and environmental organisations to give advice on waste reduction

- evaluation of increases and changes to the formulation of the tax on final treatment of waste
- evaluation of the introduction of a material tax
- further encouragement and guidance to municipalities regarding greater differentiation in waste collection charges, and evaluation of the need for legislative requirements for differentiation
- evaluation of whether environmental considerations can be better incorporated into purchasing regulations
- grants to projects for environmentally friendly product design and an environmental beacon scheme.

The Committee for Waste Reduction submitted a public report[12] to the Norwegian Ministry of the Environment on 7 November 2002. The figure below summarises the report's proposals for measures and initiatives and the connections between them.

<table>
<tr><td colspan="4">Strategies and general instruments:
? Political challenge: Increase quality of life with reduced resource consumption
? Break the consumption spiral through changed preferences
? Focus on broad alliances
? Greater cost-effectiveness
? Research and development – goals, methods and implementation</td></tr>
<tr><td colspan="4">New body – skill development, coordination, financing and alliances:</td></tr>
<tr><td colspan="3">Three preventive programmes throughout the value chain (with examples of content):</td><td></td></tr>
<tr><td>Production:
? Eco-management
? Production initiatives
? Production improvements
? Manufacturer responsibility</td><td>Sale of goods:
? Eco-management
? Cost-effectiveness
? Second-hand goods
? Better repair services</td><td>Consumer:
? Attitudes and behaviour
? www.bruktmarkedet.no
? Yearly cost labelling
? Product tests</td><td>Post-use phase:
? Landfill tax
? Landfill prohibition
? Good collection
? Manufacturer responsibility</td></tr>
<tr><td></td><td colspan="2">Professional purchasing:
? Better training options
? Purchasing policy with environmental focus
? Disseminate tools for environmentally effective purchasing
? Internet database for used equipment</td><td></td></tr>
<tr><td colspan="4">Increased material and energy recycling</td></tr>
<tr><td colspan="4">+ product-oriented initiatives for: Building materials, electrical and electronic equipment, packaging, stationery, transport methods, food and textiles</td></tr>
</table>

The report also states five primary points for achieving waste prevention and recovery:

"To achieve long-term waste prevention, the supply of materials from nature to the technosphere must be reduced. This can be realised by:

[12] Norway's Public Reports, NOU 2002: 19 "Avfallsforebygging, en visjon om livskvalitet, forbrukerbevissthet og kretsløpstenkning" http://odin.dep.no/md/norsk/publ/utredninger/nou/022001-020007/index-dok000-b-n-a.html

1. changing behaviour and demand preferences (reduce consumption of resource-intensive products)
2. changing production and product design for goods and services (use recovered materials, increase product life times, design for recovery)
3. satisfying different functions using less materials (dematerialisation, increased intensity of use)
4. developing a recycling society by refining and establishing effective collection and recovery systems (waste as a raw material)

Waste prevention also involves:

5. reducing levels of hazardous substances in products (e.g. substances that are dangerous to health or ecotoxic)

The first point requires changes to the basic forces in our economy through a permanent change in the preferences of the population. The other points are more organisational or technical in nature."

Sweden has set the long-term goal of reducing the volume of waste for landfill (excluding mining waste) by 50-70 per cent between 1994 and 2005. In "Sweden's environmental goals – the responsibility of our generation" from 1999, waste prevention is discussed under the goal of a well-developed environment. The report states that the total volume of waste and the hazard from waste must be reduced. No actual quantitative targets have been set.

In the Swedish strategy for waste management[13] the following guidelines have been established for more efficient and sustainable resource usage:

- Materials and energy must be used as efficiently as possible, taking into account all resource supplies.
- The use of fossil fuels should be kept at a low level. The total consumption of biomass must not impoverish biodiversity.
- The majority of goods must be material-saving and energy efficient, upgradeable, and re-usable or recyclable in terms of material and energy.

The strategy does not contain more precise measures to achieve resource efficiency, apart from mentioning producer responsibility as an important factor, and the recycling of resources in waste is emphasised.

In 1988, *the Netherlands* prepared a "Memorandum for waste", setting goals for 29 high-priority flows of waste. These goals aim to reduce the hazardousness and volume of waste by 5 per cent in 2000 compared to levels in 1986. Quantitative goals for absolute waste prevention were subsequently set in the first two Dutch national environment policy plans, NEPP and NEPP2. However, in the latest plan, NEPP3 from 1998, no quantitative goals have been set for waste prevention.

In 2002, the Dutch Ministry of the Environment submitted a draft national waste management plan[14] for public hearing. This plan focuses on prevention and limiting the environmental impact from waste by reducing the volume of

[13] The Swedish Government report 1998/99:63 "En nationell strategi för avfallshanteringen" of 4 March 1999
[14] Ministry of Housing, Planning and the Environment: Draft National Waste Management Plan, the Netherlands 2002-2012, 11 January 2002, Public enquiry version

waste landfilled and incinerated. The goals in the national waste management plan directed towards prevention are as follows:

- To promote waste prevention and hence intensify the relative decoupling between growth in GNP and the increase in total volumes of waste achieved between 1985-2000. Prevention must be directed particularly towards consumers, and trade, service and the authorities.
- To create innovation in the area of prevention and waste management and promote market forces

The goal is to limit growth in volumes of waste to a total of 16 per cent for the period 2000-2012. This needs to be seen in the context of expected economic growth over the same 12-year period of 38 per cent. To achieve this goal, the existing waste prevention policy needs to be maintained, and supplemented and intensified for a number of specific waste types. Initiatives need to be targeted towards large flows of waste with potential for prevention – especially industrial waste – and towards flows of waste with a high landfill or incineration rate – especially residual waste from households, and trade, service and the authorities. A number of measures for achieving these goals are mentioned:

- Incorporate prevention in the procedures for environmental permits
- Information activities in sector associations and authorities
- Cleaner technology programmes targeting small and medium-sized enterprises
- Subsidy schemes
- Incentives to develop sustainable industrial parks
- Tools for municipal approval and inspection work, including in the area of waste prevention
- Initiate a program for sustainable consumption targeting individual residents

Austria issued a national waste management plan in June 2001. The plan contains measures for more efficient waste prevention and recovery, primarily aimed at the production sector. The following solutions are proposed:

- Close material cycles
- Substitute raw and process materials
- Monitor material flows for relevant, especially hazardous, substances and substitute for contaminants
- Restructure to technologies that produce less waste

The plan identifies the following measures that can be employed:

- Implementation of economic policy instruments such as environmental taxes, environmental certificates, compulsory take-back and deposit and return systems, provisions on return rates and subsidies, and restructuring of the tax system giving greater consideration to the environment (especially in the areas of resources, energy and transport).
- Compulsory schemes implemented via regulations that define and implement minimum standards for, for example, production and recovery facilities, product requirements and emission limits.

- Voluntary or compulsory measures for making enterprise waste management more visible, leading to greater investment in waste prevention and recovery for economic reasons (e.g. sector specific concepts, establishment of interest groups involving several enterprises, waste administration staff, environmental taxes, eco-labelling and EMAS regulation).
- Internal inspection measures that can often serve as a driving force for the introduction of waste prevention and recovery. This can be seen as a self-regulating economic mechanism due to increasing landfilling costs, consumer expectations and pressure from the public sector.
- Public subsidy programmes supporting environmental protection can be extended to promote prevention and recovery of non-hazardous waste and utilisation of the energy content in waste.

The Austrian Ministry for Life has appointed work groups with representatives from the financial, scientific and administrative sectors to describe and quantify the potential for waste prevention and recovery of waste from various industrial sectors in Austria.

Appendix C

Capacity

C.1. Capacity - incineration plants

C 1.1 Volumes of waste, capacity and catchment areas

In 2001, approx. 2.9 million tonnes of waste were treated at Danish incineration plants. A further approx. 300,000 tonnes of municipal sewage sludge were incinerated at specific sludge incineration plants.

A ban on landfilling waste suitable for incineration was introduced on 1 January 1997. Increases in volumes of waste and delays in the conversion to co-generation (combined power and heating generation), led to a capacity shortfall in the years immediately after 1997. Over the last few years incineration capacity has been expanded so that by 2001, this capacity was basically in balance with the volumes of waste. While there is balance at national level, there are wide regional variations. For example, there is overcapacity in Eastern Denmark, but only just adequate capacity in other regions.

As of 1 January 2003, there were a total of 32 waste incineration plants in Denmark, including a newly opened plant in Esbjerg. Since 1991, six old incineration plants have been phased out, and the oldest incineration plant in operation today was built in 1969.

At the end of 1999, the total number of oven lines was 68, divided into 32 co-generation (CHP) and 36 hot water generating (HW) oven lines. The policy has been to ensure maximum energy utilisation and to shift as much waste as possible to CHP plants. In 1999, plant incineration capacity varied between 12,000 and 500,000 tonnes annually. Of the total volume of waste incinerated, 64 per cent was treated at CHP plants and 36 per cent at HW plants.

In 2001, waste contributed approx. 32 million GJ to the energy supply in Denmark. In the same year, approx. 130 million GJ of energy was used to produce electricity in Denmark, with approx. 3.5 per cent of this energy deriving from waste. Approx. 128 million GJ was used to generate district heating, with approx. 22 per cent deriving from waste. Thus approx. 86 per cent of the energy content in waste in Denmark was converted into district heating, while the remaining 14 per cent was converted into electricity.

Aim: regional balance

A number of waste regions have been defined in this plan. A waste region is a well-defined geographical area within which co-operation on exploitation of incineration capacity etc. is logical and expedient. The basis for the division into regions is the Danish Environmental Protection Agency Briefing no. 11, 2001 – Waste Incineration 2004 and 2008, volumes and capacities. In this briefing, Denmark is divided into 5 regions: Zealand, Bornholm, Funen, Mid and Southern Jutland and Northern Jutland.

Danish waste management policy aims at ensuring sufficient capacity within each waste region to treat the volume of waste suitable for incineration generated in the region. This policy maintains the principle of self-sufficiency

within each waste region and the principle that waste suitable for incineration should, as far as possible, be treated at nearby incineration plants.

Incineration capacity and volumes of waste in Denmark for 1999 and 2008[1] are shown below.

The figures for 1999 reflect the actual volume of waste suitable for incineration supplied to waste incineration plants in Denmark. The volume of waste suitable for incineration that was stored temporarily during this period has not been included. The volume of waste suitable for incineration in 2008 is a projection of data reported to ISAG (the Danish Information System for Waste and Recycling) combined with waste projections from the RISØ model, which are based on the economic development in the ADAM model.

The table below compares the national volume of waste with the total incineration capacity in 1999.

All of Denmark				
A total of 33 waste catchment areas				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	1783	915	2698	2770
2008	2733	541	3274	2889

From the table it can be seen that there was basically a balance between the incineration capacity and the volume of waste for incineration in 1999. The forecast up until 2008 is for a significant increase in incineration capacity and a more modest increase in the volume of waste, such that in 2008 there will be adequate incineration capacity in all regions. The tables below describe the situation in the five regions in 1999.

Regions

Waste region: Zealand				
Nine waste catchment areas: Amager incineration, West incineration, North incineration, VEGA, KARA, KAVO, FASAN, REFA, Noveren				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	690	573	1263	1267
2008	1325	234	1559	1267

For Zealand, expansions have been planned and approved that will lead to a surplus in incineration capacity in 2008.

[1] Figures for volumes of waste in 2008 are forecasts based on Briefing no. 11, 2002 from the Danish Environmental Protection Agency: Waste Incineration 2004 and 2008, Volumes and Capacities.

Waste region: Bornholm				
One waste catchment area: Bofa				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	0	20	20	23
2008	0	20	20	24

As can be seen above, there is a slight shortage of incineration capacity on Bornholm. However, there are currently no plans to extend capacity.

Waste region: Funen				
Three waste catchment areas: Svendborg, Odense (the Funen plant), West Funen				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	157	45	202	194
2008	292	26	318	224

According to the table, it appears there is already surplus capacity on Funen. However, a long-term agreement has been made regarding the delivery of 48,500 tonnes of waste annually to the Funen plant from KAVO/Noveren on Zealand.

Waste region: Northern Jutland				
Seven waste catchment areas: Thisted, Aars, Hadsund, Reno North, AVV, Frederikshavn, Skagen				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	277	115	392	368
2008	278	97	375	385

There was a slight capacity surplus in Northern Jutland in 1999. Expansion to the capacity at Reno North is planned during the period, so there is also expected to be adequate incineration capacity in 2008.

Waste region: Mid and Southern Jutland				
13 waste catchment areas: the Måbjerg plant, the Kundsmose plant, Reno South, Hammel District Heating, Århus North, Grenå, I/S Fællesforbrænding, Haderslev CHP plant, Sønderborg CHP plant, Vejen CHP plant, Kolding waste heating plant, Horsens CHP plant, Esbjerg incineration				
'000 tonnes	CHP capacity	Hot water capacity	Total capacity	Volume of waste for incineration
1999	659	162	821	918
2008	838	164	1002	989

There was a shortage of capacity in Mid and Southern Jutland in 1999. A significant quantity of waste from this region has therefore been stored. In 2003, a new incineration plant is expected to commence operations in Esbjerg, and from this point on there is expected to be adequate incineration capacity in the region.

Calorific value
The calorific value of incineration waste fell from 10.7 GJ/tonne in 1996, to 10.5 GJ/tonne in 1999. The calorific value of waste is closely linked to the separation of fractions such as paper and cardboard and organic domestic waste. Separating out various fractions leads to various effects on the calorific value of the remaining waste. Separation of organic domestic waste would, for example, lead to an increase in the calorific value, whereas increased separation of paper, cardboard and plastic would lead to a reduction.

Meat-and-bone meal
The more stringent regulations governing the use of meat-and-bone meal have meant that an increased volume of abattoir waste, previously used for animal feed, must now be incinerated. The annual volume of meat-and-bone meal incinerated is estimated to be approx. 150-180,000 tonnes. This fraction has a typical calorific value of 16 GJ/tonne, making this volume equivalent to 230-275,000 tonnes of normal waste suitable for incineration (with a calorific value of 10.5 GJ/tonne).

As far as possible, waste suitable for incineration is treated at the closest waste incineration plant

In Denmark, waste suitable for incineration is generally incinerated within the regions described above, although waste suitable for incineration is sometimes transported between the individual waste regions.

Analysis of efficiency at Danish waste incineration plants

Modest potential to improve efficiency at Danish waste incineration plants

The Ministry of Finance's Environmental Assessment of the Finance Bill for 2000 stated that: "increased efficiency, for example through outsourcing and benchmarking within the waste sector, would make it possible to achieve the same environmental quality at lower cost". The Danish Environmental Protection Agency therefore decided to carry out benchmarking of incineration and landfill plants in Denmark. The analysis, completed in early 2002, showed that there is a potential to realise savings of DKK 135-155 million in the area of incineration in 2000, equivalent to 8-10 per cent of total expenses. This represents a relatively modest potential.

C 1.2 Capacity utilisation

In 1999, capacity was maximally utilised

In 1999, a total of approx. 2.7 million tonnes of waste were supplied to waste incineration plants, corresponding to a capacity utilisation of 100 per cent.

Temporary storage
In recent years where there has been a capacity shortfall, waste suitable for incineration has been stored temporarily, waiting to be incinerated when the necessary capacity became available. At the end of 1999, 635,000 tonnes of waste suitable for incineration was in storage. The majority of this waste is stored on Zealand, where there is now adequate capacity for the waste to be delivered for incineration. Waste suitable for incineration is still being stored in the catchment area surrounding the new incineration plant in Esbjerg, as the new plant will only be commissioned in mid-2003. The accumulated stores will then be gradually reduced. Overall, the stores of waste suitable for incineration are expected to be consumed before the end of 2010.

C 1.3 Objectives and future initiatives

Objectives

- *incineration capacity adapted to actual needs.*
- *optimum energy utilisation, largest possible CO_2 mitigation*
- *regional self-sufficiency in terms of incineration capacity.*

The total volume of waste to be incinerated in 2008 is expected to be greater than the present volume. Some of the planned initiatives for increased recycling will shift waste away from incineration, but other factors will have the opposite effect. The ban on landfilling of waste suitable for incineration has shifted large volumes of waste from landfilling to incineration. However, it is believed that the planned expansions will provide sufficient capacity to meet incineration requirements in 2008.

The aim is to adapt capacity to meet actual needs and locate capacity in a way that allows for the best possible energy utilisation and largest possible CO_2 mitigation, while also taking into account the principle of regional self-sufficiency in terms of incineration capacity.

Much incineration capacity is currently based purely on hot water generation. It is estimated that after 2004, it will continue to be necessary to utilise the capacity of several of these ovens. However, these ovens are being gradually phased out as new ovens are being built, and in 2008, approx. 95 per cent of waste for incineration is expected to be processed in CHP ovens.

C 1.4 Regulation

Under the terms of the Statutory Order on Waste[2], municipalities are required to ensure that waste suitable for incineration which is not recycled is assigned to incineration at approved incineration plants, and that sufficient incineration capacity is available for waste suitable for incineration.

However, municipalities have the option to permit temporary storage of waste suitable for incineration at landfill sites for less than one year. If the waste is to be stored for a longer period, permission from the Danish Environmental Protection Agency is required.

New waste incineration plants are approved today under Part 5 of the Danish Environmental Protection Act. Prior to approval, regional authorities must carry out an EIA (Environmental Impact Assessment)[3]. Authorities must also respect the terms of the Electricity Supply Act[4] and the Heating Supply Act[5] in their approval.

EU directive on waste incineration is expected to lead to stricter environmental requirements

The new EU Directive on waste incineration places more stringent environmental requirements on Danish incineration plants in terms of dioxin and NO_x emissions. The Directive has been implemented in a new Statutory Order on waste incineration.

Incineration plants planned in recent years have been designed to meet the future requirements. This year, two thirds of Danish waste is being

[2] The Ministry of the Environment and Energy's Statutory Order no. 619 of 27 June 2000.
[3] Under Statutory Order no. 849 of 30 September 1994 on assessment of the effects of certain public and private projects on the environment.
[4] The Electricity Supply Act, Consolidated Act no. 767 of 28 August 2001 on electricity supply legislation, as most recently amended by Act no. 1091 of 17 December 2002.
[5] The Heating Supply Act, Consolidated Act no. 772 of 24 July 2000 on heating supply legislation, as most recently amended by Act no. 316 of 22 May 2002.

incinerated at plants that are capable of complying with the new lower limit value, and by the end of 2004 this will have increased to 90 per cent.

In 2002, the Government appointed a work group consisting of a number of players from the area of waste management. This work group has been charged with examining whether waste management can be organised more efficiently. The work of the work group is described in detail in Chapter 1, but involves achieving the potential efficiency improvements that were shown to exist for incineration plants. To this end, a project has been initiated to identify the advantages and disadvantages associated with varying degrees of deregulation in the area of incineration and landfill. The project was initiated at the beginning of 2003 and is expected to be completed mid-2004.

In 2002, the Government published a discussion paper on deregulation of the energy markets, including the electricity, heating and gas sector. This discussion paper discusses the Government's long-term goals of promoting deregulation and competition, and reducing the costs of energy supply.

In July 2002, the Danish Energy Authority submitted a draft Statutory Order on price ceilings for services from waste incineration plants for public hearing. The hearing responses showed that further work is needed on the price ceiling model. This work is expected to be carried out in 2003, after which the final model will be submitted for public hearing.

C 1.5 Implications for national authorities

Developments in the volumes of non-recyclable waste suitable for incineration will be monitored nationally and regionally with the aim of ensuring sufficient incineration capacity.

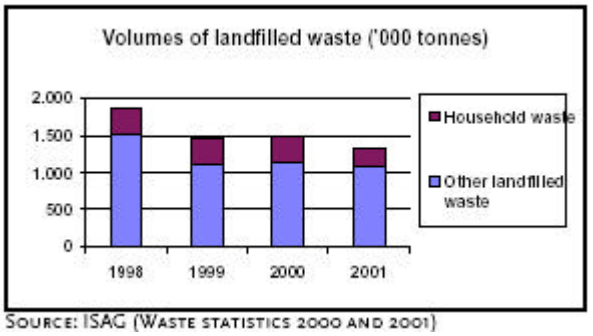
C 1.6 Implications for municipalities

Municipalities are required to account for the volume of waste incinerated in relation to the available capacity in their municipal waste management plans. In this context, municipalities must indicate how they plan to reduce the volume of waste suitable for incineration in temporary storage, and any need for additional incineration capacity.

C.2. Landfill capacity

C 2.1 Volumes of waste going to landfill sites

In 2001, 1.3 million tonnes of waste were landfilled in Denmark. As the figure below indicates, there has been a significant reduction of more than 0.5 million tonnes in the total annual volume of landfilled waste from 1998 to 2001. The figure also indicates that the reduction in the total volume of landfilled waste from 2000 to 2001 is primarily due to a fall in the volumes of landfilled household waste.



SOURCE: ISAG (WASTE STATISTICS 2000 AND 2001)

In contrast to the situation in the 1994-1997 plan period, the volume of landfilled slag and fly ash from coal-fired power plants has largely been eliminated. In 1994, approx. 600,000 tonnes of slag and fly ash from coal-fired power plants were landfilled, whereas only approx. 10,000 tonnes were landfilled in 2001. This reduction is due to the limitation of coal-based energy production (cf. the objective in Energy 21) and the fact that it has been possible to recycle almost all the slag and fly ash generated from coal-fired power plants.

C 2.2 Regional planning

Based on information supplied by municipalities (who are responsible for actual waste planning), regional authorities must ensure their regional plans set aside areas for the necessary landfill and waste incineration capacity throughout the entire planning period. Any export or import of waste must also be taken into consideration.

To ensure a balance between the expected volumes of waste and existing and/or planned capacity, regional plans must provide an overall statement of

waste treatment capacity and possible locations for waste treatment plants being considered. The revision of the regional plan in 2001 showed that there was generally sufficient landfill capacity for the four-year plan period.

When locations need to be chosen for new waste treatment plants, a number of criteria must be considered. These criteria are:

Guidelines from the Ministry of the Environment and Energy on coastal landfills, memorandum of 27 December 1991, and Ministry of the Environment and Energy Statutory Order no. 921 of 8 October 1996 on quality standards for the aquatic environment and requirements for discharge of certain dangerous substances into inland waters or the marine environment[6]. This Statutory Order bans location of landfills in areas where discharges of leachate may cause pollution of inland waters and the marine environment. Landfills should not be located near sensitive aquatic environments.

When planning large building and construction works, consideration should also be given to utilising inorganic residues. Many construction works are currently planned and carried out without giving consideration to utilising such residues, leading to a loss of resources and an increased need for landfill sites.

Any changes in regional planning have to be incorporated in a subsequent regional plan supplement.

In general, landfills are covered by regulations on EIA in the Planning Act (assessment of the effect of certain public and private projects on the environment). This is always the case for landfilling of hazardous waste.

C 2.3 Future capacity at Danish landfills

Temporary storage of waste suitable for incineration.

Waste volume projections need to be carefully reviewed to ensure that sufficient landfill capacity is available. It is also necessary to ensure sufficient space is available for temporary storage of waste suitable for incineration. However, the need to store temporarily waste suitable for incineration is expected to be relatively small in the future, and the waste currently in temporary storage is expected to be eliminated by the end of 2010.

The volume of *residues from waste incineration* (slag and flue gas cleaning products) is expected to increase slightly. In a letter of 24 August 1998 from the Ministry of Environment and Energy, three municipalities and their counties have been directed to keep relevant sites available for the establishment of landfills for flue gas waste. Flue gas cleaning products are currently exported to either Norway or Sweden for landfill.

The volume of *bioash* (from straw and wood chips) is rising, but most of this can be recycled for agricultural purposes in accordance with the Statutory

[6] Implements EU Directive 74/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.

Order on Bioash[7]. However, some special fly ash will be landfilled due to high levels of cadmium.

Conclusion

Up until 2008, there is sufficient landfill capacity at national level, but there are large regional differences – due in part to the availability of suitable sites for landfills. In addition, experience has shown that planning should be carried out with a 12-year horizon. The current trend is for capacity considerations to be restricted to a four-year period.

[7] Statutory Order no. 39 of 20 January 2000 on the use of ash from the gasification and incineration of biomass and biomass waste for agricultural purposes.

C.3. Capacity - hazardous waste

C 3.1 Status

Hazardous waste covers waste from both primary and secondary sources (e.g. residues from waste incineration plants). In 2001, 288,154 tonnes of hazardous waste were generated from primary sources (approx. 2 per cent of the total volume of waste) and 86,149 tonnes from secondary sources. Waste from secondary sources is not counted in total waste production, as otherwise these volumes would be counted twice.

An overview of the most significant hazardous waste fractions and their treatment is given in Table C 3.1, below.

Table C.3.1. Overview of the most significant sources of hazardous waste, divided by form of treatment

Hazardous waste 2001 (tonnes) (Most significant sources)	Recycling	Incineration	Special treatment	Landfilling	Total
Primary sources					
- Lead batteries	16,942				16,942
- Organic and inorganic compounds	4,174	43,454	10,359	3,697	61,684
- Oil waste	18,6794 2,347	27,797	1,005	168	47,649
- Shredder waste				92,101	92,101
- Dust-emitting asbestos				9,336	9,336
- Hospital waste		2,712	2,393		5,105
- Other hazardous waste	31,995	13,179	1,405	1,678	48,257
	71,790	**87,142**	**15,162**	**106,980**	**281,074**
- as a percentage of the total volume of primary waste	25%	30%	5%	37%	97%
Secondary sources					
- Flue gas waste	12,324				12,324
- Fly ash and flue gas cleaning products from waste incineration plants	0	0	0	73,825	73,825
Total secondary sources	**12,324**			**73,825**	**86,149**

Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003

Of the total volume of hazardous waste from primary sources:
25 per cent is recycled:

- lead accumulators and Ni-Cd batteries are collected and sent for reprocessing in Sweden or France.
- oil waste is reprocessed at Dansk Oliegenbrug.

32 per cent is incinerated:

- waste oil is disposed of at district heating plants and at Kommunekemi A/S.

- health-care risk waste is treated at SWS (Special Waste System in Nørre Alslev) and at conventional waste incineration plants.

6 per cent receives special treatment:
- organic halogen-free compounds are treated at Kommunekemi and BOFA.

37 per cent is landfilled:
- asbestos and contaminated soil is deposited at special landfills.
- shredder waste is landfilled at 4 landfill sites in Denmark.

Cars that have not had liquids or other hazardous components removed are classified as hazardous waste. The Statutory Order on end-of-life vehicles lays down regulations for the waste treatment of end-of-life motor vehicles and derived waste fractions. End-of-life passenger and commercial vehicles must be delivered to registered enterprises that have established a certified environment or quality management system. Other types of end-of-life vehicles must be delivered to approved scrapping enterprises.

There are approx. 210 registered enterprises that can treat vehicles in accordance with the regulations in the Statutory Order on end-of-life vehicles. There is an additional small number of scrapping enterprises that scrap other types of vehicles and end-of-life vehicles that have been treated at a registered scrapping enterprise. There are a further six shredder enterprises where vehicle waste is shredded and sorted.

Batteries

The collection of batteries is regulated under the Statutory Order on Waste[8]. Nickel-cadmium batteries, lead accumulators and unsorted batteries are classified as hazardous waste, whereas pure fractions, for example made up of batteries that do not contain heavy metals, are generally not considered as hazardous waste.

The collection of *lead accumulators* is covered by an agreement between the Minister for the Environment and the battery industry (Returbat), under which Returbat is responsible for collecting all spent lead accumulators in Denmark. There are approx. 80 collection agencies registered under the Returbat agreement. In 2001, approx. 16,900 tonnes of lead accumulators were collected.

The Environmental Protection Agency manages a collection scheme for *nickel-cadmium batteries*. In connection with the scheme, a Statutory Order[9] has been issued, stipulating the criteria collectors of spent nickel-cadmium batteries must meet in order to be registered as professional collectors. Approx. 20 collectors of nickel-cadmium batteries are registered under the scheme. The batteries are sent for reprocessing either in Sweden or France. In 2001, approx. 91 tonnes of nickel-cadmium batteries were collected.

[8] The Ministry of the Environment and Energy's Statutory Order no. 619 of 27 June 2000 on waste.
[9] The Ministry of the Environment and Energy's Statutory Order no. 1062 of 4 December 2000

Electrical and electronic equipment

The collection and reprocessing of electrical and electronic products is currently regulated by Statutory Order no. 1067 of 22 December 1998 on the management of waste from electrical and electronic products.

In 2001, 21,200 tonnes of electronic scrap was collected and specially treated. Of the total volume of electrical and electronic equipment, it is estimated that a further 10,000-20,000 tonnes will be collected and treated separately.

Approx. 20 disassembly enterprises exist today.

Current capacity is approx. 90,000 tonnes annually, and no capacity problems are expected in the future.

A number of enterprises have emerged that pre-treat hazardous waste, for example, by separating non-hazardous fractions from hazardous waste (e.g. oil filters, paint drums, and water in waste oil). The hazardous fractions are mainly delivered to Kommunekemi A/S, or to district heating plants (waste oil). The non-hazardous fractions are delivered to incineration or recycling.

For a few waste fractions (silver from the photographic industry and organic solvents) recycling enterprises exist (that recover silver or coolants, etc.), but in general, very few treatment methods have been developed for the recovery or recycling of hazardous waste fractions.

Secondary sources

Some residues from waste incineration plants are hazardous waste.
These are the filter dust from flue gas cleaning, fly ash and flue gas cleaning products from the waste incineration. An overview of the volumes and forms of treatment is given in Table C 3.1.

Fly ash from waste incineration constitutes approx. 18 per cent of the total volume of primary and secondary hazardous waste. Some of these residues are currently sent abroad for landfilling.

Flue gas waste will be exported and landfilled until a permanent solution has been established.

C 3.2 Future initiatives

At present, there is no basis for foreseeing any need to expand capacity for treatment of hazardous waste.

Requirements for recycling of residues from waste incineration plants will be adjusted so that groundwater resources are protected.

In 2003, the Danish Environmental Protection Agency will prepare an action plan for the future management of flue gas cleaning products in cooperation with waste incineration plants. The action plan will contain deadlines for when each problem with flue gas cleaning products has to be solved.

Once environmentally responsible reprocessing methods have been established, specific rules will be laid down for the management of flue gas cleaning products from waste incineration plants.

C 3.3 Regulation

Hazardous waste is regulated by the Statutory Order on Waste[10]. Municipal council collection schemes for hazardous waste must be used unless the waste producer can demonstrate that the hazardous waste will be managed in an environmentally responsible manner.

C 3.4 Environmental assessment

Improved collection and classification of hazardous waste will ensure environmentally appropriate management of waste.

C 3.5 Implications for the national authorities

None.

C 3.6 Implications for municipal authorities

None.

[10] Statutory Order no. 619 of 29 June 2000 on waste.

Sectors

D.1. Waste incineration plants

Environmental problem	Content of heavy metals in residues can limit recycling options Flue gas cleaning waste from waste incineration plants accounts for large volumes of hazardous waste
Initiatives	Investigate whether earlier initiatives have had a positive effect on the content of heavy metals in slag Investigate whether separation requirements should be introduced for fractions that can by recycled or that lead to environmental problems during incineration New requirements for the recycling of slag in building and construction projects On the basis of an environmental and cost-benefit analysis, an action plan will be prepared for the future management of flue gas cleaning products generated in Denmark Investigate the possibility of recovering phosphor from slag from incinerated meat-and-bone meal

D 1.1 Status

Aims for 2008

- *reduce the volume of incinerated waste*
- *recycle 70 per cent of slag from waste incineration plants*
- *a Danish solution for the management of flue gas cleaning products*

Waste incineration plants treat waste, but also generate waste.

1. In January 2003, there were a total of 32 waste incineration plants operating in Denmark, including a newly opened plant in Esbjerg. See Appendix C regarding capacity at incineration plants.

In 2001, approx. 2.9 million tonnes of waste and approx. 300,000 tonnes of sludge were incinerated.

Residues from waste incineration plants consist of slag and flue gas cleaning waste, accounting for 20 per cent and 3 per cent, respectively, of the waste amounts treated.

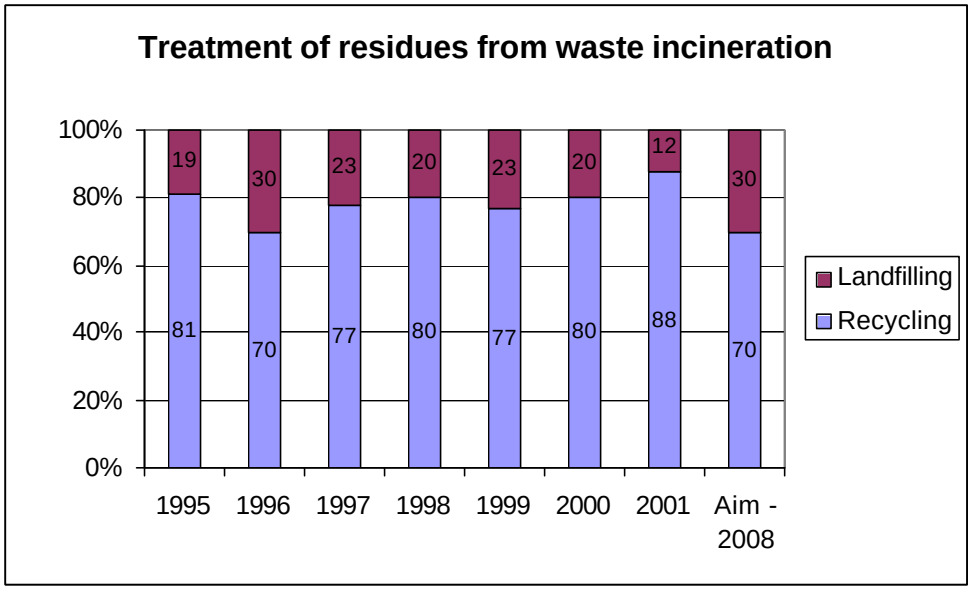
Slag is separated, and 70-80 per cent is recycled. The remaining part is landfilled, primarily due to poor quality (heavy metal content too high).

The composition of the incinerated waste has a significant impact on the volume and quality of residues. As a result of Waste 21, requirements have been introduced stipulating that a number of waste fractions containing environmental contaminants must, as far as possible, be prevented from reaching waste incineration plants. Examples of these fractions include impregnated wood, electronic equipment, and PVC.

The volume of waste incinerated is shown in the table below.

'000 tonnes	1995	1996	1997	1998	1999	2000	2001
Volume of waste incinerated	2,306	2,507	2,622	2,740	2,929	3,064	3,221

Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

D 1.3 Future initiatives

Measures

- *documentation for the effectiveness of Waste 21 initiatives*
- *investigate the possibility of separating recyclable fractions or fractions leading to environmental problems*
- *requirements for management of residues*
- *action plan for the future management of flue gas cleaning*

An investigation will be made into whether the content of heavy metals in slag has been reduced as a result of the initiatives in Waste 21.

Investigation will also be made into whether separation requirements should be introduced for fractions that can by recycled or that lead to environmental problems during incineration This could lead to a reduction in the volume of waste incinerated.

The Statutory Order on recycling of residues and soil for building and construction purposes is to be revised. In the longer term, this Order will also cover the regulation of fractions containing organic contaminants.

On the basis of an environmental and cost-benefit assessment, an action plan will be prepared for the future management of flue gas cleaning products. The plan will be prepared in cooperation with waste incineration plants. The action plan will contain deadlines for when each problem with flue gas cleaning products has to be solved. The plan will also cover the establishment of environmentally responsible reprocessing methods, leading to the recycling of flue gas cleaning products. The proximity principle will apply to all landfilling of flue gas cleaning products, wherever this is environmentally and economically justifiable.

D. 1.2 Regulation

According to the Statutory Order on waste, municipalities must assign waste suitable for incineration - which is not recyclable - to incineration at a plant with energy recovery. Certain types of waste are defined as waste not suitable for incineration, as incineration may lead to environmental problems. Examples of such waste include oil-contaminated soil, PVC waste, electronic equipment, impregnated wood and waste containing heavy metals.

The recycling of slag is currently regulated under the Statutory Order on recycling residues and soil for building and construction purposes.

Flue gas cleaning waste is hazardous waste with a high leaching rate of environmental contaminants.

D 1.4 Environmental assessment

Keeping environmentally harmful fractions away from waste incineration plants would lead to a reduction in the heavy metals being added to slag or the flue gas cleaning product.

Keeping recyclable waste fractions away from waste incineration plants would lead to a reduction in the volumes of slag and flue gas cleaning products produced.

D 1.5 Implications for national authorities

Adjustments to the Statutory Order on Waste if it is practicable to separate out recyclable fractions or fractions that lead to environmental problems during incineration. However, this will only have significance for the 2009-2012 plan period.

The national authorities will revise the Statutory Order on recycling residues and soil for building and construction purposes to also cover fractions contaminated with organic fractions.

The national authorities will be responsible for preparing an action plan for the future treatment of flue gas cleaning products from waste incineration plants.

D. 1.6 Implications for municipal authorities

If there is a need to keep other waste fractions away from waste incineration plants, municipalities must make allowances for this in their future waste planning. However, this will only have significance for the 2009-2012 plan period.

D.2. Building and construction

Environmental problem	Construction and demolition waste accounts for 28 per cent of the total volume of waste and would take up excessive landfill capacity if not recycled
Initiatives	Prepare a guide for waste prevention during renovation Analyse the level of contaminants in building and construction waste Analyse the procedure for recycling building and construction waste Enhance the foundation for the separation of hazardous waste fractions in construction waste Adjust the foundation for recycling building and construction waste Adjust the foundation for recycling residues, slag and soil in building and construction projects Make specific proposals for a complete set of indicators for individual building projects and suggest principles for a benchmarking system to assess environmental initiatives Prepare an overview of where environmental considerations should be incorporated into the existing legal and regulatory base Develop a tool for assessing and prioritising the use of chemicals in construction Assess whether environmental and health impacts arise in connection with the use, renovation or demolition of buildings containing PCB Ensure that asphalt, concrete and tiles are recycled in a manner that gives due consideration to the environment and health Ensure that electrical and electronic equipment is managed in accordance with the EU Directive Investigate whether the recycling rate for mineral wool can be increased Increase the rate of recycling for wooden packaging Prepare a strategy for hazardous waste Increase the rate of recycling for transport packaging and certain retail packaging from trade and industry

	Implement regulations on separate treatment of pre-insulated district heating pipes Ensure that the treatment of waste from building and construction is organised in a cost-effective and environmentally responsible manner

D 2.1 Status

Aims for 2008

- *90 per cent recycling of building and construction waste*
- *ensure that recycling of building and construction waste gives maximum consideration to groundwater resources*
- *ensure that recycling of residues in the building and construction sector gives maximum consideration to groundwater resources*
- *develop indicators that make it possible to evaluate environmental initiatives in construction*

Construction and demolition waste consists primarily of concrete, asphalt, stone, and other construction and demolition waste. In 2001, 3.4 million tonnes of such waste were produced. The volume of construction and demolition waste has been increasing in recent years.

The high rate of recycling for construction and demolition waste will be maintained, as recycling this waste saves resources. It is important that recycling gives maximum consideration to groundwater resources.

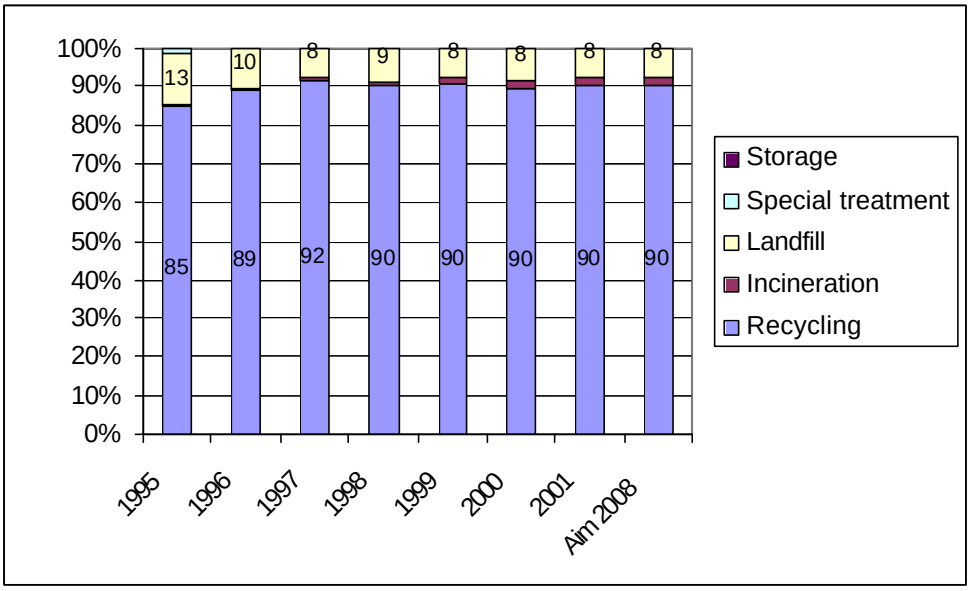
In 2001, 90 per cent of building and construction waste was recycled. Eight per cent of the total volume was landfilled, and two per cent of the waste was referred to special treatment[1].

Since 1995, the total rate of recycling has risen by 5 per cent. The proportion of waste being landfilled has fallen by a corresponding 5 per cent. Since 1997, the distribution of waste treatment has fulfilled the goal for treatment in 2004.

As well as generating waste, the building and construction sector extensively uses waste produced in other sectors, including residues from power plants and waste incineration plants.

An investigation has been carried out to describe the flow of problematic substances that can be expected to appear in building waste in the period 2001-2025. The investigation concluded that there is a need for further technical investigations into the options for removing and managing building materials containing problematic substances. Initially, measures will be undertaken to assess whether any health impacts arise from the use, renovation and demolition of buildings containing PCB's, see Appendix E 21.

[1] The Plan of action for waste and recycling 1993-1997 states that the goal for 2000 is a recycling rate of 60 per cent. The goal was revised in 1993 and set to 85 per cent recycling before 2000. The action plan highlights building and construction waste as an important focus area, and a Sub-action plan for cleaner technology and recycling initiatives in the building and construction sector 1993-97 has therefore been prepared. The goal in Waste 21 was to recycle 90 per cent in 2004.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003

There is a need to analyse whether waste from building and construction is being managed in an environmental and cost-effective manner. This analysis will be carried out by the task force on waste appointed by the Minister for the Environment and will therefore not be described in further detail in this strategy.

D 2.2 Waste prevention

Waste from building and construction represents a particular problem. This waste constitutes a significant proportion (approx. 28 per cent in 2001) of the total volume of waste. Added to this is the fact that the waste typically represents products – a building is seen as a product – marketed many years ago, as buildings have a very long lifetime. We therefore have to be able to manage large volumes of waste from this sector – waste that has been impacted by the "sins of the past".

The building and construction sector can contribute to waste prevention by:

- supplying quality buildings with long lifetimes and using environmentally-friendly materials
- ensuring optimum material utilisation by avoiding wastage or damage to materials
- demanding high quality materials and products produced with waste prevention in mind and delivered in returnable packaging
- employing environmentally correct design or equivalent tools/methods

The building and construction sector is typically subject to a number of standards and norms governing how the work is carried out. For example, when a ventilation system is installed in a building, there are requirements stipulating what proportion of fresh air must be recirculated. This can limit how much energy consumption can be reduced. Another example is a motorway, where specifications govern how thick the road pavement should be. This places a limit on how low the resource input can be. There are thus a

number of restrictions that limit options for waste prevention, both in terms of practical implementation and price competition within the sector.

The instruments needed to promote these initiatives will primarily be of an administrative and financial character. One example might be the introduction of a system capable of evaluating the environmental quality of a construction, and a corresponding reward system. This could be in the form of a declaration, or the possibility of favourable loan conditions.

D 2.3 Future initiatives

Measures

- *guide to waste prevention during renovation of buildings*
- *requirements to recycle building and construction waste in building and construction projects*
- *analyse the procedure for recycling building and construction waste in Denmark*
- *new requirements for recycling building and construction waste*
- *extend the regulations on recycling residues and soil to include organic contaminants*
- *prepare guidelines on moving soil and residues*
- *develop indicators designed to evaluate environmental initiatives*
- *investigate where environmental considerations are incorporated into existing laws and regulations*
- *develop tools to evaluate and prioritise chemicals in construction*
- *investigate whether there are environmental and health effects in connection with the use, renovation and demolition of buildings containing PCB.*
- *investigate the potential for recycling mineral wool*
- *requirements for separate treatment of pre-insulated district heating pipes*
- *requirements for the collection of iron and metal packaging*

Waste prevention

During the next few years, a guide to waste prevention will be prepared. During the renovation of older properties, it is constructive to re-use previously used building elements. The guide will describe the activities that should be carried out during demolition to ensure the optimal re-use of building components. Renovation is an alternative to new construction, and the scope of property renovation compared to demolition therefore needs to be analysed at a national level.

Other

Such high levels of contaminants have been recorded in building and construction waste that a nationwide investigation needs to be carried out to determine which contaminants are present and in what concentrations. The sources of these contaminants must also be identified. On the basis of this study it may be necessary to adjust recycling aims.

An investigation will be carried out to describe the normal procedure for managing building and construction waste in the municipalities. For example, this investigation will clarify whether the individual fractions are mixed together before they are recycled, and whether the mixed fractions are recycled with the necessary Section 19 permission.

Consideration will be given to whether the recycling of building and construction waste should be regulated under the Statutory Order on residues and soil for building and construction purposes, in the long term. The necessary basis for potentially revising the Statutory Order to also cover building and construction waste needs to be provided. It is expected that the Statutory Order will be extended to also cover fractions containing organic contaminants (see Appendix E under the asphalt, concrete and tile fractions).

Guidelines on moving soil and residues will also be prepared (see Appendix E).

A proposal will be made for specific indicators for individual construction projects. Principles will also be proposed for a benchmarking system that makes it possible to evaluate environmental initiatives.

An investigation will be initiated to provide an overview of where environmental considerations are incorporated into the existing legal and regulatory base. The existing requirements need to be assessed to determine whether they support the environment goals presented in the Construction Panel’s Action Plan.

Focus needs to be given to the use of chemicals in buildings and building products. A project will therefore be initiated with the aim of developing a simple tool to evaluate and prioritise the use of chemicals in the building sector.

An investigation will be initiated examining whether environmental and health effects arise in connection with the use, renovation, and demolition of buildings containing PCB's. The project will focus on evaluation of the PCB contribution from building dust, indoor air and soil close to buildings, in

relation to the contribution from other sources, and TDI values for PCB's (see Appendix E).

The potential for recycling mineral wool will be investigated, including the development of recycling methods and of the market for recyclable mineral wool (see Appendix E).

Regulations for separate treatment of pre-insulated district heating pipes will be implemented (see Appendix E).

PVC and impregnated wood will continue to be separated for either recycling or landfilling (see Appendix E).

Enterprises and municipalities will have to give greater focus to separating plastic film for recycling. Industry associations for waste producers need to be able to establish nationwide collection schemes, and enterprises will be required to separate plastic containers for recycling (see Appendix E).

A strategy for hazardous waste will be prepared. The purpose of this strategy will be to identify whether the various regulations relating to hazardous waste represent barriers to the best economic and environmental management of waste, and to identify potential initiatives to minimise these barriers (see Appendix E).

The new EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment (see Appendix E).

Under new EU regulations, Denmark must recycle 15 per cent of *wooden packaging* and 55 per cent of all packaging waste in 2008. In order to achieve this goal, an analysis will initially be completed of the volume of wooden packaging waste, and potential buyers (see Appendix E).

The recycling rate for iron and metal packaging is to be increased (see Appendix E).

D 2.4 Regulation

In spring 1994, the Minister for the Environment, Local Government Denmark (LGDK), the City of Copenhagen, and the Municipality of Frederiksberg entered into an agreement on waste suitable for incineration, construction and demolition waste, organic waste, and landfilling. In connection with this agreement, a Circular[2] was issued in 1995 on municipal regulations for the separation of construction and demolition waste for recycling. The Minister for the Environment also entered into an agreement with the Danish Demolition Association[3] on selective demolition of building materials. This agreement ensured separation at source.

[2] Circular no. 94 of 21 June 1995
[3] Demolition Industry Environmental Control Scheme NMK 96

The Circular stipulates that waste from demolition works involving more than 1 tonne of construction and demolition waste must be separated at source into pure fractions, for example, such that tiles and concrete are kept separate.

In pursuance of this Circular, municipalities have issued regulations containing requirements for separation. These regulations took effect no later than 1 January 1997.

The Statutory Order on recycling of residues and soil for building and construction purposes[4] regulates the recycling of residues and soil used as substitutes for primary raw materials.

The waste tax has played a significant role in the regulation of construction and demolition waste, as recycled waste is not subject to the tax.

Government grants for recycling initiatives have also had a significant effect.

D 2.5 Capacity

A large proportion of building and construction waste is reprocessed using mobile and semi-mobile crushing plants, relocated according to needs. The capacity of these plants is not considered to be a barrier to achieving the objective.

D 2.6 Environmental assessment

Subjecting the recycling of building and construction waste to the same requirements as residues will ensure that recycling takes place under the same terms and gives maximum consideration to groundwater resources. Once the contamination levels in building and construction waste have been analysed, the actual consequences of the new initiatives will be presented.

The establishment of indicators for a single building project will make it possible to compare building projects with the same purpose, e.g. constructing an office building. These indicators will also make it possible to improve environmental initiatives in the sector.

D 2.7 Implications for national authorities

The national waste authorities will be responsible for issuing requirements for the recycling of building and construction waste.

The authorities will also be responsible for initiating projects to:

- Analyse the level of contaminants in building and construction waste
- Analyse the procedure for recycling building and construction waste
- Improve the basis for the separation of hazardous waste fractions in construction waste (project on PCB's in construction waste)

[4] Statutory Order no. 655 of 27 June 2000

- Establish a complete set of indicators for individual building projects and suggest principles for a benchmarking system to assess environmental initiatives
- Prepare an overview of where environmental considerations are incorporated into the existing regulatory base
- Develop a tool for assessing and prioritising the use of chemicals in construction

The national authorities are also responsible for amending the Statutory Order on recycling residues and soil for building and construction purposes to cover fractions containing organic contaminants. The authorities are also responsible for amending the regulations for the management of asphalt, concrete, and tiles.

The authorities are also responsible for implementing the Directive on waste electrical and electronic equipment.

Regulations will be laid down for the collection of iron and metal packaging.

Guidelines will be prepared on moving soil and residues.

Investigation of the recycling options for mineral wool may lead to the need for amendments to the regulations for landfilling this waste fraction (see Appendix E).

Regulations will be prepared for the management of waste containing ozone-depleting substances.

D 2.8 Implications for municipal authorities

Municipal authorities are responsible for ensuring, via supervision and municipal regulations, that building and construction waste is correctly sorted and used.

D 2.9 Economics

Before any new regulations are implemented, environmental and cost-benefit assessments of the consequences will be carried out.

D.3. Landfills

Environmental problem	Whenever waste is landfilled, there will always be a risk of failure in one or more of the environmental protection systems established to ensure the environmentally optimum operation of the landfill facility.
Initiatives	The potential to recycle/utilise waste must constantly be investigated so that in the future, waste will only be landfilled when it is environmentally appropriate and responsible to do so Requirements will be laid down governing the design and operation of landfill sites. For each of the four categories of landfill site (inert, mineral, mixed, and hazardous waste), criteria and limit values for the content and leaching of environmental contaminants will also be set. These will aim to ensure, as far as possible, that failure in the environmental protection systems does not lead to irreversible damage to nature and/or the environment surrounding a landfill site As a result of the implementation of the EU Directive on the landfill of waste (including Annex harmonisation), new guidelines will be prepared on landfilling waste to replace the guidelines from 1997, as the contents of the 1997 guidelines are out of date in a number of areas. The guidelines will especially focus on describing how both the new requirements in the Statutory Order on landfilling and future requirements relating to waste characterisation should be tackled in order to ensure "sustainable landfilling" All employees at landfill sites will be required to hold a certificate confirming they have the necessary knowledge concerning the operation of a landfill facility. Training plans, training material and various tests must therefore be prepared to provide a sufficient basis for employees to attain the required certificates before the deadlines, cf. the requirements in Statutory Order no. 647 of 29 June 2001 on training of operations managers and personnel employed at landfill sites

Aims in 2008

- *all transition plans are expected to be completed before the end of 2004 – including plans to order all out-of-date landfill facilities to close by 16 July 2009*
- *reduce the volume of landfilled waste*
- *ensure the environmentally optimal operation of landfill facilities (sustainable landfilling)*
- *all staff employed at landfill facilities must hold an A certificate (operations managers) or a B certificate (other staff)*

D 3.1 Status

When waste can neither be recycled nor incinerated, it must be disposed of/treated at a landfill facility.

Volumes of waste landfilled

The total annual volumes of landfilled waste have generally been declining since the mid-1980's. In 1985, approx. 3.5 million tonnes of waste were landfilled, corresponding to approx. 39 per cent of the total annual volume of waste. In 1993, approx. 2.5 million tonnes of waste were landfilled (26 per

cent of the total volume of waste). In 1997, approx. 2.1 million tonnes of waste were landfilled (16 per cent of the total volume of waste). In 2001, approx. 1.3 million tonnes of waste were landfilled (10 per cent of the annual volume of waste).

In step with the decline in the volume of landfilled waste, the number of landfill facilities has also reduced. However, the reduction in the number of landfill facilities has not matched the rate of decline in the volume of landfilled waste. As a result, the average volume of waste currently landfilled at each facility is significantly less than it was previously.

As a consequence of Denmark's implementation of the EU Directive on the landfill of waste (see section A 2)[5], the number of landfill facilities in Denmark is expected to be further reduced. The requirements laid down in the Statutory Order on landfill facilities[6] are expected to lead to the closure of 40-60 landfill facilities (out of the approx. 150 existing facilities) before 16 July 2009. This date is the deadline under the Order for when the operations of all Danish landfill facilities – both new and existing – are required to fulfil the requirements of the Order.

Transition plans
The Statutory Order on landfill facilities stipulates that all existing landfill facilities must prepare and submit a transition plan to the approval authority by 16 July 2002. On the basis of this transition plan, the approval authority will reassess the facility's environmental conditions and decide whether the facility can (or has the potential to) fulfil the requirements in the Statutory Order on landfill facilities and hence be granted approval to continue operations after 16 July 2009. Alternatively – in cases where the facility does not fulfil the requirements of the Order (and does not have the potential to do so) – the approval authority will have to issue an order for the facility to be closed by 15 July 2009.

Once the approval authorities have made their decisions on the basis of the submitted transition plans (this is expected to have happened before the end of 2004), each landfill facility will receive an order in the form of a positive list specifying the waste types that the facility is permitted to receive for landfilling. The landfill facility operator will be required to provide security for the obligations relating to the closure and post-treatment of the facility and will be informed of the terms of this requirement.

In 2002, the Danish Environmental Protection Agency issued Guideline no. 5, 2002 on the preparation of transition plans. This guideline explains, in a number of key areas, the regulations relating to the preparation of transition plans laid down in the Statutory Order on landfill facilities, and should be seen as an aid and inspiration in the work of preparing transition plans for existing landfill facilities.

Harmonisation of the Annexes to the Directive on the landfill of waste
In December 2002, the Danish presidency succeeded in gaining unanimous support from all 15 Member States for a number of amendments in relation

[5] Council Directive no. 99/31/EC of 26 April 1999 on landfilling of waste, Official Journal of the European Communities 1999 L 182, p. 1.
[6] Statutory Order no. 650 of 29 June 2001 on landfill facilities.

to the Commission proposal on harmonisation of the annexes to the Directive on the landfill of waste.

The annexes to the Directive on the landfill of waste must be implemented in Danish legislation by 16 July 2004. By 16 July 2005, there will be a general legislative requirement that all waste must be characterised before it can be received for landfilling. This will mean that documentation for the waste's content and leaching of environmental contaminants will be required. This documentation is aimed at ensuring that all landfilled waste fulfils the set limits for leaching for a number of environmental contaminants, and that each type of waste is only landfilled together with other waste types with similar characteristics.

It is expected that the new requirements for waste characterisation will contribute to a further reduction in the annual volume of landfilled waste. The primary reason for this is that as a result of the new requirements, it will become more expensive to landfill waste in the future, and waste producers can therefore be expected to make extra effort to find treatment/utilisation options for the waste types (or parts thereof) that have previously been landfilled.

Expectations for landfilled waste during the plan period (2005-2008)
During the plan period it is expected that there will be:

- a new general requirement that waste must be characterised before it is received for landfilling
- a further reduction in the annual volume of landfilled waste
- a substantial increase in landfilling charges
- a reduction in the number of landfill facilities.

During the plan period, the development trend is expected to be towards fewer landfill facilities with greater average capacity. This will open the way for better/optimal environmental and economic operation of each landfill facility, but will also (in certain regions) lead to greater transportation costs.

Measures

- *all transition plans are expected to be completed before the end of 2004 – including plans to order all out-of-date landfill facilities to close by 16 July 2009*
- *implementation of the Annexes to the Directive on the landfill of waste, including setting criteria and limit values for waste characteristics in order for waste to be received at the various categories of landfill facility*
- *new guidelines on landfilling waste*
- *ensure that all staff at landfill facilities receive the opportunity to undertake a training course – including the opportunity to be examined and obtain an A or B certificate*

D 3.2 Future initiatives

The potential to recycle/utilise waste must constantly be investigated so that in the future, waste will only be landfilled when it is environmentally necessary and responsible to do so.

Requirements will be laid down governing the design and operation of landfill sites. For each of the four categories of landfill site (inert, mineral, mixed, and hazardous waste), criteria and limit values for the waste's leaching characteristics will also be set. These will aim to ensure, as far as possible, that failure in the environmental protection systems does not lead to irreversible damage to nature and/or the environment surrounding a landfill site. Waste characterisation requirements will aim to ensure a high degree of environmental protection, without placing unreasonable burden on waste producers.

As a result of the implementation of the EU Directive on the landfill of waste (including Annex harmonisation), new guidelines will be prepared on

landfilling waste to replace the guidelines from 1997, as the contents of the 1997 guidelines are out of date in a number of areas. The guidelines will especially focus on describing how both the new requirements in the Statutory Order on landfilling and future requirements relating to waste characterisation should be tackled in order to ensure "sustainable landfilling".

All employees at landfill sites will be required to hold a certificate confirming they have the necessary knowledge concerning the operation of a landfill facility. Training plans, training material and various tests must therefore be prepared to provide a sufficient basis for employees to attain the required certificates before the deadlines, cf. the requirements in Statutory Order no. 647 of 29 June 2002 on training of operations managers and personnel employed at landfill sites.

D 3.3 Regulation

The design and operation of landfill facilities must conform to the requirements in the Statutory Order on landfill facilities.

The Statutory Order on training prescribes[7] compulsory examinations for both operations managers and staff employed at landfill facilities. Under the Order, existing operations managers must hold an A certificate by 1 July 2004, and operations managers employed after 1 July 2003 must hold an A certificate within one year after commencing employment. Existing staff involved in the daily operations of a landfill facility must hold a B certificate by 1 July 2005, and any staff employed after 1 July 2003 must hold a B certificate within two years after commencing employment.

As a result of the Council's adoption of the harmonisation of the annexes to the EU Directive on the landfill of waste in December 2002, Denmark has to implement annex harmonisation in national legislation by 16 July 2004.

Almost all drinking water in Denmark derives from groundwater. When the Danish criteria and limit values for waste characterisation are being determined, special focus will therefore be given to protecting the scarce and vulnerable Danish drinking water resources. This is expected to result in more stringent limit values for a number of environmental contaminants, compared to the limit values adopted by the EU under the annex harmonisation.

Once implementation is complete, more stringent requirements for the documentation of waste content and leaching of environmental contaminants will be laid down, to ensure that in future, only waste that is suitable for disposal via landfilling is landfilled. Waste that does not comply with the set requirements may have to undergo further treatment before it can be accepted for landfill.

[7] Statutory Order no 647 of 29 June 2001 on training of operations managers and personnel employed at landfill sites.

D 3.4 Environmental assessment

Under the Statutory Order on landfill facilities, all existing landfill facilities had to submit a transition plan to the approval authority by 16 July 2002.

On the basis of the information in the transition plan, the approval authority will have the task of re-evaluating/environmentally assessing each facility's potential to continue operation after 16 July 2009. This assessment will take into account all relevant environmental factors related to the design and operation of each facility, in order to ensure that approval for continued operation is only granted to facilities that fulfil (or have the potential to fulfil) the requirements in the Statutory Order on landfill facilities.

Existing landfill facilities that cannot fulfil the requirements of the Statutory Order on landfill facilities must be ordered by the approval authority to be finally closed by 15 July 2009.

The Directive on the landfill of waste stipulates that a national strategy to reduce landfilling of biodegradable waste must be prepared by 16 July 2003. The overall goal of the strategy is to ensure that the volume of landfilled biodegradable domestic waste (incl. waste that is similar to domestic waste) is reduced to a maximum of 35 per cent of the volume of domestic waste produced in 1995. In contrast to many other EU Member States, Denmark already fulfils this requirement. As a result, Denmark is not required to prepare a strategy (incl. the initiation of various measures) in relation to this EU requirement.

D 3.5 Economics

The total costs to waste producers of implementing basic characterisation for the waste types to be landfilled in the future is estimated to be of the order of DKK 100-200 million. These expenses are expected to be incurred over approximately a two-year period (2004-2006), after the Annex of the Directive on the landfill of waste has been implemented in Danish legislation (must be completed by 16 July 2004).

This estimate is based on a number of assumptions, as several factors will have crucial significance for how great these expenses end up being. These factors include:

- the actual requirements laid down in connection with the Danish implementation of the Annex to the Directive on the landfill of waste
- the content of a number of standards (CEN tests) currently under development
- the number of waste types that the Danish implementation stipulates are covered by the requirement for carrying out basic characterisation.

With regard to the latter point, the total number of waste types requiring characterisation will be directly dependent on how many waste types each landfill facility gains approval for when the approval authority reassesses the transition plans for existing landfill facilities (see section D 3.1).

In addition to the costs of the basic characterisation of waste types for landfilling, there will be further costs incurred to carry out compliance tests. During the implementation of the Annex to the Directive on the landfill of waste in Danish legislation, requirements for the scope (and frequency) of compliance tests will be laid down.

The total annual costs to waste producers for carrying out compliance tests are estimated to be in the order of DKK 5-10 million.

D 3.6 Implications for national authorities

There will continue to be a need to landfill waste in Denmark in the future – that is, waste that can neither be recycled nor incinerated.

With the adoption and implementation of the EU Directive on the landfill of waste, requirements have been laid down for the design and operation of both new and existing landfill facilities to ensure that all facilities in operation after 16 July 2009 are subject to a uniform approval basis that ensures the environmentally responsible operation of all landfill facilities. In particular, the implementation of the harmonisation of the Annex to the Directive on the landfill of waste will ensure that in the future, waste is only landfilled that is deemed suitable for landfill based on an environmental assessment. If waste contains concentrations of substances that can lead to significant problems, for example, in the form of unacceptable groundwater contamination resulting from leaching emissions from a facility, the waste in question will not be included on the facility's positive list. As a consequence, the waste will either have to be treated (or further treated) before it can be landfilled, or disposed of in another way.

D 3.7 Implications for county authorities

According to the Planning Act[8], the county authorities are responsible for ensuring that there is adequate landfill capacity in their region. This is achieved by assessing future landfill requirements – including the need to supply further landfill capacity during the plan period – in regular regional planning (see Appendix C2).

Under the Statutory Order on waste[9], municipalities are required to refer waste requiring landfill (that is neither recyclable nor suitable for incineration) for disposal/treatment at a landfill facility.

Municipalities need to be very aware of which waste types a municipality can (or cannot immediately) refer to landfill in the future. This needs to be seen in the context of the positive lists that all landfill facilities are obliged to observe once the approval authority has notified terms (for new facilities), or an order (existing facilities), to this effect. If a waste type is not included on the positive list for a landfill facility, that type of waste cannot be landfilled at the facility until the waste type in question has been approved (by the approval authority) and included on the facility's positive list. Since the

[8] Consolidated Act no. 518 of 11 June 2000 on planning.
[9] Statutory Order no. 619 of 27 June 2000 on waste, as most recently amended by Statutory Order no. 616 of 22 July 2002.

inclusion of a waste type on a positive list requires a certain period of time to provide and assess the necessary documentation, there may be a need for greater cooperation between municipalities across waste enterprises, etc., in order to ensure that municipalities can fulfil their referral obligations under the Statutory Order on waste.

D.4. Households

Environmental problem	The volume of waste from households has been increasing, but appears to now be stagnating. The recycling rate for household waste is unchanged compared to earlier years. The energy resources in household waste are being utilised to a great extent Household waste contains environmental contaminants, and these cause problems in waste treatment
Initiatives Household waste	Information campaign on the link between consumption and waste Efforts to communicate information about the municipal schemes will be increased Preparation of information and teaching materials for pre-schools, and primary and high schools
Domestic waste	The Ministry of the Environment will develop a tool to be used to locally evaluate the environmentally and economically most appropriate management of organic domestic waste This will enable municipalities to assess whether two-part collection of the organic component of domestic waste should be locally introduced, and make a decision about this Focus on collection systems and the development of pre-treatment technologies to manage organic domestic waste Investigate central sorting of combined domestic waste, with the aim of recycling the organic component Increased collection and recycling of metal and plastic packaging
Bulky waste	Increased re-use and recycling of bulky waste Implementation of the EU Directive on waste electrical and electronic equipment by the end of 2004, including regulations for the management of refrigeration equipment Only wood impregnated with chromium, copper, and arsenic-containing substances may be treated as waste not suitable for incineration
Hazardous waste	Prepare new requirements for the management of PVC waste Once the EU Directive on batteries has been adopted, the provisions of the Directive will be implemented

Garden waste	Improved information on hazardous household waste to increase collection Maintain present initiatives for garden waste

D 4.1 Household waste

D 4.1.1 Status

Aims for 2008

- *ensure that consumers have the opportunity to choose products that help prevent waste*
- *increased information about collection of hazardous waste from households*
- *33 per cent recycling of household waste*
- *60 per cent incineration of household waste*
- *7 per cent landfilling of household waste*

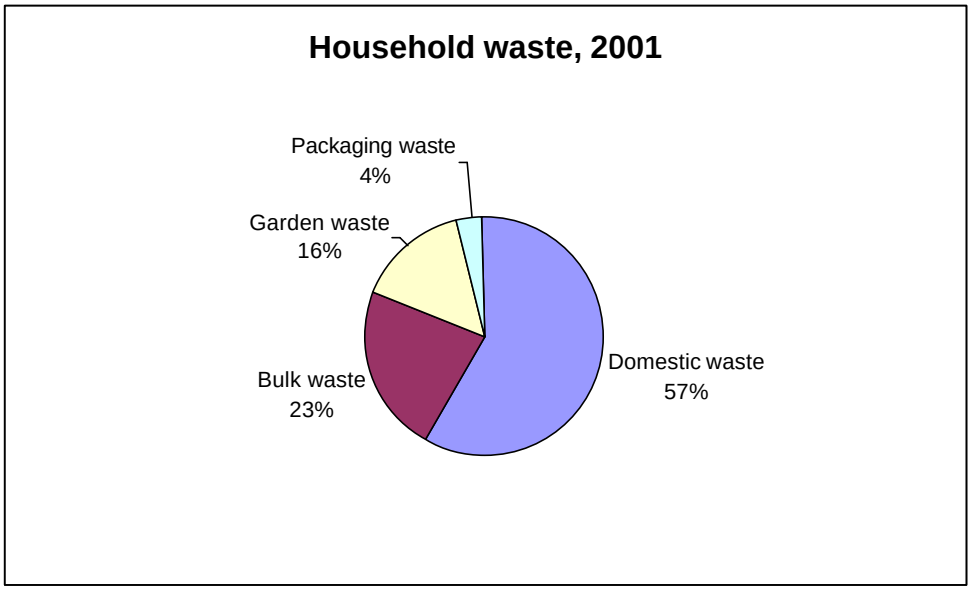
Household waste consists of domestic waste, bulky waste, and garden waste. In 2001, 29 per cent was recycled, 61 per cent was incinerated, 8 per cent was landfilled, and 1 per cent was stored temporarily. A small proportion of household waste is hazardous.

The volume of household waste was 3,083,000 tonnes in 2001. From 1995 to 2001, the volume of household waste increased by 473,000 tonnes. This increase was mainly attributable to an increase in the volume of garden waste collected. But the volumes of domestic waste (including packaging waste), and bulky waste have also risen by 11 per cent and 10 per cent, respectively, over the same six years.

Consumer habits have a crucial impact on the volumes of household waste. Purchasing goods with a long lifetime and high environmental quality would, all things being equal, result in a lower volume of waste.

Household waste contains environmentally harmful waste fractions, causing problems in waste management. Residents have been given better opportunities to deliver these fractions for separate treatment (PVC, impregnated wood, waste electrical and electronic equipment).

In most municipalities, management of household waste is financed via an overall waste collection fee. However, in recent years, a number of municipalities have introduced fees that differentiate in relation to the amount of waste (weight or volume) in order to give households an extra incentive to make use of recycling schemes in the municipality. Investigations have shown that it is important in municipalities with weight-based fees to monitor that the component of domestic waste that should be incinerated is not delivered to recycling centres, rest areas, or incinerated in private boilers, etc.



Hazardous household waste is found in both domestic waste and bulky waste. Such waste is typically residues from hazardous chemicals and products, paint residues, medicine residues, batteries etc., which residents want to discard. Hazardous household waste must be collected separately by the municipality.

Various collection schemes currently exist in the various municipalities. The objective is to make it easy for residents to have their hazardous waste collected. Collection schemes must be adapted to the prevailing conditions in urban and rural municipalities, and in single-family housing areas and housing estates. There will also be differences due to variations in each municipality's structure.

Some municipalities have introduced green collection vehicles that collect hazardous waste in residential areas at certain intervals. Other municipalities have introduced kerbside collection schemes for hazardous waste, using special containers.

Distributor schemes also exist whereby residents are able to deliver hazardous waste to shops that sell the products (medicine residues to pharmacies, paint and varnish residues to paint shops, batteries to shops selling new batteries, etc.). In some municipalities, container schemes have been established, with collection containers placed at different urban locations.

In addition, municipalities have established permanent recycling centres where other waste can be delivered.

Studies have shown that municipalities with kerbside collection schemes collect the largest volume of hazardous waste.

D 4.1.2 Waste prevention

Consumer waste consists primarily of end-of-life products and packaging. The volume of consumer waste is closely linked to how much is consumed and the nature of that consumption (material products or immaterial services,

products with short or long lifetimes etc). Reducing the volume of consumer waste is not an easy task.

Consumers should not be compelled to make particular consumption choices. Consumers must rather have the possibility of free choice, but this requires that each consumer be given choices.

Private consumers need to be have the opportunity to contribute to waste prevention by:

- limiting unnecessary consumption and converting material consumption into immaterial consumption[10]
- acquiring products that are eco-labelled, have a proven, long lifetime and are easy to repair
- repairing/seeking repair for items
- participating in joint ownership schemes
- buying products in returnable packaging
- re-using products through purchase or sale

The actions of private consumers are largely controlled by external influences such as advertising, disposable income, access to relevant information, the range of goods available, prices of goods, and the organisation of and service offered by the waste system. Private consumers are thus influenced by many of the other players in society. But there are naturally a number of general basic needs, such as food, clothing, and housing, that must be met.

Examples of instruments that can be used to support prevention are: information campaigns, teaching materials on resource consumption and environmental problems from waste to improve teaching in schools, promotion of products with long lifetimes, good repair opportunities for products, etc.

D 4.1.3 Future initiatives

Measures

- *carry out an information campaign on the link between consumption and waste*
- *prepare educational material on resource consumption and waste prevention*
- *information on management of hazardous waste*

Waste prevention
An information campaign will be carried out on the link between consumption and volumes of waste, giving specific recommendations on, for example, quality/durable products, products manufactured from recycled materials, re-useable packaging, and packaged goods etc. The information campaign should ideally be carried out in cooperation between the Danish Environmental Protection Agency and the National Consumer Agency of Denmark, and be coordinated with municipalities and waste enterprises. The effects from this initiative should be seen from a long-term perspective.

Many consumption and behaviour patterns become established as children. To ensure that future residents are conscious of resource and waste problems, information and teaching materials will be prepared for pre-schools, and primary and high schools. This material will highlight the link

[10] "Immaterial consumption" refers to the consumption of non-physical products, such as services.Immaterial consumption will often involve a certain level of consumption of energy or other materials, but this will typically be lower than for the consumption of physical products.One example of such a service is the service whereby a telephone enterprise takes messages, instead of each consumer having to purchase an answering machine.

between increased material consumption and environmental problems related to resource consumption and waste generation. Similarly, all children's and educational institutions should be encouraged to sort their own waste.

Product wastage at the consumer due to inappropriate packaging that is impossible or difficult to completely empty could be significantly reduced if packaging designers and manufacturers developed packaging that it was possible to empty (see Appendix D5 Industry). This would lead to reductions in both the volume of packaging waste and organic waste in the form of food items in domestic waste.

Other
In order to achieve the objectives for domestic waste, garden waste and bulky waste, it will be necessary for residents to be involved and to participate actively in the various collection schemes. This means that municipal communication efforts will need to be increased in order to achieve the best possible awareness of the specific waste collection schemes.

Residents need to be informed about what items are hazardous waste and how municipal schemes function.

D 4.1.4 Regulation

The management of household waste, including hazardous household waste is regulated by the Statutory Order on waste[11]. Waste must be collected by the municipality. Rules on hazardous household waste have been clarified in a guideline on hazardous waste.

On 1 January 1997, a ban was introduced on the landfilling of waste suitable for incineration.

D 4.1.5 Environmental assessment

Waste prevention reduces resource consumption and the volume of waste requiring treatment.

Improved collection of hazardous waste will ensure environmentally appropriate management of waste.

D 4.1.6 Implications for national authorities

An information campaign on consumption and waste must be carried out.

Information and teaching materials will be prepared for pre-schools, and primary and high schools, with the aim of highlighting the link between increasing consumption and environmental problems related to resource consumption and waste generation.

[11] The Ministry of the Environment and Energy's Statutory Order no. 619 of 27 June 2000 on waste, as most recently amended by Statutory Order no. 616 of 22 July 2002.

D 4.1.7 Implications for municipal authorities

It is important that municipalities focus their information initiatives on the link between residents' consumption and the increasing volumes of waste – and the behavioural changes that might contribute to reducing the volume of waste.

Municipalities and counties should introduce waste separation in all their children's and educational institutions.

It is important that municipal authorities inform residents about the municipal schemes for hazardous waste.

D 4.2 Domestic waste from households

D 4.2.1 Status

Paper and glass are currently collected separately under the regulations in the Statutory Order on waste, while the separate collection of organic domestic waste is less widespread.

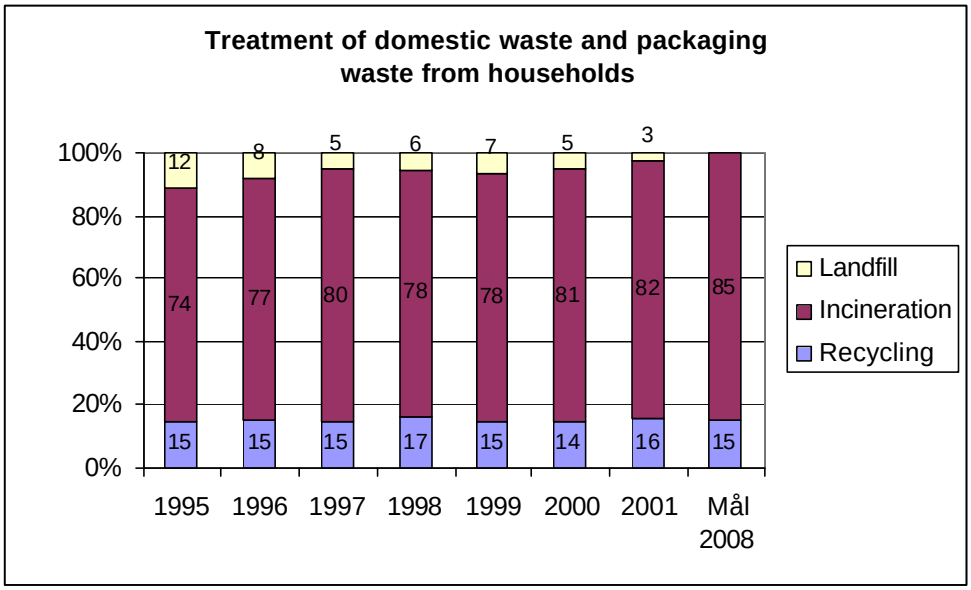
A limited amount of metal and plastic packaging is currently collected for recycling in some municipalities.

Aims for 2008

- *20 per cent recycling of domestic waste*

In 2001, the volume of domestic waste, including packaging waste, was 1,808,000 tonnes. Compared to 1995, the volume of domestic waste has risen 11 per cent. In 2001, the recycling rate was 16 per cent[12]. The total volume of domestic waste for incineration and landfilling has been stable for a long period.

[12] The goal for recycling of domestic waste in Waste 21 is 30 per cent in 2004. This was intended to be achieved through increased recycling of paper and the organic component of domestic waste.According to the objectives, the remaining volume of domestic waste is to be incinerated with energy recovery. The recycling rate has risen from 15 per cent in 1995 to 16 per cent in 2001.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003

Municipalities that do not have collection schemes for paper and cardboard have reported the collected volumes to the Danish Environmental Protection Agency for 2001. If the ISAG figures for the municipalities that do have collection schemes are added, a total of 237,000 tonnes of paper and cardboard have been collected from households in 2001. This is equivalent to 59 per cent of the potential for recyclable paper and cardboard from households.

Packaging waste accounts for around one quarter of domestic waste, corresponding to 425,000 tonnes, of which 30 per cent is materially recycled and the remaining 70 per cent is incinerated.

Two thirds of the incinerated packaging is made up of cardboard, paper, and plastic. The rest is glass, tin-plate, and aluminium packaging. Glass is not suitable for incineration, whereas a small proportion of aluminium packaging is recovered. Thin aluminium foil can be combusted, whereas aluminium cans do not combust in incineration plants. Tin-plate packaging can be recovered after incineration. The iron is separated from the slag using magnets and sold as incineration scrap, but the loss of metal is very great.

The table below shows the total volume of domestic waste collected in 2001 via municipal collection schemes, amounting to approx. 1.14 million tonnes per annum from all households in Denmark[13].

This figure has been derived from an analysis of the composition of domestic waste based on the collection of domestic waste from approx. 2,000 households in a number of different municipalities. These figures therefore do not include glass/bottles and paper separated for recycling and collected separately. The calculations are based on 2,398,389 households nationwide, including permanently inhabited holiday houses.

[13] Petersen, Claus (2002): "Evaluation of home composting schemes and analysis of the composition of domestic waste"

In Waste Statistics, the total volume of domestic waste in 1998 was calculated to be 1.7 million tonnes. After a slight decrease in the volume of domestic waste in 1999 and 2000, the figure for 2001 was calculated to be 1.8 million tonnes. These figures include glass and paper collected via separate collection schemes. These 1.8 million tonnes of waste include a small, but unknown, volume of domestic waste from commercial enterprises. Recyclable paper and glass collected from households is calculated to be approx. 300,000 tonnes in ISAG. There is no equivalent calculation for how much waste from commercial enterprises is collected with domestic waste.

For the analysis of the composition of the collected domestic waste, the waste is sorted into 19 fractions, as shown in the table.

Generated domestic waste divided into type of residence per week and nationwide

Fraction	Apartments National avg. Kg/household Per week[4)]	Single-family houses National avg. Kg/household Per week[5)]	Apartments[1)] Tonnes/year	Single-family houses[2)] Tonnes/year	All households[3)] Tonnes/year	Relative distribution (%) Tonnes/year
Unprocessed vegetable	1.69	2.32	83,803	174,298	258,101	22.6
Other vegetable waste	0.65	0.93	32,232	69,870	102,102	8.9
Animal waste	0.77	1.00	38,183	75,129	113,311	9.9
Recyclable paper	0.96	0.98	47,604	73,626	121,230	10.6
Blotting paper	0.32	0.29	15,868	21,787	37,655	3.3
Other clean, dry paper	0.17	0.20	8,430	15,026	23,456	2.1
Other dirty paper	0.45	0.76	22,314	57,098	79,412	7.0
Recyclable Plastic packaging	0.19	0.23	9,422	17,280	26,701	2.3
Other plastic	0.54	0.68	26,777	51,087	77,865	6.8
Garden waste etc.	0.24	0.51	11,901	38,316	50,217	4.4
Nappies etc.	0.70	0.52	34,711	39,067	73,778	6.5
Other suitable for incineration	0.43	0.50	21,323	37,564	58,887	5.2
Glass packaging	0.21	0.25	10,413	18,782	29,196	2.6
Other glass items	0.03	0.029	1,488	2,179	3,666	0.3
Metal packaging	0.18	0.29	8,926	21,787	30,713	2.7
Other metal items	0.07	0.045	3,471	3,381	6,852	0.6
Other not-suitable for incineration	0.33	0.36	16,364	27,046	43,410	3.8
Composite products	0.02	0.010	992	751	1,743	0.2
Hazardous waste	0.01	0.018	496	1,352	1,848	0.2
Total waste	7.96	9.94	394,718	746,778	1,141,496	100.0

Source: Petersen, Claus (2002): "Evaluation of home composting schemes and analysis of the composition of domestic waste" and Statistics Denmark 2002 – Households divided by area, type of residence and time, as of 1 January 2001

Apartments include: multi-family buildings (924,609 households) and student residences (29,000 households). 953,609 households in total.

Single-family houses include: farmsteads (122,336 households), terrace houses and duplexes (311,974 households), detached houses (996,156 households) and (permanently inhabited) holiday houses (14,314 households). 1,444,780 households in total.

Multi-family buildings (953,609 households) and single-family houses (1,444,780 households). 2,398,389 households in total.

The calculations do not include joint households (institutions, etc.) (13,497 households) and other permanent residences (13,699 households). As of 1 January 2001, 198,860 holiday houses were registered, of which only a small proportion were registered as permanently inhabited.

1) No. of people in household: 1.9.
2) No. of people in household: 2.4.

D 4.2.2 Future initiatives

Measures

- *develop a tool to evaluate the significance of local factors on the management of organic domestic waste*
- *municipalities can make decisions on the management of organic domestic waste*
- *focus on collection costs and the development of pre-treatment technologies to manage organic domestic waste*
- *investigate central separation of combined domestic waste*
- *value other environmental effects relating to the management of organic domestic waste*
- *collect metal and plastic packaging for recycling*

Recycling
A tool will be developed to help municipalities evaluate whether incineration, biogasification or composting of the organic component of domestic waste is best. This will enable municipalities to assess which treatment for organic domestic waste is environmentally and economically most effective and make decisions accordingly.

Further work will also be done on developing cheaper collection methods and improving pre-treatment technology. As an alternative, the options for centrally sorting combined domestic waste will be investigated. These investigations will focus on working environment conditions and the quality of the separated materials. Central sorting will only be promoted if it is found to be a good idea in terms of the environment and the working procedure.

The collection of metal and plastic packaging for recycling will be increased. From 2005, municipalities will be required to give residents the opportunity to separate certain items of plastic packaging and deliver them for recycling, for example at recycling centres. Residents must also be given the opportunity to separate metal packaging for recycling, for example, by delivering it to recycling centres or via certain bulky waste schemes.

The volume of paper collected for recycling will be maintained at the goal for 2004.

See also discussion of the separate fractions in Appendix E.

D 4.2.3 Regulation

In areas with more than 1,000 inhabitants, domestic waste must be collected[14]. In rural areas, waste must be assigned to treatment. Mixed domestic waste must be assigned to incineration.

Municipalities are required to collect paper, divided into a number of categories, for recycling, from private residential areas with more than 1,000 inhabitants, using permanent collection equipment. Municipalities must also collect other paper and cardboard, including cardboard packaging, in residential areas with more than 1,000 inhabitants. However, municipalities are not required to fulfil these regulations if they have collected 40 per cent and 55 per cent of the recyclable paper and cardboard potential from households in 2001 and 2002, respectively. In future, municipalities will only be required to fulfil the above regulations if the collected volume is less than 55 per cent of the recyclable paper and cardboard potential for two consecutive calendar years, starting from 2003.

Municipal councils may establish collection schemes or other joint schemes for other fractions.

Residents, freeholders, enterprises, and institutions have a duty to use municipal schemes.

[14] Under the Ministry of the Environment and Energy Statutory Order no. 619 of 27 June 2000 on waste, as most recently amended by Statutory Order no. 616 of 22 July 2002.

Municipal councils may assign waste suitable for incineration to temporary storage for a maximum period of one year. Domestic waste and other perishable waste may not be assigned to temporary storage.

D 4.2.4 Environmental assessment

Increased recycling reduces resource consumption and volumes of waste for incineration.

Recycling plastic and metal ensures the resources in waste are utilised and reduces the total environmental impact from the management of these waste fractions.

D 4.2.5 Economic evaluation

It is estimated that collection schemes for metal and plastic packaging from households would cost approx. DKK 2 million per annum in increased expenses. If it becomes necessary to implement further initiatives in order to achieve the goals in the Packaging Directive, the expenses for households may increase.

D 4.2.6 Implications for national authorities

The Ministry of the Environment is initiating the development of a model for local evaluation of which treatment for organic domestic waste is most appropriate, in terms of the environment and costs.

Regulations will be formulated for the collection of iron and metal packaging.

D 4.2.7 Implications for municipal authorities

Municipalities can locally evaluate which treatment for organic domestic waste is environmentally and economically optimal.

Collection schemes will be established for metal and certain types of plastic packaging from households.

D 4.3 Bulky waste

D 4.3.1 Status

Aims for 2008
- *25 per cent recycling*
- *50 per cent incineration*
- *25 per cent landfilling*

Recycling of bulky waste can be increased through improved separation of household waste.

Many municipalities have established manned recycling centres in recent years. However, there are big variations in which waste fractions (and how many) are separated. Recycling centres are often supplemented by separate collection schemes.

With more stringent requirements for separation of waste fractions or special treatment for bulky waste schemes, residents can actively contribute to increasing recycling.

The volume of bulky waste has been increasing, in part due to the increased prevalence of separate collection schemes and manned recycling centres. A significant quantity of waste is therefore no longer being disposed of in other ways. Between 1996 and 1998, the volume decreased by 67,000 tonnes. However, between 1998 and 2000, the volume of bulky waste increased again by 158,000 tonnes.

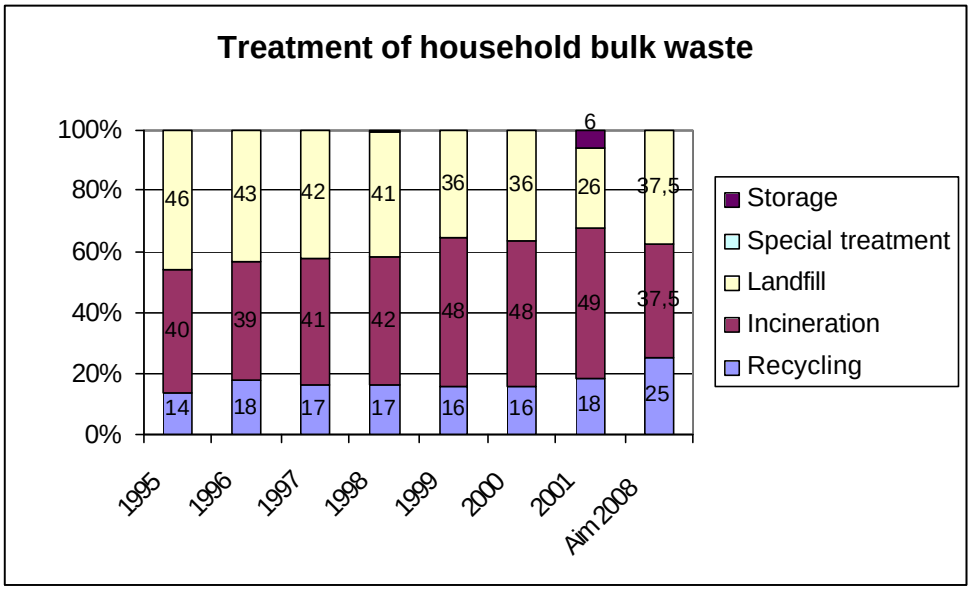
In 2001, the volume of bulky waste was 680,000 tonnes. Of this, 18 per cent was recycled, 49 per cent incinerated, and 26 per cent landfilled. Six per cent was temporarily stored.

Due to different methods of calculation in local administrations, figures for bulky waste are uncertain – in some administrations, bulky waste is included under industrial waste. Aims for recycling, incineration, and landfilling should therefore be evaluated with caution[15].

The ban on landfilling of waste suitable for incineration introduced on 1 January 1997 has reduced the volume of bulky waste landfilled.

It is not feasible to calculate the environmental and cost-benefit effects of alternative forms of treatment for the many hundreds of different products that end up in bulky waste. Municipalities will therefore have to base their evaluations of which types of products should be directed to recycling on the waste indicators for the various material types, and on the potential markets for the various fractions.

[15] Waste 21:Goals in 2000 for forms of treatment:25 per cent recycling, 37.5 per cent incineration, and 37.5 per cent landfill.



Source: Waste Statistics 2001

D 4.3.2 Future initiatives

Bulky waste is an area that requires local solutions and where there are advantages in building networks.

Waste prevention

The Ministry of the Environment will encourage municipalities to participate in establishing or improving existing re-use schemes. There are many examples of very well-developed schemes that ensure that re-usable products do not end up in the waste system. These schemes are established by municipalities, often in cooperation with charities, or by charities alone. Examples include: shops selling second-hand items – sometimes combined with repair workshops, second-hand markets on the Internet, collection schemes for re-usable products from households, and an Internet-based repair guide. Setting aside a special area at municipal recycling centres for the collection of re-usable items, in combination with marketing or sales, would significantly increase the re-use of bulky waste.

Measures

- *encourage municipalities to increase the re-use of bulky waste*
- *promote the expansion of bulky waste schemes to include further recyclable waste fractions*
- *establish networks for personnel involved in bulky waste schemes*
- *disseminate experience from the re-use and recycling of bulky waste in apartment buildings*
- *implement the EU Directive on waste electrical and electronic equipment,*

Recycling

The Ministry of the Environment will encourage municipalities to extend municipal bulky waste schemes to cover many more recyclable waste fractions. A number of municipalities have extended bulky waste schemes to cover more than 20 fractions, leading to a much greater proportion of bulky waste being separated for recycling, and reducing the volumes of waste collected in the suitable for incineration and not suitable for incineration fractions.

Municipalities will be encouraged to establish networks for staff at recycling centres and involved in collection schemes for bulky waste, to allow them to share practical experience with increasing the re-use and recycling of bulky waste, including knowledge of potential markets for the many material fractions and products in bulky waste.

The Ministry of the Environment will also encourage building associations and other apartment buildings to establish bulky waste schemes to ensure that re-usable items do not end up in the waste system (exchange centres), and that recyclable waste fractions are separated for recycling. Experience from existing schemes should be collected and disseminated to a wider circle of caretakers, property administrators and housing associations, e.g. via the Danish Centre for Urban Ecology.

Waste collection staff and property administrators should be in close contact with residents to inform them about correct separation of their waste, with the particular aim of increasing the re-use and recycling of bulky waste. Municipalities will therefore need to take the initiative to train and instruct janitors, caretakers, waste collection staff and staff at recycling centres, to equip them to give better advice to residents about waste separation.

The new EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation by the end of 2004. Implementation of this directive will mean changes to requirements, and that more products will be subject to separate treatment, including refrigeration equipment. The directive is based on producer responsibility.

Impregnated wood containing chromium, copper and arsenic-containing substances will continue to be treated as waste not suitable for incineration, and landfilled. When better treatment methods have been developed, these types of impregnated wood will be collected separately. Requirements for the management of certain types of impregnated wood will be introduced on the basis of an environmental and cost-benefit assessment.

Efforts will be made to ensure that PVC waste is managed in an environmentally appropriate manner. This can be achieved by drafting requirements for the collection and management of PVC waste.

D 4.3.3 Regulation

Municipalities must assign treatment methods for bulky waste and must ensure that residents separate waste suitable for incineration.

Management of waste electrical and electronic equipment has so far been regulated by general rules in the Statutory Order on waste, the Statutory

Order on management of waste from electrical and electronic products, and through environmental approvals for enterprises managing, reprocessing or disposing of this waste fraction.

Collection and management of CFC-containing refrigeration equipment is covered by an agreement between the Minister for the Environment and relevant associations on the disposal of CFC-containing refrigeration equipment, as well as in a Circular[16] on municipal regulations on disposal of CFC-containing refrigeration equipment.

D 4.3.4 Environmental assessment

Efforts to increase re-use and recycling will ensure the utilisation of resources in waste and reduce the need for incineration and landfill capacity.

It is estimated that the initiatives for waste prevention can reduce the volume of bulky waste by 2-4 per cent.

D 4.3.5 Economic evaluation

No economic evaluations of initiatives to increase the re-use and recycling of bulky waste have been carried out.

D 4.3.6 Implications for national authorities

The Ministry of the Environment will ensure that material is sent to municipalities and housing associations, etc., on the options for increasing the re-use and recycling of materials in household bulky waste. The Ministry of the Environment will encourage municipalities to establish networks for staff involved in bulky waste schemes.

D 4.3.7 Implications for municipal authorities

Municipalities must consider and implement possible improvements to bulky waste schemes, so that re-use and recycling can be significantly increased. Municipalities should establish networks of personnel involved in bulky waste schemes/at recycling centres, with the aim of promoting experience exchange.

Municipalities should take the initiative to ensure that janitors, caretakers, waste collection staff and staff at recycling centres are trained and instructed, to equip them to give better advice to residents about waste separation.

D 4.4 Garden waste

D 4.4.1 Status

Aims for 2008

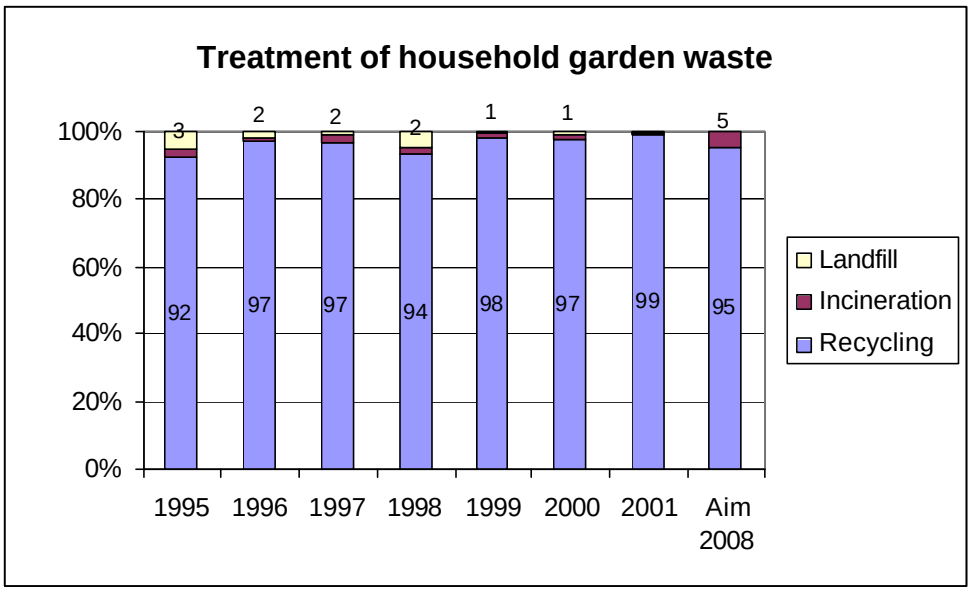
- *95 per cent recycling of garden waste*

A total of 99 per cent of garden waste was recycled in central composting plants in 2001, exceeding the aim of 95 per cent for 2004. As a consequence, landfilling of garden waste decreased from 10 per cent in 1994 to one per cent in 2001. It is not expected to be possible to further increase the rate of recycling for garden waste.

[16] Circular no. 132 of 13 June 1996 on municipal regulations on disposal of CFC-containing refrigeration equipment

Home composting has been promoted for a number of years through information material and campaigns, and municipalities have voluntarily established schemes and composting plants for garden waste. Garden waste initiatives are considered to have been a success.

In addition to home composting, garden waste is collected via municipal recycling schemes. Volumes have increased considerably in recent years, from 290,000 tonnes in 1994 to 458,000 tonnes in 2001. This is due to increased use of the schemes and improved collection of data on garden waste.



Source: Waste Statistics 2001

D 4.4.2 Future initiatives

Measures

- *maintain present initiatives*

Present efforts will be maintained, and no new initiatives are called for.

D 4.4.3 Regulation

Municipalities must assign garden waste to treatment. Garden waste can be treated in home composting without permission from municipal councils, as long as the relevant regulations are complied with.

Incineration of waste is only permitted in approved plants. Municipalities may permit private burning of garden waste.

D 4.4.4 Implications for national authorities

None.

D 4.4.5 Implications for municipal waste authorities

Municipalities will continue their information initiatives regarding schemes for home composting and/or collection and central composting, and will ensure that the present recycling rate for garden waste is maintained.

D.5. Industry

Environmental problem	Increasing volumes of waste from industry – a large proportion of which is landfilled
Initiatives	Guidelines on waste reduction conditions for enterprises both subject to and exempt from approval Improved information on waste in green accounts, environmental management, environmental approvals, and through sector-specific briefings Develop and improve tools to help enterprises and commercial waste consultants in relation to the analysis and minimisation of enterprise waste generation and management Develop recycling technologies that make it possible to recycle enterprise production waste internally within the enterprise Establish a knowledge base for new treatment and recycling methods Develop alternative recycling for packaging glass and plane glass Develop reprocessing methods for problematic flows of waste, e.g. impregnated wood, PVC and shredder waste Investigate the possibility of directing animal waste to biogasification, especially abattoir waste, and the possibility of recovering phosphor from slag from the incineration of meat-and-bone meal Lay down requirements for increased recycling of plastic components from vehicles and utilise a greater proportion of waste from end-of-life vehicles Initiate information campaigns to limit damage during fitting, and promote the sale of retreaded tyres Implement the EU Directive on waste electrical and electronic equipment, including regulations for the management of refrigeration equipment and producer responsibility Develop environmentally-friendly packaging and improve packaging design to allow complete emptying Improve the collection of plastic packaging from trade and industry Increase the recycling of wooden and metal packaging, hazardous waste, and waste with a high environmental impact Increase the re-use and recycling of large plastic containers Special initiatives aiming sectors that landfill large volumes of waste (for example foundries and scrap enterprises)

D 5.1 Status

Aims for 2008

- *65 per cent recycling of waste from industry*
- *maximum of 15 per cent landfilling*
- *improved collection of hazardous waste*

Industrial waste in this connection refers to waste from discarded products and production waste from manufacturing enterprises.

Waste prevention must be improved, and recycling of industrial waste must be increased - including hazardous waste. Environmentally harmful waste fractions must be separated, and separate treatment technologies must be developed so that energy and raw material resources are utilised to a maximum extent.

The volume of industrial waste has reduced by 11 per cent from 2000 to 2001. In 2001, the volume of waste was 2,616,000 tonnes. The recycling aim for 2008 is 65 per cent, and the volume of landfilled waste must not exceed 15 per cent[17].

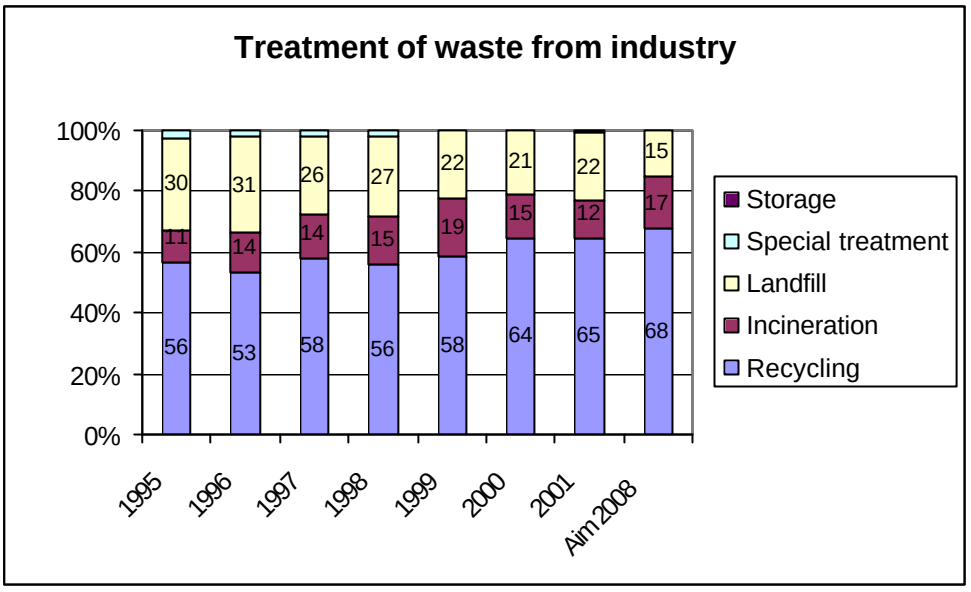
Continued focus will therefore be given to industrial waste and the loss of resources connected with waste generation. In future, information on waste generation, waste composition, and options for separating environmental contaminants from waste will be important elements in green accounting and environmental approvals, as well as in environmental management.

The green accounts were evaluated in late 1999. On the basis of this evaluation, the regulatory base has been adjusted.

In 2001, 22 per cent of waste was landfilled, 65 per cent was recycled, and 12 per cent was incinerated[18]. The volume and composition of industrial waste vary greatly and depend on the sector generating the waste, and the size and number of enterprises. The options for recycling or reducing volumes of waste are therefore very different from one waste fraction to another, and from one sector to another.

[17] Waste 21 1998-2004: the goal for 2004 was that industry should recycle 65 per cent, and that no more than 15 per cent of waste should be landfilled.

[18] The rise in landfilling and the decline in incineration is partly due to the separation of PVC, impregnated wood, and electrical and electronic equipment.

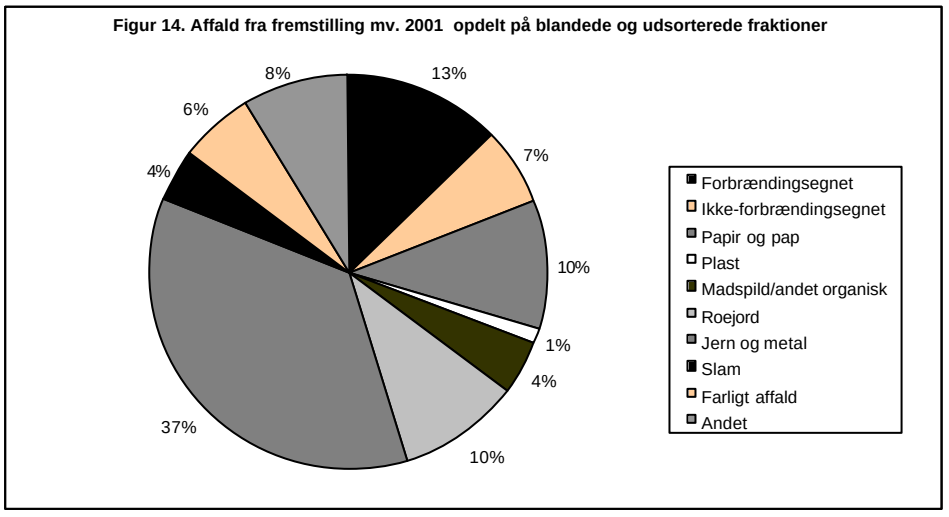


Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

For sectors containing many small enterprises, it may be crucial to collect waste in larger units, to provide the necessary supply and economic basis for recycling.

The figure below shows a summary of industrial waste divided by form of treatment. The figures shows that the “iron and metal”, “suitable for incineration”, “not suitable for incineration”, and “beet soil” fractions account for the largest volumes of industrial waste.

Fig. 8. Waste from production, etc., 2001, divided into mixed and separated fractions



Summary of waste from manufacturing enterprises divided by form of treatment
Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003

The "not suitable for incineration" fraction is mainly landfilled. This fraction primarily contains beet soil, foundry waste, and waste from scrap enterprises. Consideration should be given to whether it is possible to recycle beet soil instead of landfilling this fraction.

A project has been carried out to identify where the largest and most important volumes of waste are generated in the industrial sector. Using a screening method, the most important flows of waste produced by waste-intensive sectors have been identified. The sectors identified were: the pharmaceutical industry, the electronics industry, iron and metal and the furniture industry. The volume and types of waste from these sectors have been analysed and the disposal channels have been evaluated.

The evaluation showed that the most harmful fractions come from the iron and metal industry. The volumes of waste analysed within the other sectors are estimated to represent either small volumes, or waste with relatively low environmental impact. It was found that waste from these sectors is being disposed of in a responsible manner. The volume of waste can possibly be reduced or recycled to a greater extent.

BAT – Best Available Techniques
Following up on the IPPC Directive, the European Commission, supported by national experts, regularly prepares "BAT Reference Documents" – or BAT notes – containing information on best available techniques within a number of sectors. BAT refers to the technique that is technically possible and economically viable for a particular type of enterprise. BAT notes are primarily issued for IPPC enterprises. The information for non-list enterprises is limited.

The aim of the BAT notes is to provide information about the level of contamination that can be achieved using the best available technology. Energy consumption and waste generated from production are included as an integrated part of this assessment. The technology specified in the BAT notes becomes the standard within the particular branch of enterprises.

The European Commission also intends to prepare BAT notes for reprocessing technologies.

D 5.2 Waste prevention
Waste from enterprises is largely process and packaging waste. Manufacturing enterprises play the role of both producer, and consumer of raw materials, components, and semi-finished goods from suppliers. They can contribute to waste prevention by:

- analysing the enterprise's waste generation and resource consumption
- minimising wastage in the production process
- using quality management systems that contribute to reduced production errors

- demanding products for use in enterprise operations that have a long lifetime, are easy to repair, can be upgraded and are produced with waste prevention in mind
- demanding raw materials produced with waste prevention in mind
- purchasing raw materials and semi-finished goods in returnable packaging
- marketing products that have an eco-label or environmental declaration
- designing products that have a long lifetime, are easy to repair, can be upgraded and for which components can be re-used and packaging consumption minimised

When manufacturing products, enterprises need to take into account demand, market price, costs, technological factors in production, product quality and functionality, and current laws, standards and codes. Thus there are many factors that have influence on an enterprise's decisions in relation to waste prevention initiatives.

A number of administrative tools can help to generate greater focus on waste from enterprises. These include: Part 5 conditions, green accounting, eco-management, and environmental management. Economic mechanisms can also be brought into play in order to reduce volumes of waste from enterprises. Within this category, initiatives such as changes to depreciation rules, duties on raw materials, reduced tax deductions for advertising, etc., can be considered.

D 5.3 Future initiatives

Waste prevention
Information on volumes of waste, composition, and potential for recycling will be improved in future preparation of environmental approvals, green accounts, and in the establishment of environmental management in enterprises, or through sector agreements.

Environmental approvals will be improved in the area of waste management. With the implementation of the IPPC Directive[19] in Statutory Order no. 646 of 29 June 2001 on approval for specially polluting activities, the waste component has been given higher priority. Section 13(2)(4) of the Statutory Order states that enterprises must take the necessary steps to avoid waste generation, and where this is not possible, to exploit the potential for recycling and recirculation.

[19] Industrial Prevention Pollution Control Directive no. 96/61/EC, 24 September 1996.

Measures

- *focus on waste in environmental approvals, green accounts, and environmental management*
- *guidelines and conditions for waste reduction or the establishment of sector agreements*
- *refine the existing waste analysis model*
- *promote internal recycling of waste from enterprises*
- *improve packaging design so that it can be emptied*
- *increase the re-use of large plastic containers*
- *establish a knowledge base for commercial waste consultants*
- *develop alternative recycling options for glass packaging and plane glass*
- *separate recyclable fractions from waste suitable for incineration*
- *requirements for increased recycling of a number of fractions*

Assessment will be made as to whether increased use of environmental management in enterprises can be best achieved through sector agreements or whether guidelines on conditions for waste reduction need to be prepared for enterprises subject to and exempt from approval. These guidelines could also describe BAT's to help reduce waste, etc., for a number of waste-intensive enterprises, and the significance of BAT's in relation to the maximum waste volumes.

The existing waste analysis model will be refined so that it can also be used in large enterprises and in the service sector.

Recycling of enterprises' internal waste will be promoted.

In 2003, a sector initiative was launched for packaging, aimed at ensuring that better packaging systems are developed based on life-cycle analysis, including the development of tools and documentation for minimising material consumption for each type of packaging, and practical tools for using life-cycle assessments in the design of packaging and packaging systems.

Product wastage at the consumer due to inappropriate packaging that is impossible or difficult to completely empty could be significantly reduced if packaging designers and manufacturers developed packaging that it was possible to empty. Packaging manufacturers and producers who fill packaging will therefore be encouraged to develop and use better packaging that reduces wastage. This issue will also be incorporated into the sector initiative for packaging.

Based on an economic assessment, efforts should be made to ensure that large plastic containers (over 20 litres) from industrial enterprises are re-used. It is therefore expected that regulations will be implemented, requiring large containers to be collected for re-use or recycling (see Appendix E).

Recycling

In 2001, "Description and assessment of consultancy schemes for industrial waste in local authorities and waste management companies" was published as Environment Project no. 583. In response to one of the recommendations of the report, an electronic knowledge base will be established in the form of a website aimed at commercial waste consultants, providing information that consultants can use in their daily work. The website will be set up under Waste Centre Denmark's website.

The agreement on transport packaging will be extended to include more materials and commercial packaging types. Commercial metal packaging must be referred to recycling. The collection of plastic film from trade and industry will be improved. Enterprises and municipalities will have to give greater focus to separating plastic film for recycling. Sector associations for waste producers must be able to establish nationwide collection schemes.

Development activities will be initiated aimed at developing alternative recycling processes for glass fragments.

Waste suitable for incineration contains recyclable fractions that must be separated because they can be recycled, or contain environmental

contaminants. In future, industry must separate paper and cardboard, plastic packaging, electrical and electronic equipment, PVC, iron and metal packaging, and impregnated wood (see Appendix E).

The EU Directive on waste electrical and electronic equipment, based on producer responsibility, must be implemented (see Appendix E).

An investigation will be carried out into the options for recycling greater volumes of animal waste for agricultural purposes through biogasification (see Appendix E).

Requirements will be laid down for increased recycling of plastic components from vehicles and utilising a greater proportion of waste from end-of-life vehicles (see Appendix E).

An information campaign will be launched to limit damage during fitting and promote the sale of retreaded tyres (see Appendix E).

A strategy will be prepared for the management of hazardous waste (see Appendix E).

Landfilling
In general, too much industrial waste is landfilled. Specific initiatives will be carried out, targeting individual fractions and sectors. See Appendix E on foundry and shredder waste, electronic equipment, refrigeration equipment, and end-of-life vehicles.

D 5.4 Regulation

Under Statutory Order no. 646 of 29 June 2001 on approval for specially polluting activities, before issuing approvals, authorities must assess whether an enterprise has taken the necessary precautions to prevent contamination, including waste generation.

Management of industrial waste is regulated in the Statutory Order on waste[20]. Enterprises are responsible for knowing the composition of waste, assessing whether waste is hazardous, and notifying the municipality if it is.

Municipalities must assign disposal options for industrial waste. Municipalities must also establish collection schemes for hazardous waste from enterprises.

Special Statutory Orders have also been prepared for the following specific flows of waste:

- Statutory Order no. 655 on recycling of residues and soil for building and construction purposes.
- Statutory Order no. 1067 of 22 December 1998 on management of waste from electrical and electronic products.

[20] The Ministry of the Environment's Statutory Order no. 619 of 27 June 2000, on waste.

Enterprises are currently required to separate cardboard, paper, paper board, steel drums, electrical and electronic equipment, PVC, impregnated wood and plastic transport packaging for recycling[21] and special treatment/landfilling.

D 5.5 Environmental assessment

Greater focus on enterprise production waste will increase opportunities for recycling, and minimise waste generation and landfilling.

The specific requirements laid down in relation to collection and reprocessing in the special Statutory Orders increase the opportunities for recycling some of the most problematic flows of waste and minimise the environmental risks associated with disposal of the remaining waste.

Increased separation of environmentally harmful waste fractions will lead to better recycling opportunities for residues. Separation of recyclable fractions from the waste suitable for incineration fraction will also mean that resources in waste are utilised, and that the need for incineration capacity is reduced.

D 5.6 Implications for national authorities

Packaging manufacturers and producers who fill packaging will be encouraged to develop and use better packaging that reduces wastage.

The EU Directive on waste electrical and electronic equipment must be implemented.

The collection of plastic and metal packaging from industry will be improved.

Requirements are expected to be laid down stipulating that large plastic containers must be collected for re-use or recycling.

The volume of wooden packaging will be analysed and an estimate will be made for how the goal of 15 per cent recycling will be achieved.

A number of sector-specific briefings will be prepared.

D 5.7 Implications for municipal and county authorities

Use of Chapter 5 approvals in connection with waste minimisation and increased recycling of enterprise production waste will place greater demands on county competence in particular.

Municipalities must extend the collection and source separation of cardboard, plastic, impregnated wood, and waste electrical and electronic equipment, and must assign separated waste fractions for recycling, landfilling, or special treatment.

[21] Section 36 of the Statutory Order on Waste.

D.6. Institutions, trade and offices

Environmental problem	Volumes of waste are increasing dramatically. Currently, less waste is recycled than desired, and consequently resources are lost. Waste from the trade and service sector contains environmental contaminants that must be separated for separate treatment
Initiatives	Encourage the trade and repair sector to use re-usable boxes in transport and logistic systems Develop and improve tools to help enterprises and commercial waste consultants in relation to the analysis and minimisation of enterprise waste generation and management The management of organic waste from the trade of convenience goods will be evaluated The collection of plastic packaging will be improved Investigate how the recycling of wooden packaging can be organised Prepare draft requirements for the management of PVC waste The EU Directive on waste electrical and electronic equipment must be implemented by the end of 2004 Prepare environmental guidelines for public purchasers of a number of electrical and electronic products and eco-labelling criteria for several products Regulations for the management of refrigeration equipment will be included in a revised Statutory Order on management of waste electrical and electronic equipment More stringent requirements for the management of waste from vehicles and the separation of recyclable and environmentally harmful fractions Information campaign to promote the use of retreaded tyres

D 6.1 Status

Aims for 2008

- *50 per cent recycling*
- *45 per cent incineration*
- *5 per cent landfilling*

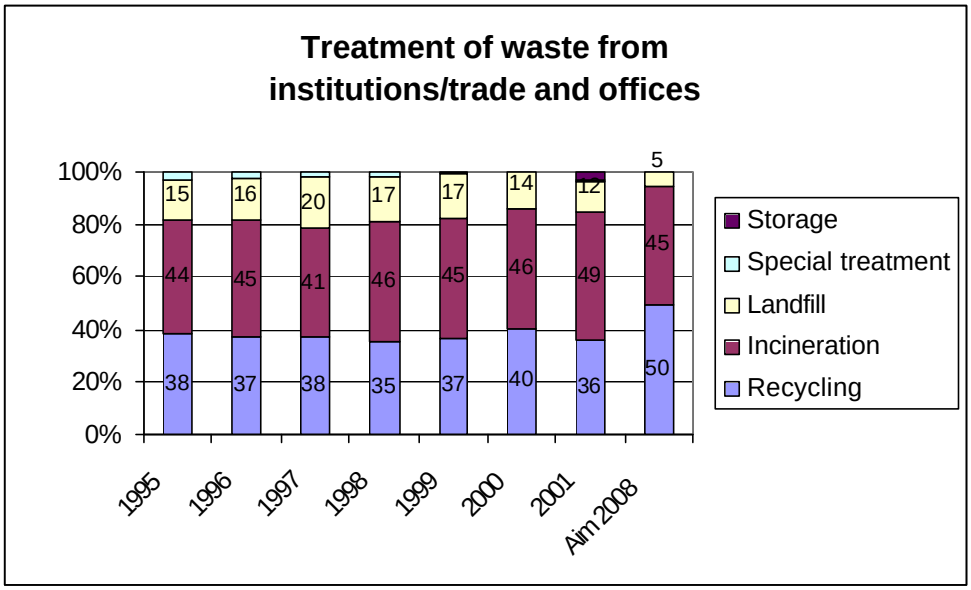
This sector covers waste from institutions, trade, and private and public offices, i.e. the trade and service sector.

The volume of waste from the trade and service sector is increasing dramatically. Recycling of waste from this sector must be increased, and environmentally harmful fractions must be separated for special treatment.

Enterprises and public and private institutions play an important role in increasing the separation of recyclable materials and environmentally harmful fractions.

In 2001, the total volume of waste was 1,307,000 tonnes[22]. The volume of waste from the trade and service sector increased dramatically by over 25 per cent from 1994 to 1995, but has only risen by between one and two per cent per annum between 1995 and 1997. Between 1999 and 2001, there was again a dramatic increase of 17 per cent per annum.

In 2001, the rate of recycling was 36 per cent, which is below the objective of 50 per cent for 2004. 49 per cent of waste was incinerated, and 12 per cent landfilled. A further three per cent was stored temporarily. Since there has been a significant increase in the volume of waste from the trade and service sector, it is not expected to be possible to increase the rate of recycling. The aim for recycling has therefore been maintained at 50 per cent. It is still the case that it is not expected that landfilling can be completely avoided.



Source: Waste Statistics 2001

Waste consists of many different waste fractions. With the aim of supporting targeted initiatives for the sector as a whole, an investigation has been carried out into the composition of waste in a number of industries within the service sector: trade of convenience goods, other retail trade, garages, hotels, etc., schools and institutions, and office enterprises. An analysis of the volume of waste from the trade of convenience goods has been carried out using classifications in a number of shops. If the volumes found are extrapolated to the national level, there are approx. 212,000 tonnes of waste annually. Of this amount, approx. 38 per cent was cardboard, approx. 22 per cent was organic waste, and approx. 39 per cent was waste suitable for incineration[23]. An investigation of the volume of waste in a number of other sub-sectors within

[22] In Waste 21, the Government's waste plan 1998-2004, the goal was to recycle 50 per cent of the waste from institutions, trade and offices, to incinerate 45 per cent, and to landfill 5 per cent.
[23] Environment Project no. 671 2002: Analysis of waste from the trade of convenience goods in Denmark.

the area of trade, offices and institutions has also been carried out. This analysis showed that there was a significant potential for recycling larger quantities. But there are large variations in the volume of waste between sectors and between enterprises in the same sector[24].

Many municipalities and waste enterprises have established schemes involving waste consultants, with the aim of increasing information on municipal regulations and guiding enterprises towards more appropriate waste management. An evaluation of the schemes revealed that approx. 200 municipalities were covered by a consultant scheme in 2000. The evaluation also showed that the schemes are successful in drawing attention to waste from enterprises, leading to better separation of environmental contaminants and the movement of waste from landfilling and incineration to recycling.

D 6.2 Waste prevention

Waste from the trade and service sector consists mainly of end-of-life products. Initiatives in this sector should be targeted at helping the service sector to be better at providing immaterial services, so that the population can shift from material consumption to immaterial consumption. It is important that the sector is able to provide services that can increase product lifetimes, e.g. repair services. The volume of waste from the sector can be further reduced by using standardised re-usable packaging within the sector.

Service enterprises and the trade sector play an important role in waste prevention since they both purchase goods (and can hence place demands on suppliers) and offer goods/services for sale to consumers (and can thus influence demand).

Service enterprises can contribute to waste prevention by:

- providing services (e.g. repair services) that ensure that product lifetimes are increased
- demanding and consuming products that have a long lifetime, are easy to repair, and are produced with waste prevention in mind
- using products shipped in returnable packaging
- introducing administration procedures to prevent waste generation
- marketing leasing schemes in which product lifetimes are optimised through component re-use and maintenance

The trade sector can contribute to waste prevention by:

- purchasing and selling eco-labelled products, produced with waste prevention in mind, shipped in packaging that has been minimised or is returnable
- demanding products for use in enterprise operations that have a long lifetime, are easy to repair, and are produced with waste prevention in mind
- providing storage and transport systems that minimise packaging and using return systems for transport packaging
- participating in deposit and return systems for retail sales packaging

Measures

- *encourage the trade and repair sectors to use re-usable boxes for transport packaging*
- *refine the existing waste analysis model*
- *evaluate the management of organic waste from the trade of convenience goods*
- *increase the collection and recycling of plastic packaging*
- *sector associations for waste producers must be able to establish nationwide collection schemes for plastic film*

[24] Environment project no. 723 2002: Detailed analysis of the composition of waste in the service sector

- carrying out information campaigns that promote the sale of environmentally-friendly products

D 6.3 Future initiatives

A number of the initiatives launched in this sector will be targeted towards specific fractions.

Waste prevention
Steps need to be taken to encourage the trade and repair sectors to make greater use of re-usable transport packaging and extend, improve and optimise the use of returnable transport packaging, as, for example, is seen today for milk crates and boxes for fruit and vegetables. These are used for transportation and can be directly use in shops to present goods. Another example is Toyota Denmark, who have begun using specially-produced re-usable boxes for smaller items. These items were previously transported in cardboard boxes that were discarded after being used once. This initiative has achieved savings in excess of DKK 1 million in the transport and logistics system.

- *Investigate how the recycling of wooden packaging can be organised*
- *collect PVC in an environmentally appropriate manner*
- *regulations for the treatment of refrigeration equipment will be incorporated into the Statutory Order on management of waste from electrical and electronic products*
- *more stringent requirements on the management of waste from vehicles*
- *requirements for the management and disposal of electrical and electronic equipment, environmental guidelines for public purchasers of electronic office equipment, and the appointment of a product panel*
- *information campaign to promote the use of retreaded tyres*

The existing waste analysis model will be refined so that it can also be used in large enterprises and in the service sector.

The Danish Environmental Council for Cleaner Products appointed a Retail Trade Panel in 2002. The aim of the panel is to generate activities to change attitudes and behaviour, with the aim of reducing the total environmental impact from retail trade. The panel also aims to promote the range of and market for cleaner products in the area of convenience goods. The panel will also examine the indirect environmental impact from associated transport and packaging, and the operational waste and resources linked to the sale of products. In the area of waste management, the panel will initiate activities relating to organic waste, packaging waste, shop personnel training and packaging systems.

Recycling
There are large quantities of organic waste in convenience stores. The best way of managing organic waste from the trade of convenience goods is to be determined in cooperation with the Retail Trade Panel and the food authorities. Ways of making it easier for retail chains to organise nationwide collection of organic waste will also be investigated.

The collection of plastic packaging from trade and industry will be enhanced by improving the separation of transport packaging film. Waste producers will have to participate more actively in the organisation of effective schemes. It needs to be easier for sector associations that represent waste producers/retail chains to establish nationwide collection schemes. Separation of other plastic packaging from trade and industry must also be increased. These initiatives are described in more detail in Appendix E22.

Investigation will be made into how the recycling of wooden packaging can be organised.

Efforts will be made to ensure that PVC waste is managed in an

environmentally appropriate manner. This can be achieved by drawing up requirements for the collection and management of PVC waste, and providing tax exemption for products that are managed in an environmentally responsible manner.

Regulations on the waste treatment of refrigeration equipment will be incorporated in a revised Statutory Order on management of waste electrical and electronic equipment, expected to be issued in 2004.

An amendment to the Statutory Order on end-of-life vehicles will lay down requirements for increased recycling of plastic components.

The EU Directive on waste electrical and electronic equipment must be implemented in Danish legislation, in requirements governing the management and disposal of electrical and electronic equipment. Environmental guidelines will also be prepared for public purchasers of electronic office equipment. Finally, a product panel will be appointed, focusing on electronic equipment.

An information campaign will be carried out to promote the use of retreaded tyres.

D 6.4 Regulation

Municipalities must assign treatment or disposal options for waste generated in this sector.

Enterprises, institutions, offices, etc., are currently required to separate cardboard, paper, paper board, steel drums, and plastic transport packaging for recycling.

As of 1 August 2003, in the Statutory Order on sludge, new regulations for the recycling and disposal of animal waste, including commercial kitchen waste, have been drawn up in cooperation with the Ministry of Food, Agriculture and Fisheries. The scheme for food waste from commercial kitchens has been evaluated and discontinued against the background of the prohibition against use in pig food.

In 1994, an agreement was made between the Ministry of the Environment and Energy, the Confederation of Danish Industries, the Danish Plastics Federation and the Packaging Industry on transport packaging. The agreement set goals for the recycling of paper/cardboard and plastic transport packaging. The committee for the Agreement on Transport Packaging continues to monitor the agreement to ensure future recycling goals are fulfilled for packaging made from plastic, paper and cardboard, metal and wood.

D 6.5 Capacity

There is no shortage of treatment capacity for the majority of recyclable fractions. For several environmentally harmful fractions, treatment methods have not yet been fully developed.

D 6.6 Environmental assessment

Initiatives to increase recycling will reduce the need for incineration and landfill capacity and ensure the utilisation of resources in waste.

It is not possible to estimate how much the volume of waste can be reduced through these waste prevention initiatives.

D 6.7 Implications for national authorities

The trade and repair sectors must be encouraged to increase the re-use of transport packaging.

D 6.8 Implications for municipal authorities

Municipalities must improve the information on existing schemes and the supervision of enterprises and institutions in this sector, especially in relation to the obligation to use assignment schemes for recyclable waste.

D.7. Power plants

Aims for 2008

- *90 per cent recycling of residues from coal-fired power plants*
- *reduce coal-based energy generation*
- *ensure that recycling of bioash takes place in an environmentally responsible manner*

Environmental problem	The use of coal as an energy source leads to the emission of large quantities of CO_2. Under initiatives to counter climate changes, the use of coal as a fuel must cease
Initiatives	Implementation of Energy 21 Re-evaluation of current regulations for the recycling of bioash for agricultural purposes

D 7.1 Status

The Danish power supply has been largely based on coal. In 1996, the Danish Government presented a comprehensive plan of action for energy - Energy 21 – aimed at ensuring that Denmark contributed to reducing CO_2 emissions by 20 per cent in year 2005 compared to 1988 levels.

The objective of Energy 21 is to reduce energy consumption by utilising energy more efficiently, and to convert the energy supply from fossil fuel to renewable energy sources.

As a consequence, the use of coal as a fuel will be phased out almost completely within the next 30 years, in parallel with an increase in energy generation based on renewable energy, including biofuel.

Biofuels are currently being used at both heat and electricity generating plants.

Energy generation produces varying amounts of residues. For example, oil and natural gas-fired power plants generate hardly any residues.

The volume of residues generated depends on how much electricity is generated and electricity imports and exports. The volume of waste from power plants can therefore only be reduced by reducing how much electricity is generated, increasing power plant energy efficiency, or by phasing out fuels that generate waste, such as coal.

Phasing out coal-based energy generation will have a crucial impact on the volume of residues generated. These are expected to fall significantly over the next 30 years. On the other hand, increasing the use of biofuel will lead to an increase in the volume of bioash. Recycling this waste fraction will be given high priority in the years ahead.

To date, residues from coal-fired power plants have accounted for the largest waste fraction from power plants. Residues from coal-fired power plants include slag, fly ash, gypsum, TASP and sulphuric acid. Residues contain a number of heavy metals, limiting recycling options.

The Waste 21 objective of 90 per cent recycling of residues from coal-fired power plants has been reached. In 2001, the registered recycling rate was 99 per cent.

The volume of residues has fallen since 1996. This is due to the decline in the export of electricity from Denmark in recent years, and the stated objective in the former Government's energy plan, Energy 21, that the use of coal should be discontinued in the long-term and be replaced by natural gas and renewable energy, including biofuel.

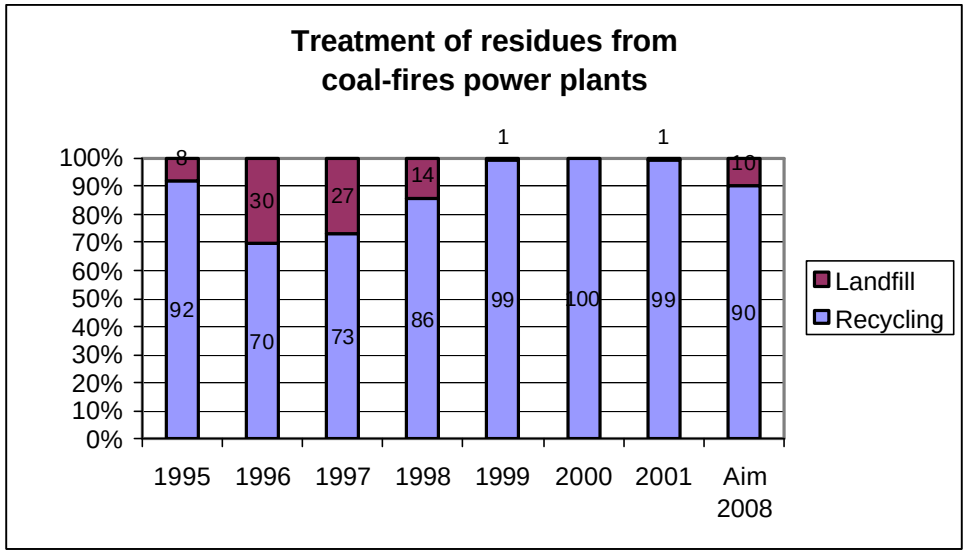
In 2000, the Statutory Order on the recycling of bioash was issued. This Order makes it possible for the nutrients in bioash, primarily potassium and phosphor, to be recycled as fertiliser in agriculture and forestry. Calculations have shown that 64 per cent of bioash was recycled in 2000.

Measures

- *implementation of Energy 21*

D 7.2 Future initiatives

Energy 21 will be implemented. The Plan of Action is particularly part of initiatives to combat climate change. However, phasing out coal-fired power plants will also lead to a reduction in residues.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003.

The Statutory Order on bioash will be revised to incorporate the latest knowledge on the availability of nutrients in hardened bioash.

D 7.3 Regulation

The waste tax was restructured in December 1998 to include the landfilling of residues under the higher charge for landfilling. This provides a further incentive to reduce the volume of residues or to recycle them.

Energy 21 will lead to a conversion from the use of fossil fuel to renewable energy sources.

The recycling of bioash for agricultural purposes is regulated in Statutory Order no. 39 of 20 January 2000 on the use of ash from the gasification and incineration of biomass and biomass waste for agricultural purposes.

D 7.4 Environmental assessment

In the long term, residues from coal-based energy generation will disappear as energy generation based on coal is phased out. As a consequence, leaching of metals and salts from such residues will cease. The value of bioash as a fertiliser will be utilised. The regulation is based on a recirculation principle, such that each forest and piece of farmland cannot have more heavy metals added (especially cadmium) than were taken away in the original biomass (straw or wood).

D 7.5 Implications for national waste authorities

None.

D 7.6 Implications for municipal authorities

None.

D.8. Public wastewater treatment plants

Environmental problem	Sewage sludge represents a resource that can be utilised for agricultural purposes
Initiatives	General phase out of environmental contaminants

D 8.1 Status

Aims for 2008

- *50 per cent recycling of sludge for agricultural purposes*
- *25 per cent incineration of sludge with recycling of the ash in industrial processes*
- *20 per cent incineration*
- *5 per cent landfilling*
- *influence the EU's revision of the Sludge Directive*

In 1987, the Danish Folketing adopted an Action Plan for the Aquatic Environment. Under this plan, wastewater treatment from all wastewater treatment plants larger than 5,000 person equivalents was to be improved before 1 January 1993. Extensions to the wastewater treatment plants were completed in the beginning of 1996.

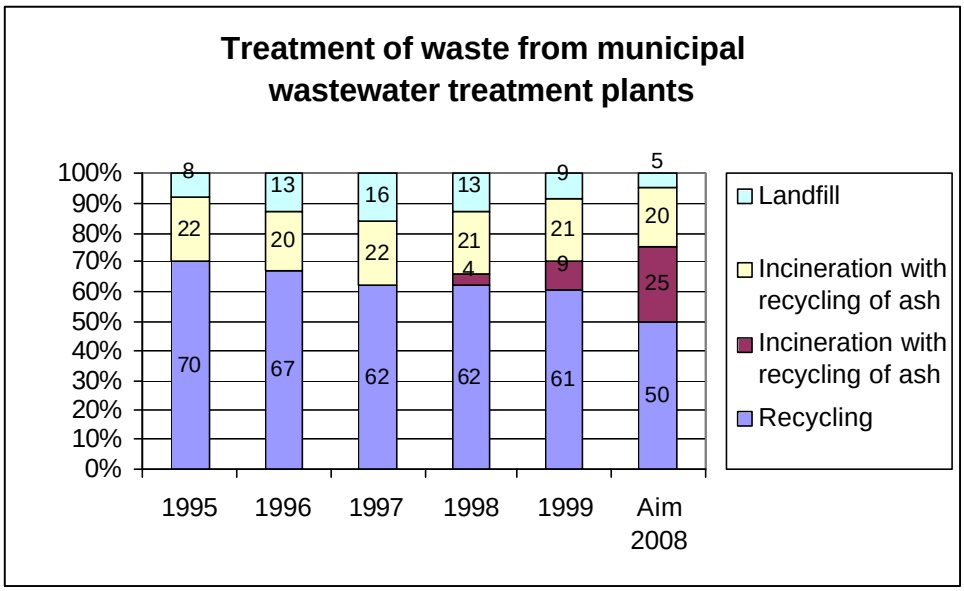
Waste from wastewater treatment plants consists of sludge, sand, and screenings. There has been stable production of between 150,000 and 160,000 tonnes of sludge dry matter annually in recent years. For a typical dry matter content of 20 per cent, this is equivalent to 750-800,000 tonnes of wet sludge. In 2001, a further approx. 100-200,000 tonnes of waste in the form of sand and screenings was generated at municipal wastewater treatment plants, with a dry matter content of 25 per cent. No significant changes are expected in these volumes in future in terms of dry matter. However, sludge treatment technologies will significantly change the dry matter content at the time sludge is recorded, leading to a significant increase in the total volume in terms of wet weight.

Of the total volume of waste from wastewater treatment plants in 1999, 61 per cent was recycled, 9 per cent was incinerated with the ash recycled in industrial process, 21 per cent was incinerated, and 9 per cent was landfilled. This means that the Waste 21 objective of 50 per cent recycling of sludge in 2004 has been fulfilled.

In 1997, requirements governing the content of certain organic environmental contaminants in sludge were introduced, and these were made more stringent in 2000 and 2002. These requirements, together with the increased pressure on soil from livestock manure, are expected to lead to a continuing decline in the recycling of sludge for agricultural purposes.

An increased proportion of sludge is expected to be used in thermal industrial processes in the years ahead, primarily the production of sandblasting sand and cement. Under these processes, the sludge is incinerated and the inorganic component, typically 30-40 per cent of the sludge's dry matter, is incorporated into the products.

Incineration processes in which the ash is used, for example, to produce sandblasting sand or cement, are not considered to be recycling, but rather disposal with intelligent utilisation of the inorganic residue. Proper recycling would require that the nutrient contents of the sludge were utilised.



Source: Waste Statistics 2001, Danish Environmental Protection Agency 2003, Briefing from the Environmental Protection Agency no. 3, 2001. The percentages given are based on dry matter figures.

D 8.2 Future initiatives

In the long term, it is expected that the quality of sludge and its recycling potential will be improved through the general policy of phasing-out environmental contaminants. The levels of these substances in sludge are thus expected to be further reduced.

Denmark hopes to influence the revision of the EU Sludge Directive so that it contains more stringent requirements on the levels of heavy metals, in line with the Danish limits, and introduces requirements for certain organic environmental contaminants.

D 8.3 Regulation

The application of sludge to farmland is regulated in the Statutory Order on sludge[25], and the Statutory Order of the Ministry of Food, Agriculture and Fisheries on inspection of the quality of municipal sewage sludge and

[25] Statutory Order no. 49 of 20 January 2000 on the use of waste products for agricultural purposes.

composted household waste applied to farmland[26]. The Statutory Order on sludge lays down limit values for a number of heavy metals and cut-off values for these organic xenobiotic substances: NPE, DEHP, LAS, and certain PAH's.

The Statutory Order on sludge is being revised in spring 2003 as a result of the EU Animal By-products Regulation.

D 8.4 Environmental assessment

The levels of environmental contaminants in sludge are expected to be reduced in the long term, making it possible for sludge to continue to be recycled for agricultural purposes, thus allowing the nutrient contents of sludge, especially phosphor, a limited world resource, to be recycled.

For sludge that is not recycled for agricultural purposes, it is important that the inorganic contents (the ash) can be recycled in industrial processes such as the production of cement and sandblasting sand.

D 8.5 Implications for national waste authorities

None.

D 8.6 Implications for municipal authorities

None.

[26] Statutory Order no. 56 of 24 January 2000 on inspection of sewage sludge used for agricultural purposes.

Fractions

E.1. Animal waste including food waste from industrial kitchens

Environmental problem	Use of animal waste for feed has been banned, and alternative methods of recycling must therefore be developed.
Initiatives	Studies of the possibility to add animal waste to biogas, especially waste from abattoirs. Examine the possibility of recovering phosphorus from the slag from incineration of meat-and-bone meal.

E 1.1 Status

Aims for 2008:

- *increase the amount of animal waste for biogasification*
- *recover phosphorus from slag after incineration of meat-and-bone meal*

Animal waste is produced at abattoirs, by the fish industry, and at industrial kitchens. A large amount of the animal waste has previously been considered as a homogenous by-product and therefore it has not been included in the ISAG (the Information System for Waste and Recycling, see Appendix B), but it has been reprocessed into meat-and-bone meal and lard.

Industry produces 1.0-1.5 million tonnes animal waste per year. The waste is biologically degradable waste and often has a low dry matter content.

To date, most of the waste has been recycled, either through reprocessing into meat-and-bone meal and lard, or by adding it to biogas plants as an energy source. However, the problems of the BSE and foot-and-mouth epidemics in Great Britain in 2001 have meant increased focus on recycling and management of animal waste. This led to a Regulation from the EU on animal by-products in autumn 2002.

In future there will be severe restrictions or bans on using animal waste in meat-and-bone meal for feed for livestock. The approximately 800,000 tonnes of animal waste converted to meat-and-bone meal and lard each year will in future be recycled as fertilizers after sanitation, or it will be incinerated. This will reduce recycling from the previous level of 95 per cent. The content of phosphorus in meat-and-bone meal is an important resource and it should be exploited. The total phosphorus content in meat-and-bone meal could fertilise 400,000 hectares.

Food waste from industrial kitchens[1] has previously been reprocessed into animal feed. This is no longer allowed from 1 November 2002, and future management of waste from industrial kitchens has been evaluated. This evaluation has led to a lifting of the requirement to collect food waste from

[1]Defined as kitchens producing more than 100kg food waste per week.

industrial kitchens from 1 August 2003. In recent years, approximately 22,000 tonnes waste from industrial kitchens has been collected each year.

E 1.2 Future initiatives

Measures:

- *trials with biogasification of animal waste and meat-and-bone meal have been carried out.*
- *extraction of phosphorus from meat-and-bone meal slag is being tested*

New regulations for recycling and disposal of animal waste, including waste from industrial kitchens were being prepared in spring 2003 in cooperation with the Danish Ministry of Food, Agriculture and Fisheries. The reason for the change is that it is not permitted to use this waste in animal feed. The regulations are included in the Statutory Order on sludge and aim at securing optimal treatment of animal waste on the basis of environmental considerations.

Studies are being carried out into the possibilities to increase the amounts of animal waste being recycled by agriculture through biogasification.

Trials are being carried out on recovering phosphorus from slag from incinerating meat-and-bone meal.

E 1.3 Regulation

In spring 2003, new regulations were prepared for managing animal waste and waste from industrial kitchens. These regulations were issued by the Ministry of Food, Agriculture and Fisheries and the Danish EPA.

E 1.4 Capacity

Joint biogas plants and biogas plants on farms will be able to receive part of the organic waste products. However, for meat-and-bone meal it will not be possible to add the entire amount, partly because of the high content of fertilizer in meat-and-bone meal, particularly phosphorus, and the problems associated with this when it is spread on fields.

Therefore, much of the production of meat-and-bone meal will continue to be incinerated in the future.

E 1.5 Environmental assessment

The ban on using meat-and-bone meal and waste from industrial kitchens in feed for livestock means significant reorganisation of the management of animal waste and a greater proportion will have to be incinerated. Meat-and-bone meal has a positive calorific value (about 15-16 MJ/kg) but a lot of energy is used when the destruction installation treats the animal waste. Therefore, the environmental advantages of burning animal waste directly should be considered.

E 1.6 Economic aspects

With the adoption of the EU Regulation on animal by-products[2] the use of meat-and-bone meal as feed has been banned until further notice. Similarly, it is banned to use waste from industrial kitchens in feed.

In future, Danish production of meat-and-bone meal must therefore be incinerated in whole or in part. The amount has been assessed at about 200,000 tonnes per year. The Waste Tax Act was amended in 2000 so that incineration of meat-and-bone meal and animal fat was exempted from waste taxes. Incineration of meat-and-bone meal takes place at incineration plants and by the cement industry. The annual costs of incineration of meat-and-bone meal alone are about DKK 100 million. In addition to these, the costs of collection and treatment amount to about the same figure.

Repealing the requirement to collect food waste from industrial kitchens[3] will imply less waste-management costs for restaurants and industrial kitchens.

E 1.7 Implications for national authorities

There will be significant follow-up work on the regulations introduced in 2003 as a result of the EU Regulation on animal by-products.

E 1.8 Implications for local authorities

None

[2] Council Regulation (EC) No 1774/2002 of 3 October 2002 on health rules concerning animal by-products not intended for human consumption.
[3] Statutory Order no. 624 of 30 June 2003 on repealing the Statutory Order on municipal collection of food waste from industrial kitchens.

E.2. Asphalt

Environmental problem	Asphalt is a significant proportion of the total waste from building and construction, and it will take up landfill capacity if it is not reused or recycled.
Initiatives	It must be ensured that asphalt is recycled appropriately in relation to the environment and health.

E 2.1 Status

Aims for 2008:

- *ensure a high rate of recycling and/or reuse of broken-up asphalt*
- *ensure that recycling of broken-up asphalt takes place appropriately in relation to the environment and health*

Asphalt is composed of stone, gravel, sand, filler, and an oil distillate (bitumen). Filler can be materials such as chalk, cement, and fly ash.

In 2001, asphalt comprised 11 per cent of the total amount of waste from building and construction. Most waste asphalt is either reused or recycled.

Recycling asphalt primarily takes place at stationery plants or semi-mobile plants, but some is reused directly by mobile plants. Stationery recycling is the most widespread type and at these plants old, broken-up asphalt is crushed. After this it is transported for laying either as a bearing course in roads or as a replacement for granular sub-base material.

Semi-mobile plants are smaller units that can be relatively easily transported to new road projects where they act as stationery plants.

Mobile plants are used to mill-off and crush the asphalt, which is subsequently laid directly as new bearing course or wearing surface.

Asphalt treated at a mobile plant is not considered as waste and therefore it is not included in the amounts of waste registered in the ISAG. The amounts of asphalt registered in the ISAG therefore comprise the recycled amounts at stationery asphalt factories and semi-stationery plants.

It has been estimated that the amount treated corresponds to 37 per cent of the total recycled amount treated at mobile plants (reuse).

The table below is an overview of the total waste amounts.

Treatment option	**1995 tonnes**	**1996 tonnes**	**1997 tonnes**	**1998 tonnes**	**1999 tonnes**	**2000 tonnes**	**2001 tonnes**
Reuse	67,340	67,340	315,610	241,980	208,650	203,500	138,014
Recycling (ISAG)	182,000	182,000	853,000	654,000	563,920	550,000	373,010
Total	249,340	249,340	1168,610	895,980	772,570	753,500	511,024

Source: Waste Statistics

E 2.2 Future initiatives

Measures:

- *issue regulations or guidelines for recycling broken-up asphalt*

It must be ensured that in future asphalt is recycled appropriately in relation to the environment and health.

The first step is to ensure that the health risks in laying crushed asphalt are minimised. This will take place by demanding that asphalt is compressed or stamped after laying so that dust emissions are as low as possible.

In the long term it is expected that the Statutory Order on recycling residual products and soil in building and construction work will include guidelines on recycling asphalt.

E 2.3 Regulation

The guidelines for recycling broken-up asphalt appear today in the circular on use of broken-up asphalt for road-building purposes, etc. This states that recycling broken-up asphalt may take place without restriction, and therefore recycling broken-up asphalt for cushion courses and surfacing in roads, paths, squares, etc. does not require a section 19 permit under the Danish Environmental Protection Act[4]. This applies irrespective of whether these applications are fitted with a waterproof bearing course/wearing surface.

On the other hand, establishment of permanent or temporary landfills of broken-up asphalt requires an environmental approval under part 5 of the Danish Environmental Protection Act.5.

E 2.4 Capacity

There is probably a lack of treatment capacity in Denmark.

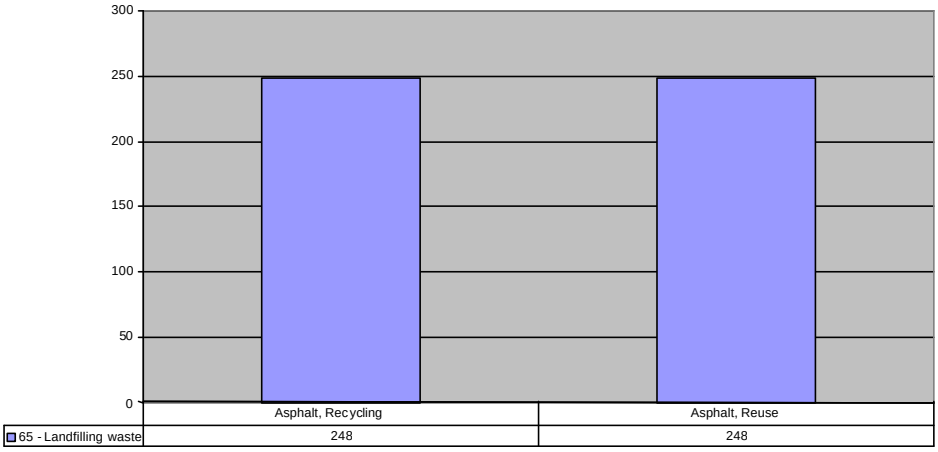
E 2.5 Environmental assessment

After implementation of regulations to reduce dust emissions during laying of broken-up asphalt, the health risks will be reduced.

Waste indicators
The new waste indicators for saving resources, energy and landfill requirements [6] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

[4] Consolidated Act no. 698 of 22 September 1998.
[5] Consolidated Act no. 698 of 22 September 1998.
[6] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

Figure: Saving from reusing and recycling 1 tonne of asphalt waste compared to landfilling the same amount (in mPE)



There is no LCA data for recycling by transporting for reprocessing or reuse at mobile plants. If there is a difference, this will probably be very small as transport distances are typically very short. Therefore, the figure only shows the indicator for savings in landfilling of 1 tonne waste for recycling and reuse respectively. The saving compared to landfilling 1 tonne of waste asphalt is the same for reuse and recycling as both reuse and recycling in this situation give rise to the same treatment.

E 2.6 Economic aspects

It is not expected that changes in the regulations will influence the costs of recycling broken-up asphalt.

E 2.7 Implications for national authorities

New guidelines will be prepared for recycling broken-up asphalt

In addition environmental economic assessments will be carried out of the consequences of allowing recycling of broken-up asphalt to be subject to the Statutory Order on residual products.

E 2.8 Implications for local authorities

In their inspection, the municipalities must ensure compliance with the regulations and guidelines for recycling broken-up asphalt.

E.3. Lead batteries and accumulators

Environmental problem	Batteries and accumulators can contain large amounts of heavy metals, especially lead, but also mercury, cadmium and nickel. Nickel-cadmium batteries not collected make up the most important source of cadmium in waste streams. Mercury is the greatest barrier to effective treatment of batteries. Many batteries also contain resources such as steel, zinc, manganese, and carbon that can be recovered.
Initiatives	New initiatives are pending the revision of the EU Battery Directive. Denmark will work to ensure batteries are collected and recovered. New calculations will be prepared for the potential in nickel-cadmium batteries.

E 3.1 Status

Aims for 2008:

- *the objective is awaiting the revision of the EU Battery Directive*

Special collection schemes and suitable recycling methods exist for lead accumulators and nickel-cadmium batteries. The collection schemes work well.

In 2001, 16,963 tonnes of lead accumulators were sold in Denmark. According to estimates, accumulators mainly derive from the service sector, and from bulky waste. The figure corresponds to the amount of accumulators that become waste each year on average. The collection rate for spent lead accumulators is 98.7 per cent.

Batteries may be subdivided roughly into two categories: single-use batteries and rechargeable batteries (see table).

Types of battery
Single-use batteries:
alkaline batteries that previously contained mercury. Today, however most of these do not contain mercury
pyrolusite batteries that have not contained mercury for many years
lithium batteries
silver oxide
rechargeable batteries:
nickel-cadmium batteries
nickel-metalhydride batteries
lithium batteries

In 2001, 91 tonnes of nickel-cadmium batteries were collected and exported for reprocessing abroad. This figure does not correspond to the actual amount of discarded nickel-cadmium batteries, as it is estimated that many batteries end in waste incineration, where their content of heavy metals contaminates the residues.

On the basis of models[7] it is possible to calculate the potential amount of nickel-cadmium batteries that could be collected. The collection potential can be described on the basis of calculations of the number of batteries that are used up each year. This is combined with an estimate of the length of time spent batteries are stored by the consumer (storage effect), and the length of time the batteries are in the collection system (pipeline effect). On the basis of these figures, the efficiency of collection schemes for batteries can be calculated.

An approximate calculation shows that the collection efficiency for 2001 was between 44 and 75 per cent. Correspondingly, in 2000 58 tonnes was collected, corresponding to a collection efficiency of between 28 and 62 per cent. The variation in the figures is because the calculations are based on payments of allowances for collecting the batteries. The actual collection of the batteries can take place in a year other than the year of registration.

Nickel-cadmium batteries and lead accumulators are reprocessed in Sweden or France.

Experience from many years' collection of batteries in Denmark shows that it is difficult for consumers to distinguish between different types of battery, despite the fact that recyclable batteries carry a special recycling label. The result is that many consumers either collect all batteries regardless of type, or dispose of all types in domestic waste. As a consequence, around half the discarded batteries are collected as a mixture of single-use and rechargeable batteries. The rest are disposed of in domestic waste.

Local authorities, municipal waste companies, and Kommunekemi A/S separate Ni-Cd batteries for recycling. The rest of the batteries collected are landfilled. Mercury-containing batteries are normally landfilled at the Kommunekemi A/S special landfill site, and other types at conventional landfills.

The mercury content in batteries used to inhibit reprocessing. Today, the majority of single-use batteries do not contain mercury, and this makes recovery much easier. Internationally there has been great progress in developing new technologies to recover the resources in batteries not containing mercury. It is therefore expected that far more batteries can be recovered in future. Once they are completed, Danish studies initiated in 2002 will reveal opportunities to recover Danish batteries.

However, a prerequisite for efficient recycling is that reliable separation technologies are developed in addition to recovery technologies.

[7] Environmental Project no. 557, 2000, Mass-flow analysis of Cadmium.

It is expected that the EU will revise the current Battery Directive during the period of this Waste Strategy. However, no timetable has yet been set for the revision.

Measures:

- *influence EU negotiations*
- *preparation of new potential calculations*

E 3.2 Future initiatives

At EU level, Denmark will continue its work to influence negotiations on the revision of the Battery Directive so that batteries are collected and recovered. Denmark will also place priority on phasing out heavy metals including cadmium in rechargeable batteries as well as mercury in button batteries.

There will be a need to revise existing calculations for the collection potential of nickel-cadmium batteries as a basis for future efficiency calculations.

Other national initiatives on collection of batteries and phasing-out heavy metals are pending final adoption of the revised EU Battery Directive which is expected to place new requirements for collection and reprocessing.

E 3.3 Regulation

Collection of batteries is regulated in the Statutory Order on Waste[8]. Nickel-cadmium batteries and lead accumulators, together with unseparated batteries are classified as hazardous waste, while pure fractions of, for example batteries not containing heavy metals are generally not hazardous waste.

The collection of nickel-cadmium batteries and lead accumulators is also regulated by economic instruments, and collection is carried out by both private and public companies.

Collection of lead *accumulators* is ensured in an agreement between the Minister for the Environment and the battery industry (Returbat), under which Returbat is responsible for collection of all spent lead accumulators in Denmark. The agreement is supplemented by two Statutory Orders. The first Statutory Order[9] lays down conditions for becoming registered as a collector and eligible to receive subsidies. The second Statutory Order[10] forms the financial basis for the scheme.

Returbat administers the scheme and, on the basis of an approved budget, receives funds from the Danish EPA for payment of subsidies.

A maximum subsidy of DKK 0.9 per kg is available to collectors that deliver spent accumulators to approved recycling facilities.

An environmental tax has been introduced[11] on *nickel-cadmium batteries*. The tax is repaid through an allowance for collecting spent nickel-cadmium

[8]Statutory Order no. 619 of 27 June 2000 on waste.
[9]Statutory Order no. 1060 of 4 December 2000 on subsidies for collecting and recycling lead accumulators.
[10]Statutory Order no. 1061 of 4 December 2000 on fees on lead accumulators.
[11]In 1995 Denmark introduced an environmental tax for nickel-cadmium batteries pursuant to Act no. 414.

batteries. In connection with the scheme, a Statutory Order has been issued[12], stating criteria to be met by collectors of spent nickel-cadmium batteries in order to achieve registration as a professional collector and thereby be granted the allowance.
The scheme is administered by the Danish EPA.

An allowance of DKK 150 per kg is paid for collected spent Danish batteries delivered to an approved recycling facility.

E 3.4 Capacity

Capacity for recovery of lead, cadmium and nickel is available in Sweden and France.

Batteries containing mercury can be treated in Germany, the Netherlands, and Switzerland.

E 3.5 Environmental assessment

Establishment of a collection scheme for all batteries could lead to an even better collection rate, including for nickel-cadmium batteries. Furthermore, in the longer term, collection of all types of battery will provide a better basis for financial exploitation of resources in more types of battery.

However, in order for resources to be exploited, the plastic and mercury content in batteries must not be so high that in causes problems for treatment.

E 3.6 Economic aspects

Exact treatment costs for all types of battery cannot be calculated before treatment methods have been developed. A final decision on requirements for treatment of batteries is pending negotiations and initiatives in the EU, as well as a socio-economic analysis of the various alternatives.

E 3.7 Implications for national authorities

Once the EU Battery Directive has been revised and adopted, the Directive will be implemented in Danish legislation.

E 3.8 Implications for local authorities

Implementation of the Battery Directive in Danish legislation could lead to changes in municipal planning and regulations.

[12] Statutory Order no. 1062 of 4 December 2000.

E.4. Concrete

Environmental problem	Concrete is a significant proportion of the total waste from building and construction, and it will take up landfill capacity if it is not recycled.
Initiatives	Efforts must ensure that concrete is recycled in an environmentally appropriate manner.

E 4.1 Status

Aims for 2008:

- *ensure high recycling of concrete*
- *ensure that recycling of concrete takes place appropriately in relation to the environment*

Concrete and tiles comprise the most significant part of building waste and could replace about 5 per cent of the total Danish gravel and stone consumption.

In 2001, concrete comprised 28 per cent of the total amount of waste from building and construction.

Concrete is crushed and recycled in road construction and as aggregate in new concrete. The distance to landfills and gravel quarries with virgin material determines how attractive it is to recycle concrete.

The amount of pure concrete added to waste treatment plants appears in the table below.

Tonnes	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Recycling				780,000	750,000	1,054,000	949,480

E 4.2 Future initiatives

Measures:

- *changes in regulations for managing concrete*

In the long term, management of concrete will be included in the Statutory Order on recycling residual products and soil in building and construction work.

E 4.3 Regulation

Concrete in building and construction waste is managed primarily through the circular ”Circular on municipal regulations on separation of building and construction waste with a view to recycling”, 1995, as well as the circular ”Utilisation of pure, separated building waste for building and construction purposes”, 1990.

The circular states that municipalities are to prepare a regulation for managing building and construction waste. Municipalities have two options in developing the scheme:

In the first option waste can either be assigned to recycling on-site or to a reprocessing plant.

In the second option waste can either be assigned to recycling on-site or the local council may decide that waste that is not recycled on-site is covered by a collection scheme for recyclable building and construction waste.

In accordance with the circular from 1990, there is a free choice for recycling of pure fractions of concrete. This means that recycling of pure fractions of concrete does not require authorisation under section 19 of the Danish Environmental Protection Act.

E 4.4 Capacity

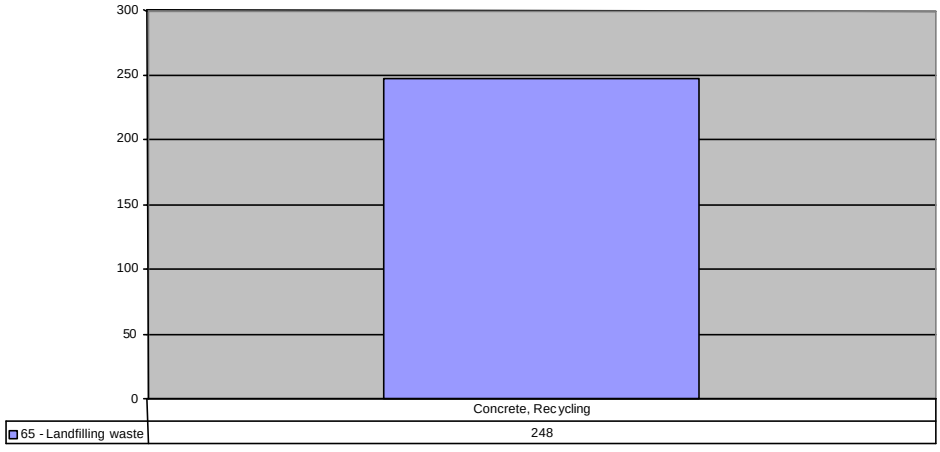
There is considered to be adequate treatment capacity in Denmark.

E 4.5 Environmental assessment

By amending the Statutory Order on recycling of residual products and soil in building and construction work, a more uniform set of regulations will be prepared that ensures that recycling of a number of larger waste fractions takes place on equal terms.

Waste indicators
The new waste indicators for saving resources, energy and landfill requirements13which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

Figure: Savings from recycling 1 tonne of concrete compared to landfilling the same amount of concrete (in 10 mPE)



The figure shows the saving from recycling 1 tonne of concrete compared to landfilling the same amount of concrete. Recycling is the only treatment option included as recycling was the only treatment option for concrete in

[13] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

2000. It has not been possible to include crushing of concrete waste and transport, and therefore only the indicator value for landfills is included in the figure. However, neither has the saving in extraction and transport of sand and gravel from recycling crushed concrete been included. Overall, these omissions will tend to cancel each other out.

E 4.6 Economic aspects

An environmental economic assessment will be carried out of the consequences of allowing recycling of concrete to be subject to the Statutory Order on recycling residual products and soil in building and construction work.

E 4.7 Implications for national authorities

The basis for preparing new guidelines for recycling concrete must be laid down.

The national authorities will be responsible for preparing the new guidelines and for carrying out the environmental-economic assessments of impacts.

E 4.8 Implications for local authorities

Through inspection, the municipalities ensure compliance with the regulations and guidelines for recycling concrete.

E.5. End-of-life vehicles

Environmental problem	End-of-life vehicles contain a range of environmental contaminants, heavy metals, oils etc.
Initiatives	Increased recycling of plastic components. Development of new treatment technologies. Mapping of existing treatment technologies for recovery of shredder waste. Information on the end-of-life vehicle scrap scheme. Implementation of producer responsibility for end-of-life motor vehicles (private cars and vans).

Goals for 2006:

- *at least 80 per cent recycling achieved in the management of waste of private cars and vans*
- *increased recycling of glass and plastic*

E 5.1 Status

The Statutory Order on scrapping of vehicles lays down rules on the management of end-of-life motor vehicles and derived waste fractions.

The revised Statutory Order on scrapping of vehicles, which entered into force on 1 July 2002, implements the EC Directive on end-of-life vehicles.

The Statutory Order on scrapping of vehicles provides for recycling of a number of waste fractions generated in connection with management of end-of-life vehicles and with repair of vehicles.

The Order also lays down rules on payment of environmental premiums and reimbursement in connection with dismantling and scrapping of private cars and vans. These rules motivate car owners to deliver end-of-life vehicles to authorised shredder plants that dismantle and scrap vehicles in accordance with the rules applying to such activities.

End-of-life private cars and vans must be delivered to enterprises that have been authorised and have set up certified environment or quality management systems. Other types of end-of-life vehicles must be delivered to enterprises that have been approved for dismantling operations.

The rules ensure or contribute to efficient recycling of waste from vehicles, for instance used oil, lead accumulators, nickel-cadmium batteries, catalytic converters, tyres, windscreens and plastic components. For used oil, tyres, lead accumulators and nickel-cadmium batteries, special arrangements have been set up, which are described in the relevant sections of this Annex.

Shredding operations generate fractions such as iron and other metals, which are recycled. Today, the residual fraction (shredder waste) is deposited in landfills. See section E 28.

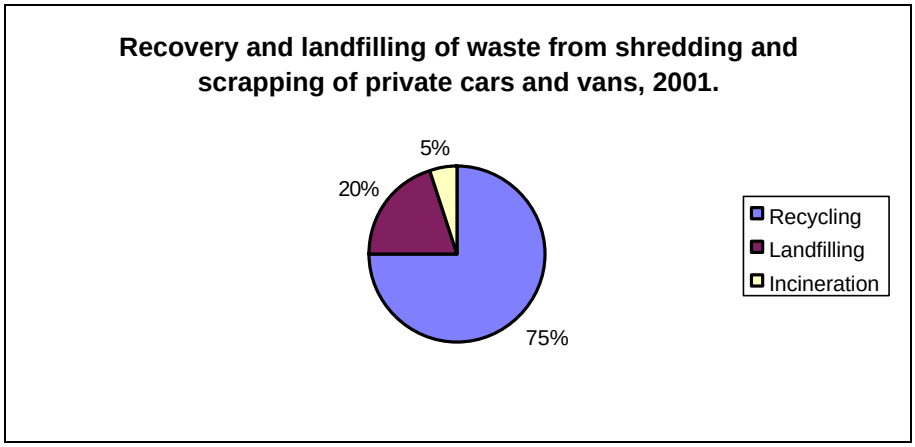
In 2002 a total of 119,000 private cars and vans were deregistered, and approx. 80,000 vehicles were delivered for dismantling in authorised plants. Moreover, a considerable number of end-of-life private cars and vans are exported to Africa, Eastern Europe etc. According to data held by Statistics Denmark, a total of 15,000 end-of-life vehicles are exported every year. An unknown number of private cars, vans and trucks are exported without notification to Statistics Denmark, because the exportation is in the hands of private persons or small companies, which are exempt from the duty to report data to Statistics Denmark.

Beside the waste volumes generated in connection with dismantling and scrapping, car repair generates a similar volume of waste; mainly used tyres, lead accumulators, parts of chassis, other components of metal and plastic, and used oil and other liquids resulting from repair and maintenance of motor vehicles.

For the overall volumes of waste generated in connection with dismantling and scrapping, the rates of recycling are estimated at approx. 75 per cent and landfilling at approx. 20 per cent. The remaining 5 per cent is incinerated. According to the goal for 2006, a minimum of 80 per cent of the waste volumes generated during dismantling and scrapping of private cars and vans must be reused or recycled. This goal is to be achieved by increased recycling of plastic components and glass from end-of-life vehicles.

Data for waste volumes from repairs are not available at present, except data for the three fractions covered by special collection schemes, i.e. tyres, accumulators and used oil.

As regards abandoned cars, rules were stipulated in the amended legislation that the local authorities and the police may be reimbursed for the costs of disposal they incur, provided other conditions specified for reimbursement are fulfilled. In connection with the egislative amendment, the Danish Parliament decided that special rules will not be introduced for cars that have been abandoned on private property.



Measures:

- *stricter requirements for management of waste from cars*
- *requirements for separation of recyclable components and materials*
- *information on the vehicle scrapping scheme*
- *producer responsibility*

E 5.2 Future initiatives

In connection with an amendment to the Statutory Order on vehicle scrapping that will be made in the period covered by this plan, requirements will be laid down for increased recycling of plastic components.

Initiatives to support the development of new separation technologies with the aim of increasing the rate of recycling of plastic and recovery of other organic fractions will be furthered.

Work has been done to map the treatment technologies, and work will continue, with a view to establishing plants for recovery of shredder waste generated during scrapping of vehicles and of a number of other composite products.

Information material will be prepared, in order to inform about rules on scrapping of vehicles. The initiative will be financed by the proceeds resulting from the environment and scrapping premiums.

Rules will be implemented in 2005-2006, providing for producer responsibility for private cars and vans, and to take effect from 1 January 2007.

E 5.3 Regulation

Management of end-of-life vehicles is regulated by Statutory Order on vehicle scrapping and in environmental approvals of plants authorised to carry out vehicle dismantling and scrapping operations.

E 5.4 Capacity

Approx. 210 enterprises are authorised to carry out waste management operations for vehicles in accordance with the Statutory Order on vehicle scrapping. Further, a small number of dismantling plants are in charge of breaking up other types of vehicles and end-of-life cars that have been subject to waste treatment in authorised dismantling plants. Finally, six shredder plants work with shredding and separation of scrapped vehicles.

E 5.5 Environmental assessment

The proportion of car scrap to be disposed of in landfills will fall from 25 per cent to not more than 20 per cent. The rate of recycling of plastic components will increase from approx. 5 kg to approx. 25 kg/vehicle.

E 5.6 Economic aspects

It is estimated that the increased costs pertaining to dismantling and recycling of plastic components will amount to DKK 2-5 million.

E 5.7 Implications for national authorities

The Statutory Order on vehicle scrapping will be amended.

E 5.8 Implications for local authorities

None.

E.6. Tyres

Environmental problem	Tyres contain rubber and steel, i.e. resources that should be utilised if possible, by reuse or recycling.
Initiatives	Initiate information campaigns aiming at limiting faulty assembling of tyres and promote the sale of retreaded tyres.

E 6.1 Status

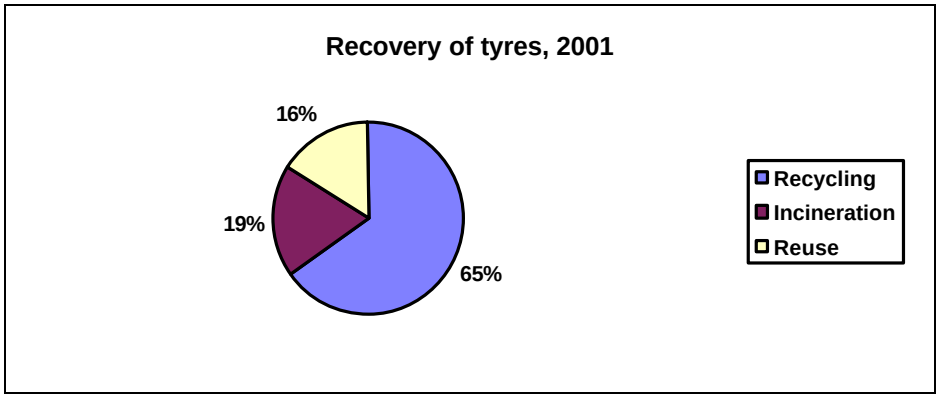
Goals for 2008:

- *90 per cent reuse or recycling of all discarded tyres*

Collection and recovery of tyres is regulated by the Statutory Order on a fee on tyres and a recovery subsidy.

Tyres contain rubber, steel, and textiles. Rubber and steel can be recycled, and textile waste can be recovered by incineration.

In 2001 waste volumes amounted to approx. 42,800 tonnes, of which approx. 34,500 tonnes were reused or recycled. The remaining waste volumes were disposed of by incineration or landfilling. Around 40 per cent of the total amounts of tyres is assessed to derive from private consumers, and 60 per cent is assessed to come from industry and business. Most of the tyres are disposed of via the service sector, where tyres become waste in connection with renewal and repair.



E 6.2 Future initiatives

Measures:

- *information campaign*

As part of the agreement with the Danish Tyre Trade Environmental Foundation information campaigns are being carried out, aiming at minimising waste volumes and promoting the use of retreaded tyres

E 6.3 Regulation

On 20 February 1995, the Minister for Environment and Energy entered into an agreement with the tyre and motor trade associations, the Association of Danish Recycling Industries and municipal associations on a take-back scheme for discarded tyres.

Through the agreement it is ensured that discarded tyres are collected and recycled or incinerated, thus avoiding landfilling and ensuring resource utilisation of waste tyres. The collection and treatment scheme is organised on the basis of the following order of priority: retreading, rubber powder production, and incineration.

The agreement requests enterprises selling tyres to take back a corresponding number of discarded tyres without additional costs for the consumer.

Professional collectors are required to receive all tyres from enterprises collecting or receiving discarded tyres, including municipal collection schemes, and to deliver these for recycling or incineration.

Further to the agreement, a fee was introduced on tyres[14] for financing of collection and treatment costs, administration of the scheme, and information campaigns[15].

Subsidies are paid to the tyre collectors that are registered in the Danish EPA. Registered enterprises must state in which municipalities tyres are collected. On certain conditions, enterprises are required to collect tyres from waste producers. Subsidies for collection of tyres will only be given, if the tyres are delivered to a reprocessing plant.

No subsidies are granted for tyres delivered for reuse, including retreading.

An intermediary goal is that at least 80 per cent of all discarded tyres from private cars, vans, and motorbikes will be collected and recycled or incinerated before 1997. According to the agreement, 80 per cent of all discarded tyres must be recycled or incinerated before 2000.

According to the goal at least 90 per cent should be reused or recycled in 2008.

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[14]The agreement was implemented by Statutory Order no. 144 of 3 March 1995, which is now replaced by Statutory Order no. 111 of 5 February 2000 on fees and subsidies for recovery of tyres. The Statutory Order is issued among others in pursuance of section 53 of the Environmental Protection Act, empowering the Minister to decide that importers or manufacturers of specified products shall pay a fee for the disposal of waste, in full or partial coverage of costs incurred in connection with disposing of the products, and to lay down detailed rules on the collection and application of fees.

[15]Since January 1996 the support scheme has been administered by the Danish Tyre Trade Environmental Foundation.

E 6.4 Capacity

In Denmark there are around 10-15 reuse facilities working with retreading tyres. Furthermore, two reuse facilities are engaged in processes to produce rubber powder or rubber granulate.

E 6.5 Environmental assessment

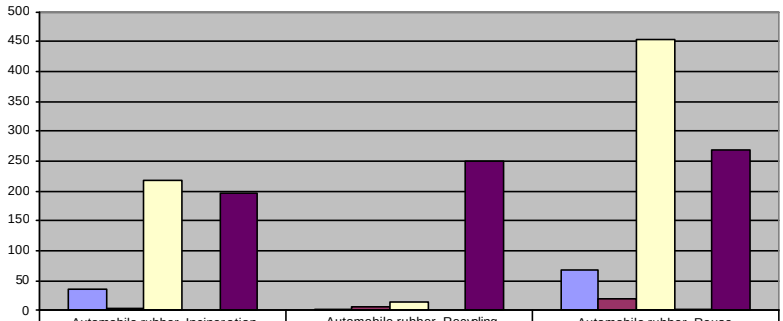
All tyres used on motor vehicles are covered by the Statutory Order. The collection scheme ensures that 98 per cent of all discarded tyres are collected. At least 80 per cent are reused or recycled. For a minor part of the tyres, corresponding to 5-10 per cent, technical reasons prevent recycling, and the tyres are therefore recovered by incineration.

Possibilities exist for minimising the waste volumes by waste prevention and increased reuse (retreading) of tyres.

Waste indicators

The new waste indicators for saving resources, for energy and for landfill requirements[16] which are presented in chapter 2, have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with one tonne of waste being landfilled.

Figure: Savings from incineration, recycling and reuse of one tonne of automobile rubber, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



	Automobile rubber, Incineration	Automobile rubber, Recycling	Automobile rubber, Reuse
61 - Energy resources	37	1	68
62 - Other resources	3	6	19
63 - Gr. energy, non-renew.	218	14	453
64 - Gr. energy, renewable	0	0	2
65 - Landfilling waste	196	250	270

LCA data is not available for the granulation process, which is therefore not included in the calculation. Account has therefore not been taken of the fact that rubber powder and rubber granulate replace new rubber raw material. Thus, the calculated benefits gained are a result of recycling the steel components of the tyres, and of the fact that landfilling is not required. However, the calculation does not take account of the fact that steel ending up in the incineration slag will in practice be collected and utilised. For the purpose of reuse, new rubber does not need to be produced, and this is included with LCA data for butadiene rubber.

[16] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

From the figure it appears that the largest savings per tonne are achieved by incineration and reuse. And for these two treatment options, particular savings are gained for energy resources and gross energy consumption. Further, it should be noted that by recycling, the savings achieved in energy resources, other resources and gross energy are quite modest.

Recycling of rubber is not possible after vulcanisation, because tyres cannot be vulcanised again. It is only when the tyres as such are reused by retreading, that considerable savings are achieved in terms of energy and resources.

E 6.6 Economic aspects

Information activities will not trigger additional costs, since the funds required are allocated via the income deriving from fees.

E 6.7 Implications for national waste authorities

None

E 6.8 Implications for local waste authorities

Local authorities are to assign tyres to special treatment.

E.7. Waste electrical and electronic products

Environmental problem	Waste electrical and electronic products contain many contaminants, especially heavy metals.
Initiatives	The EU Directive on Waste Electrical and Electronic Equipment must be implemented by the end of 2004. Drafting of environmental guidelines for public procurement of a number of electrical and electronic products, and eco-labelling criteria for several products. Improved resource utilisation by development of new technologies for reprocessing of the products.

E 7.1 Status

Aims for 2008:

- *increase the recycling rate for resources from electrical and electronic products*
- *make sure that waste from electrical and electronic products is not delivered to waste incineration plants and landfills*
- *environmentally sound disposal of electrical and electronic products*

Electrical and electronic products primarily include radio and television sets, IT products, regulation and monitoring equipment, white goods, refrigeration equipment, and office equipment.

Collection and reprocessing of electrical and electronic products is currently based on Statutory Order no. 1067 of 22 December 1998 on management of waste from electrical and electronic products. A special scheme has been set up for treatment of refrigeration equipment, see section E 15.

Under Statutory Order no. 1067, the local authorities have set up collection/assignment schemes for waste electrical and electronic products.

The Order requires that products listed in Annex 1 of the Order are reprocessed in accordance with Annex II and III. Moreover, under section 8 of the Order, anyone receiving waste electrical and electronic products must remove the nickel-cadmium batteries and lead accumulators before reprocessing.

Total amounts of waste electrical and electronic products, excluding refrigeration equipment, which is discussed in Section E 15, have been calculated at 103,000 tonnes in 1997[17]. The largest part is assessed to come from municipal bulky waste schemes (48 per cent). The remaining part is assumed to come from domestic waste (15 per cent), from institutions, trade and offices, the service sector (20 per cent), and industry (15 per cent). Many discarded electrical and electronic products are disposed of by putting them away in the attic. Moreover, many products are sold on second-hand markets. Therefore registration of the volumes of electrical and electronic

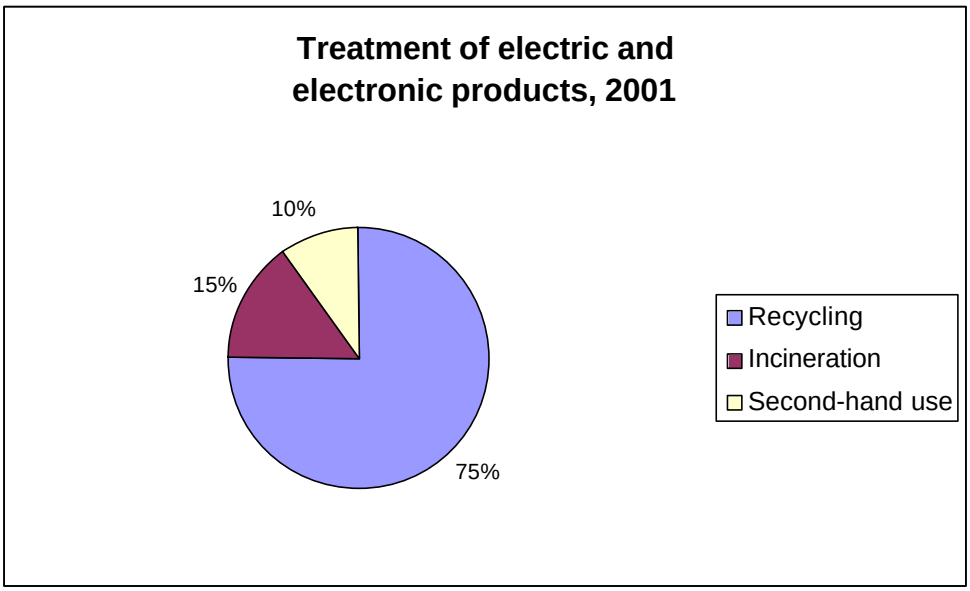
[17]Of the total waste volumes, approx 43,000 tones are electronic equipment, and approx. 60,000 tonnes are electrical equipment.

products suffers from great uncertainty. The volumes recorded here are considered somewhat overestimated.

In 2001, 21,200 tonnes of electronic waste and 11,940 tonnes of refrigeration equipment and freezers were collected and subjected to special treatment. To this should be added the products delivered to shredding plants for the purpose of reprocessing. In 1997 the volume was calculated at 64,400 tonnes/year. These products are not registered in the ISAG (Information System for Waste and Recycling), but the products seldom appear on second-hand markets, and are typically so large that they are not dumped. Estimates of processed volumes at 50,000 tonnes in 2001 should therefore be considered a very conservative estimate.

According to estimates based on the above data, 75 per cent of the waste of all electrical and electronic products was delivered for reprocessing/recycling in 2001, approx. 15 per cent was disposed of in incineration plants, and 10 per cent was put on the market for second-hand products.

On 10 October 2002 the European Parliament and the EU Council of Ministers agreed on a directive regulating the future management of waste electrical and electronic equipment. The Directive is due to be implemented in Danish legislation no later than December 2004.



E 7.2 Future initiatives

Measures:

- *requirements for management and disposal of electrical and electronic products*
- *environmental guidelines for public procurement of electronic office equipment*
- *setting up product area panels*
- *development of improved reprocessing methods*

The EU Directive on electrical and electronic equipment is to be implemented, with the purpose of securing minimum implementation of the provisions of the Directive. However, for particularly dangerous fractions supplementary requirements for treatment will be laid down.

The EU Directive on management of waste from electrical and electronic equipment is based on producer responsibility. This means that within 30 months after the Directive comes into force, the producers must take over responsibility for the management of the waste by environmentally sound methods, and they must finance management of the waste from the location where it was collected.

The Directive lays down rules on reprocessing of the waste, and for the rates of recycling and recovery to be achieved before 31 December 2006. Reprocessing of the waste must only take place in approved reprocessing facilities.

Implementation of the Directive implies that the requirements will be changed, and more products will have to be treated separately.

Moreover, within 30 months after the Directive comes into force, producers must label the products, stating the date of marketing, and inform the consumers of the possibilities available for upgrading the product in order to give it a longer lifetime. Further, the producers must inform customers where they may dispose of the product free of charge.

Finally, the producers must inform the reprocessing facilities of the environmentally harmful substances/components contained in the products, and state their location.

Under the Directive, Member States must ensure that within 30 days after the Directive comes into force, collection schemes have been set up to minimise the risk that electrical and electronic waste ends up in other municipal wastes.

Further, Member States must, before the end of 2006, ensure that a collection quota of no less than 4 kg per person per year has been achieved for electrical and electronic products from households.

In connection with the action plan for environmentally conscious public procurement, guidelines have been prepared, aiming at assisting public procurers in purchasing a number of electronic office products. Eco-labelling criteria will be worked out for several of the products.

Product-oriented environmental policies aim at improving the products and integrating waste disposal in the design of the products. In 1999 a product panel for electronic products was established.

Among the initiatives launched by the product panel was a conference for designers, dealing with the design of products that are easy to reprocess, and with electronic tools assisting the designers in their daily work.

Development of new technologies for reprocessing waste electrical and electronic products will be evaluated regularly. If there is a need for amending rules and regulations with a view to using best available technology, this will be done on an ongoing basis.

E 7.3 Regulation

Management of waste electrical and electronic products has so far been regulated in general rules in the Statutory Order on waste, the Statutory Order on management of waste from electrical and electronic products, and through environmental approvals of enterprises managing, reprocessing or disposing of this waste fraction.

E 7.4 Capacity

A further, estimated 10,000-20,000 tonnes of the total amount of electrical and electronic products will be collected and treated separately.

Around 20 disassembly enterprises exist today.

The total existing capacity is approx. 90,000 tonnes per year, and capacity problems are not expected in future.

E 7.5 Environmental assessment

The EU Directive on the management of electrical and electronic equipment will result in environmentally more sound management of this type of waste.

The Directive provides for separate treatment of a range of electrical and electronic equipment, which, today, are not covered by rules on separate treatment in the Danish Statutory Order. Further, the Directive requires that a considerably larger number of substances/components must be removed from the products prior to mechanical treatment. Such selective pretreatment will reduce the environmental impact resulting from subsequent reprocessing in for example incineration plants and in steel and metal works.

The rate of recycling/recovery of the heavy metals and the energy contained in the products will, to a smaller extent, increase as a result of the reprocessing and recovery requirements set out in the EU Directive.

However, it is the Directive's requirements for selective pretreatment of the products that will trigger the most favourable effects on the environment. During pretreatment, environmentally harmful components and substances are removed, for instance mercury, PCBs, lead and brominated flame retardants, which we know from experience present environmental nuisances in connection with final recycling/recovery.

It is expected that the EU Directive will move approx. 15,000 tonnes of electrical and electronic waste from incineration and landfilling to recycling and recovery.

In the years to come, product-oriented environmental policies are expected to increase the market share for products that are easier to recycle, and also for products containing fewer environmental contaminants.

E 7.6 Economic aspects

The costs pertaining to collection and processing of electrical and electronic products will amount to 0.2-3 per cent of the price of the products, and, thus, represent only a small fraction of the costs of acquisition. This increase of the price of acquisition will/should be offset somewhat by the reduced municipal costs for waste collection.

E 7.7 Implications for local authorities

The local authorities can still collect electrical and electronic products, but the producers may establish their own alternative waste collection schemes.

When the EU Directive comes into force at the end of 2004, the local authorities will no longer be responsible for environmentally appropriate reprocessing of collected electrical and electronic waste.

E 7.8 Implications for producers

When the EU Directive takes effect, responsibility for the collected products, including recycling/recovery of the products and the economic costs pertaining to these operations, is vested in the producers. The producers may delegate the practical work relating to transportation and reprocessing to third parties acting on behalf of the producers.

In connection with the implementation of the Directive, the Danish EPA will cooperate with the associations of the electronics sector and with the local authorities to ensure that the reprocessing requirements set out in Annexes II and III are met in a manner that is efficient and environmentally and economically sound.

E.8. Packaging waste

Environmental problem	Packaging waste contains large quantities of reusable packaging and recyclable materials. If environmentally and economically appropriate, packaging waste is to be recycled instead of incinerated.
Initiatives	Increased recycling of metal and plastic packaging. Retain the rate of recycling of glass and cardboard/paper packaging. Mapping of quantities of volumes of wood packaging in 2004. Report to the Danish Parliament in 2005 on the most appropriate action to be taken to reach the overall recycling goal of 55 per cent. Report to the Danish Parliament in 2006 on experience gained with the Dansk Retursystem.

E 8.1 Status

Goals for 2008:

- *cardboard/paper packaging - minimum 60 per cent recycling*
- *plastic packaging - 22.5 per cent recycling*
- *metal packaging - 50 per cent recycling*
- *glass packaging - 80 per cent recycling*
- *wood packaging - 15 per cent recycling*
- *packaging waste total - 55 per cent recycling*
- *rate of return for containers for beer and soft drinks in disposable packaging in 2005: no less than 95 per cent*
- *rate of return for containers for beer and soft drinks in refillable packaging to be retained at no less than 98 per cent*

Volumes of packaging waste were assessed at approx. 1 million tonnes in 2000. This corresponds to 186 kg/per inhabitant in Denmark. However, 57 per cent of this amount consists of transport packaging, of which only very limited amounts end up in private households. Sales packaging amounts to 43 per cent. Since 1997 volumes of packaging have been slightly increasing.[18] Packaging waste represents approx. 8 per cent of total waste volumes in Denmark.

As opposed to a number of other countries, Denmark has decided not to establish separate management of all packaging waste, with the exception of collection of disposable packaging for beer and carbonated soft drinks. Instead, focus is on how best to utilise various recyclable materials in waste from different sectors. This also applies to packaging waste.

Packaging waste includes a large number of waste fractions, such as glass, paper and cardboard, metal, wood, and plastic. These fractions are described in the sections dealing with the various fractions.

For 2001 the following recycling goals were set up: cardboard/paper packaging - 55 per cent, plastic packaging - 15 per cent, metal packaging - 15 per cent, and glass packaging - 65 per cent.

All goals were achieved in 2001, except for plastic, where the rate of recycling reached 14 per cent. In 2001, the Danish Parliament adopted a report on recycling of plastic, in which the goal was 22 per cent recycling by 2004, provided a number of conditions are fulfilled.

In 2000 the overall rate of recycling was 56 per cent for the four packaging materials (cardboard/paper, plastic, metal, and glass).

The national goals for recycling of waste packaging in 2008 have been adjusted to the objectives set in the revised EU Packaging Directive. The work to revise the Directive is expected to be completed in 2003.

So far, the general rule has been not to include sales packaging of paper and cardboard, metal and plastic from households in the recycling systems. From a working-environment and eco-environmental perspective, these types of sales packaging are considered less suitable for collection with the purpose of material recovery than transport packaging. However, to achieve the goals in 2008, greater efforts should be made to include sales packaging in the recycling schemes.

The goal for recovery of paper and cardboard must be fulfilled primarily by recycling of cardboard packaging from industry and households. In 1994 a voluntary agreement on recycling of transport packaging was made between the Minister for the Environment and Energy, the Confederation of Danish Industries, the Danish Plastics Federation, and the Danish Packaging

[18] Environmental Project No. 696, 2002, www.mst.dk/udgiv/Publikationer/2002/87-7972-141-9/html/default.htm (only available in Danish).

Industry. In 2000, the recycling percentage for transport packaging made from paper and cardboard was 83 per cent**.**

The recycling goal for plastic packaging is also expected to be fulfilled by transport packaging from industry. Therefore, the collection of packaging from industry must be considerably strengthened. Moreover, selected sales packaging from industry and households must be collected in order to contribute to achieving the goal. Disposable packaging collected via Dansk Retursystem will also contribute to achieving the goal.

Recycling of metal packaging includes both recycling of steel and tinplate packaging from industry, and a certain amount of recycling of the metal scrap ending up in incineration plants after incineration of domestic waste. Finally, metal packaging collected via the Dansk Retursystem also contributes to recycling. In order to achieve the future goal, metal packaging must be collected from households for the purpose of recycling, and possibilities of improving the management of waste at incineration plants must be investigated.

Recycling of glass packaging includes both recycling of discarded containers for beer and soft drinks, recycling of bottles for wine and spirits, and packaging glass collected via municipal collection schemes. Finally, disposable packaging collected via the Dansk Retursystem also contributes to recycling.

The requirement for a 15 per cent recycling rate for wood packaging is new. This requirement will be achieved by repairing pallets and by recycling pallets for chipboards. It is very difficult to assess the quantities of wood packaging waste in Denmark. It is very important to quantify the volumes of wood packaging waste, because it will influence the way in which the goal of 15 per cent recycling of wood packaging waste, and the overall 15 per cent recycling goal, will be achieved.

The majority of remaining packaging waste is incinerated with energy recovery. In view of the ongoing and planned initiatives in the field of packaging, it is expected that in 2008 - and if incineration at waste incineration plants is included - the overall recovery of packaging waste will exceed 90 per cent.

Dansk Retursystem A/S

When the Danish Government took office it decided that in the future the Danes must have a free choice of packaging for beer and carbonated soft drinks, and the Government therefore lifted the ban on cans as of 23 January 2002. Moreover, Danish producers were given a general permission to use disposable packaging. It was also decided to establish a common mandatory deposit and return system, in order to ensure that the cans and other disposable packaging are collected via the Dansk Retursystem A/S.

Already in May 2001, the Danish Parliament adopted an amendment to the Danish Environmental Protection Act, allowing for modernisation of the bottle return machines set up in approx. 2,000 Danish supermarkets. Modernisation was required because sorting of refillable bottles, mainly of plastic, was becoming increasingly difficult, and also in order to prepare for the reception of disposable packaging, in case this was to be permitted in

Denmark. Total investments will amount to DKK 260 million. Furthermore, the shops will be compensated for their handling of refillable bottles. In December 2002, Dansk Retursystem A/S was given the sole right to be in charge of this process to modernise and adjust the return machines.

23 September 2002 was the first day Danish consumers could buy cans and other disposable packaging, labelled in accordance with the new requirements. Under the new system, it is much easier for the consumers to dispose of non-refillable containers for beer and soft drinks. The about 2,000 shops with modern return machines are now able to receive all kinds of disposable packaging, irrespective of whether the shops sell the product or not. Dansk Retursystem A/S has been given the sole right to be in charge of work to operate the deposit and return system for disposable packaging.

Denmark is the only country in Europe that has set up a single-line mandatory return and deposit system for all types of disposable containers for beer and soft drinks. This paves the way for high return percentages for disposable packaging, and for avoiding dumping in streets and nature. In addition to this, resources in the packaging waste are utilised, to the benefit of the environment. According to objectives, Dansk Retursystem A/S will before 1 January 2004 have achieved a return rate for disposable packaging of no less than 90 per cent, increasing up to 1 January 2005 to no less than 95 per cent. The objective set for reuse of refillable packaging is 98 per cent.

According to assessments for the coming years, the future sale of beer and soft drinks in disposable packaging will amount to a minimum of 320 million containers. Thus, with a return percentage of at least 95 per cent in 2005, 4,000 tonnes of metal waste, almost 1,000 tonnes of plastic waste, and just less than 5,000 tonnes of waste glass will be recycled.

The sole right of operation of the return and deposit system vested in Dansk Retursystem A/S expires on 4 December 2008. No later than September 2006, the Minister for the Environment will submit a report to the Danish Parliament, presenting experience gained with the system, and an evaluation of how the system may function most appropriately after the sole right expires. This evaluation will also include an assessment of whether the scheme should be liberalised, if, it is assessed that the establishment of more deposit and return systems will not weaken the scheme as such, in terms of both the environment and consumers.

Other specific Danish initiatives for prevention of packaging waste and reuse of packaging are described in Appendix A 2.2.9 on specific requirements for packaging and packaging waste.

E 8.2 Future initiatives

Measures:

- *increased recycling of metal and plastic packaging*
- *retain the rate of recycling for glass and cardboard/paper packaging*
- *mapping of quantities of wood packaging in 2004*
- *report to the Danish Parliament in 2005 on the most appropriate way to reach the 55 per cent recycling goal*
- *report to the Danish Parliament in 2006 on experience gained with the Dansk Retursystem A/S*
- *evaluate the deposit system for further types of packaging*

In the individual sections on fractions, the initiatives to be taken to achieve the specific goals are described. The most important initiatives focus on increased recycling of plastic, metal and wood packaging. Collection of plastic packaging from industry must be strengthened. In the future the citizens will be able to deliver metal packaging and selected plastic packaging for recycling, for instance at recycling stations or via bulky waste collection schemes.

Volumes of wood packaging waste must be mapped in 2004, as part of a study of how the recycling of wood packaging waste might be organised. The size of wood packaging waste volumes will be extremely important for possible further initiatives required to achieve the goal of 55 per cent recycling of all packaging waste in 2008.

A report will be prepared and submitted to the Danish Parliament in 2005, describing how the 55 per cent recycling goal can be achieved. Possible further initiatives must be based on the most cost-effective solutions for society and the environment.

A study will be made to determine whether more types of beverage containers should be included in the deposit scheme. The Cleaner Products Council is currently financing a project evaluating selected beverage containers. The project focuses on voluminous products and on products that have a consumer pattern similar to that of beer and soft drinks.

For detailed information, see the sections on the fractions plastic, paper and cardboard, glass, metal and wood.

E 8.3 Regulation

Regulations pertaining to management and recovery of packaging waste have been laid down in Statutory Order no. 619 of 27 June 2000 on waste.

Requirements for manufacture and composition of packaging are laid down in Statutory Order no. 298 of 30 April 1997 on certain requirements for packaging.

Requirements for beverage containers are implemented by Lov nr. 475 af 7. juni 2001 om ændring af lov om miljøbeskyttelse (Pant- og retursystemer) (Act no. 475 of 7 June 2001 amending the Environmental Protection Act (Deposit and Return Systems)), and Statutory Order no. 713 of 24 August 2002.

E 8.4 Capacity, environmental assessment and economic aspects

It is estimated that the costs of the new initiatives launched to reach the specific goals for plastic and metal will amount to a total of approx. DKK 2 million per year. If further initiatives have to be taken in order to reach the

overall recycling goal, additional costs may be incurred. This will appear from the report to the Danish Parliament in 2005.

For detailed information, see the sections on the fractions plastic, paper and cardboard, glass, metal and wood.

E 8.5 Implications for local waste plans

According to the Statutory Order on waste, local authorities must report on initiatives for prevention and recycling packaging waste in their waste plans.

For detailed information, see the sections on the fractions plastic, paper and cardboard, glass, metal and wood.

E.9. Hazardous waste

Environmental problem	By definition, hazardous waste implies risk of fire, or danger to health and the environment, and it must therefore be managed in an environmentally appropriate way.
Initiatives	Prepare a strategy for hazardous waste. Promote recovery of hazardous waste. Disseminate further the understanding of how the criteria for hazardous waste should be applied. Implement criteria for hazardous waste (danger to the environment).

E 9.1 Status

Aims for 2008:

- *optimised economic and environmental treatment of hazardous waste*
- *increased recycling of hazardous waste*

Hazardous waste is waste which is inflammable or constitutes a risk for health or the environment. Rules for hazardous waste are regulated in the EU and are developed regularly.

Hazardous waste includes waste from both primary and from secondary sources (such as residual products from incineration plants). In 2001, waste generation from primary sources amounted to 288,154 tonnes (equalling approx. 2 per cent of the total waste quantities) and 86,149 tonnes from secondary sources. Waste from secondary sources is not included in the total waste production, since - if it were - it would be included in the calculation twice.

Hazardous waste includes many different waste fractions, originating from all sectors.

Some of these fractions are described in the relevant sections of this annex. For example batteries and accumulators, cars, electronic products, impregnated wood, health-care risk waste, PCBs/PCTs and used oil. For these fractions, separate schemes have been established.

In addition to these, some residual products from waste incineration plants are classified as hazardous waste; namely acid flue-gas cleaning products. These fractions are described in E25.

The table gives an overview of main sources of hazardous waste analysed by treatment option.

Hazardous waste 2001 (tonnes) (Main sources)	Recycling	Incineration	Special treatment	Landfilling	Total
Primary sources					
- Lead batteries	16,942				16,942
- Organic and inorganic compounds	4,174				
- Waste oil	18,679	27,797	1,005		
- Shredder waste				92,101	92,101
- Dust-emitting asbestos				9,336	9,336
- Health-care risk waste		2,712	2,393		5,105
- Other hazardous waste	31,995	13,179	1,405	1,678	48,257
Total	**71,790**	**87,142**	**15,162**	**106,980**	**281,074**
- in per cent of total primary waste amounts	25	30	5	37	97
Secondary sources					
- Flue-gas cleaning waste	12,324				12,324
- Fly ash and flue-gas cleaning products from waste incineration plants	0	0	0	73,825	73,825
Total secondary sources	**12,324**			**73,825**	**86,149**

Source: Waste Statistics 2001; Danish EPA 2003

Apart from acid flue-gas cleaning products from waste incineration plants, Kommunekemi A/S generates residual products from its own facilities. These waste residual products are likewise hazardous.

Criteria for hazardous waste more or less correspond to the EU Directive on hazardous waste[19] and the European waste catalogue[20].

Criteria have been adopted under the Basel Convention pertaining to what constitutes a danger to the environment.

Requirements for reporting of hazardous waste to the ISAG have been expanded so that in future the Danish EPA will receive information on hazardous waste stated with EWC codes.

There are now several regulations regarding treatment of waste (landfilling, incineration), which use the term ”hazardous waste” to delimit, how waste types may be treated.

Hazardous waste is exempt from waste taxes. A study has been completed to examine whether it would be environmentally appropriate to continue this exemption of hazardous waste from waste taxes, however, the study has not provided any clear answers. A more thorough assessment will be part of work on a national hazardous waste strategy.

[19] Council Directive 91/689/EEC of 12 December 1991 on hazardous waste.
[20] Commission Decision 2000/532/EC of 3 May 2000 establishing a list of wastes and hazardous waste, Commission Decision 2001/118/EC of 16 January 2001, Commission Decision 2001/119/EC of 22 January 2001, and Council Decision 2001/573/EC of 23 July 2001.

Flue-gas cleaning waste will not be dealt with in the national hazardous waste strategy, as the plan is to prepare a separate action plan for flue-gas cleaning waste.

E 9.2 Future initiatives

Measures:
- *hazardous waste strategy*
- *development of new treatment methods*

A hazardous waste strategy will be prepared. The purpose is, firstly, to clarify whether the different regulations pertaining to or referring to hazardous waste are an impediment to economically and environmentally sound treatment of waste, secondly, to point to possible initiatives to reduce such impediment. There will be an assessment of whether the QSAR classifications are to be used for assessment of the hazardousness of waste.
An ongoing task will be to disseminate knowledge about the use of hazardous waste criteria. Both to ascertain the environmentally sound management of waste and to make sure that there are no unnecessary costs associated with treatment of waste, which in reality should not be managed as hazardous waste.

Initiatives to increase recovery of hazardous waste will be encouraged.

Work will be done to ensure that criteria for what constitutes a danger to the environment will be implemented in Danish legislation - preferably via adoption within the EU.

E 9.3 Regulation

Hazardous waste is regulated via the Statutory Order on Waste[21] and special Statutory Orders pertaining to individual waste fractions. Rules for hazardous waste were incorporated in Danish legislation in 1996 and by and large follow the rules on classification of chemical substances and products.

Enterprises are responsible for assessing whether their waste is hazardous and for notifying any such waste to the local authorities. Local authorities must collect all hazardous waste.

E 9.4 Capacity

Today, 25 per cent of hazardous waste from primary sources is recycled:
- lead accumulators and Ni-Cd batteries are collected and recycled in Sweden or France
- waste oil is reprocessed at Dansk Oliegenbrug (Danish oil recycling company).

32 per cent is incinerated:
- used oil is treated at district heating plants and at Kommunekemi A/S
- health-care risk waste is mainly disposed of at Special Waste System A/S in Nørre Alslev, and at traditional waste incineration plants.

[21] Statutory Order no. 299 of 30 April 1997 on waste from the Ministry of the Environment and Energy.

6 per cent is subject to special treatment:

- organic compounds without halogens are treated at Kommunekemi A/S and BOFA (municipal waste disposal centre on Bornholm).

37 per cent is landfilled:

- asbestos and contaminated soil are landfilled at special landfills
- shredder waste is landfilled at 4 different landfills in Denmark.

14 per cent of hazardous waste from secondary sources is recycled, whereas 86 per cent is landfilled.

A number of enterprises carry out pre-treatment of hazardous waste with a view to separating the non-hazardous fractions (oil filters, paint drums, and the aqueous component in used oil).

Recycling enterprises exist for individual waste fractions (silver from the photographic sector and organic solvents), for example enterprises recovering silver or coolant. Traditionally, however, not many methods of treatment have been developed for recovery or recycling of hazardous waste fractions.

Cars which have not been emptied of liquids, or other dangerous components, are classified as hazardous waste.

The Statutory Order on management of waste in the form of motor vehicles and derived waste fractions lays down rules on the management of end-of-life motor vehicles and derived waste fractions.

End-of-life private cars and vans must be delivered to enterprises that have been authorised and have set up certified environment or quality management systems. Other types of end-of-life vehicles must be delivered to enterprises that have been approved for dismantling operations.

Approx. 210 enterprises are authorised to carry out waste management operations for vehicles in accordance with the Statutory Order on management of waste in the form of motor vehicles and derived waste fractions. In addition, a small number of dismantling plants is responsible for breaking up other types of vehicles and end-of-life cars that have been subject to waste treatment in authorised dismantling plants. Finally, six shredder plants work with shredding and separation of vehicle scrap.

Electrical and electronic products

Collection and reprocessing of electrical and electronic products is currently based on Statutory Order no. 1067 of 22 December 1998 on management of waste from electrical and electronic products.

In 2001, 21,200 tonnes of electronic scrap were collected and treated separately. A further, estimated 10,000-20,000 tonnes of the total amount of electrical and electronic products will be collected and treated separately.

Around ten disassembly enterprises exist today.

The total existing capacity is around 90,000 tonnes per year, and capacity problems are not expected in future.

Filter dust and flue-gas cleaning products from waste incineration plants make up around 30 per cent of total hazardous waste amounts.

Flue-gas cleaning products are exported and landfilled pending the establishment of a permanent solution. Requirements for recycling of residual products will be adjusted to take account of groundwater, see also E25.

E 9.5 Environmental assessment

Hazardous waste comprises many different waste types with many different environmental properties. Hazardous waste is classified due to its inherent properties, which means management of the waste is potentially dangerous. The actual danger risk of hazardous waste, however, depends on conditions for management/treatment.

E 9.6 Implications for national authorities

A hazardous waste strategy will be prepared with the objective of ensuring economically and environmentally sound treatment of waste.

E 9.7 Implications for local authorities

Local authorities will inform citizens about municipal schemes for hazardous waste.

E.10. Glass

Environmental problem	On recycling of glass and reuse of refillable glass bottles, energy consumption is reduced compared to the manufacture of new glass. Moreover, this means the raw material (the glass) is exploited more than one time. Collection of glass for recycling must therefore as a minimum be kept at the present level.
Initiatives	Instigation of development work with a view to developing alternative methods to recycle glass cullets.

E 10.1 Status

Goals for 2008:

- *80 per cent recycling of glass packaging*[22]

On recycling of glass, energy consumption in the manufacture of new glass is reduced. Furthermore, raw materials (glass) are exploited several times. Collection of sheet glass, bottles, and glass packaging for recycling must therefore be kept at the present level and be improved.

The amount of waste sheet glass was estimated at around 35,000 tonnes in 2000. Of this, 27,000 tonnes, or 78 per cent, were recycled in Denmark, primarily for insulating material. Part of the remaining amount is exported for recycling abroad, the rest is landfilled.

Technology for separation of recyclable sheet glass from frames exists and is in function at at least one facility in Jutland. The glass is recycled in e.g. mineral wool production. According to a project not yet published entitled "Other problematic substances in building and demolition waste", separation of PCB filler may pose a problem.

The amount of packaging glass marketed in Denmark in 2001 amounted to 184,000 tonnes.

A total of 132,000 tonnes of waste glass was collected from wine/ liquor bottles, glass packaging for food and medicines. Of this, 130,000 tonnes were recycled as cullets or whole bottles for reuse. The rate of recycling has increased slightly in recent years[23].

Via the recycling system for beer and softdrinks bottles, Danish brewers collected 9,000 tonnes of glass cullets for recycling in 2001.

Total recycling of glass in Denmark amounted to 140,000 tonnes in 2001, corresponding to 76 per cent. Private border trade accounted for about

[22] The goal for 2008 is not readily comparable to the goal for recycling of glass from households stated in the section on glass fraction in Waste 21, since the goal for 2008 includes more material flows and applies a different calculation method.

[23] Environmental Project no. 697, 2002.

20,000 tonnes. If this trade is included in supply amounts, the recycling rate for glass packaging is 65 per cent.

The amount of glass packaging from Danish households, which ended up in the trash can, in 2001 amounted to about 29,000 tonnes. This amount is led to waste incineration plants where the glass does not contribute to energy recovery, but ends up as slag.

A large number of whole bottles are separated from the collected amounts of glass packaging and reused as bottles. In 1999-2000, the Danish EPA carried out an assessment of the market potential of reusable wine bottles in Denmark and of the environmental effects of export of wine bottles for reuse outside Denmark[24].

The study showed that there is an environmental benefit to be gained from reusing bottles, also in terms of exports to central Europe. Reuse of whole bottles can be increased by applying "gentle" collection methods, which reduce the number of broken bottles. Municipal experience gained from different collection methods was collected and disseminated in 2002.

Around 60 per cent of the amount of glass recycled is remelted to make new packaging.
There is not adequate capacity in Denmark to reprocess coloured cullets to make new packaging. There is therefore a need to come up with alternative ways of recycling glass cullets.

There is capacity to reprocess more clear glass cullets in Denmark to make new glass packaging. However, for this end more cullets will have to be separated. Today, cullets are separated at source in a select number of municipalities. Cullets from clear glass primarily originate from colour separation at bottle washing and separation plants. According to assessments, around 70 per cent of cullets from municipal collection is separated by colour. Further clear cullets could be separated from existing collection; however, the amount is probably limited.

The EU Packaging Directive is being revised. The expected goal for recycling glass in 2008 is 60 per cent.

E 10.2 Future initiatives

A project to come up with alternative ways of recycling glass packaging waste was commenced in 2002. The project will survey amounts and assess possibilities for using waste glass in cement, tiles, and road construction. There will be further needs for developing and testing methods for alternative recycling of glass.

Measures:

- *develop alternative ways of recycling packaging and sheet glass*

[24] Statistics on glass packaging 2001.

E 10.3 Regulation

Municipalities are under obligation[25] to establish schemes for collection of glass from built-up areas with more than 2,000 households. The collection must be organised so that essential parts of the glass are recycled. In most municipalities, bring-schemes have been introduced with bottle banks located at central places in the area, and at recycling centres. Citizens have the duty to use collection schemes as described in municipal waste regulations.

Recyclable sheet glass and glass packaging from industry must be assigned to recycling.

E 10.4 Capacity

According to assessments, the total amount of glass collected for recycling could be sold to recovery in full, once alternative uses have been established.

E 10.5 Environmental assessment

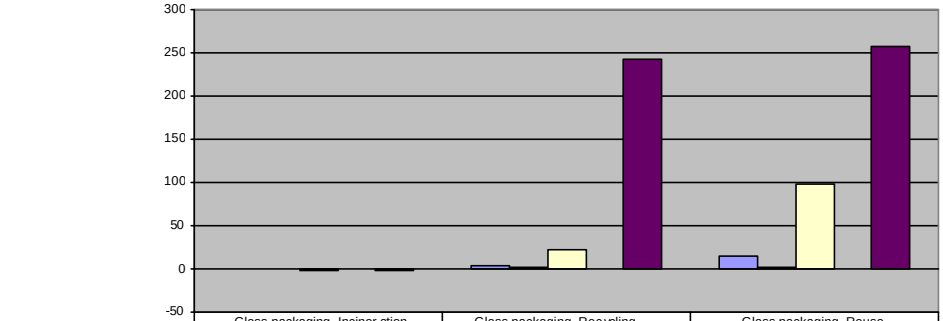
A lower rate of cullets will reduce resource and energy consumption in connection with manufacturing glass. Reduction of the rate of cullets may lead to increased reuse of whole bottles, ensuring a significant reduction in energy consumption. Reuse only requires around 15 per cent of the energy needed to produce a new bottle.

Waste indicators
The new waste indicators for saving resources, for energy and for landfill requirements[26] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

Glass packaging
The figure below shows savings gained for the five indicators via incineration, recycling, and reuse, respectively, of one tonne of glass packaging. Savings are calculated in relation to landfilling. Benefits from recycling and reuse of glass are reduced energy consumption and landfill requirements.

Figure: Savings from incineration, recycling and reuse of one tonne of glass packaging, compared to landfilling the same amount (in mPR, mPE, and 10 mPE).

[25] Statutory Order no. 619 of 27 June 2000 from the Ministry of the Environment and Energy.
[26] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.



	Glass packaging, Inciner ation	Glass packaging, Recycling	Glass packaging, Reuse
61 - Energy resources	0	3	14
62 - Other resources	0	1	1
63 - Gr. energy, non-renew.	-1	23	98
64 - Gr. energy, renewable	0	0	0
65 - Landfilling waste	-1	242	258

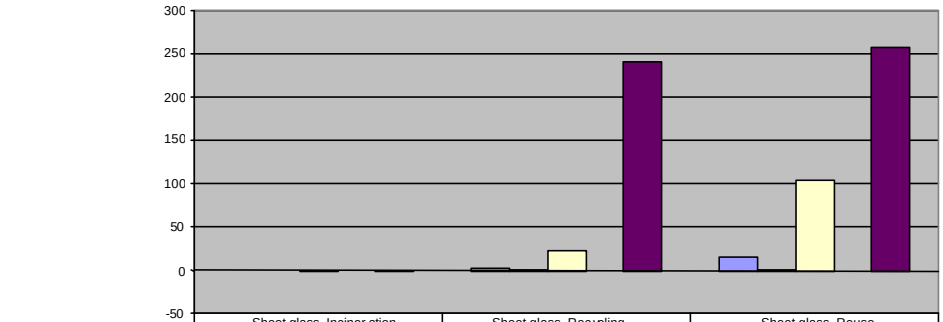
The figure shows that the largest savings can be achieved from reuse of glass packaging. This applies to all indicators except "renewable gross energy", which for all three treatment options is zero. Recycling provides savings of around the same amount of waste for landfilling, but gross energy is significantly lower due to a high consumption of energy associated with manufacturing new glass from waste glass packaging.

Incineration shows negative marginal savings (-1 in the figure) for "non-renewable gross energy" and "waste for landfilling" respectively. This is because incineration of glass packaging demands energy without in turn producing energy.

Sheet glass

The same LCA data has been used for treatment options for sheet glass as for glass packaging. However, energy consumption for washing processes in connection with reuse has not been included in calculations. The figure below shows savings gained for the five indicators via incineration, recycling, and reuse, respectively, of one tonne of waste sheet glass, compared to landfilling the same amount.

Figure: Savings from incineration, recycling and reuse of one tonne of sheet glass, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



	Sheet glass, Inciner ation	Sheet glass, Recycling	Sheet glass, Reuse
61 - Energy resources	0	3	15
62 - Other resources	0	1	1
63 - Gr. energy, non-renew.	-1	23	105
64 - Gr, energy, renewable	0	0	0
65 - Landfilling waste	-1	242	259

Treatment of one tonne of sheet glass shows the same result as for glass packaging since the same data are used. Thus, the largest savings can be achieved from reuse.

E 10.6 Economic aspects

It is not expected that retention of the existing collection level for glass packaging will influence renovation fees.

E 10.7 Implications for national authorities

Development of alternative recycling technologies must be encouraged.

E 10.8 Implications for local authorities

In order to retain the present level of collection for glass packaging, it is important to regularly inform relevant actors about collection schemes and separation requirements. It will be necessary to ensure a "gentle" collection system so that as many bottles as possible are reused.

E.11. Dredged material

Environmental problem	Dredged material, which cannot be disposed of at sea, recovered or reused, must be landfilled on land. This landfilling requirement is covered by the Statutory Order on landfills[27], and at present it is not yet clear how many of the existing landfills for disposal of dredged material will be able to continue operations after July 2009. It is not possible to estimate the amount of sediments that will require landfilling in future; including estimating whether there will be a capacity shortage. This is due to, among other things, the current revision of the administrative basis for management of dredged material.
Initiatives	To develop a tool which may help county councils and landfill owners to assess whether existing landfills may be continued after 16 July 2009. To create a new administrative basis for management of dredged material. To initiate new initiatives as follow-up to the proposed new administrative basis.

Aims for 2008:

- *to assess whether existing landfills for dredged material may continue operation after 16 July 2009*
- *to follow up on new administrative basis for management of dredged material*

E 11.1 Status

Ports and harbours need to get rid of material which settles on the sea bed, both in the harbour and in shipping lanes. Such material is called sea-bed sediment or dredged material/harbour sludge. The material may be disposed off either via landfills on land or via dumping the material outside harbour premises at sites, designated for such purpose by the county. However, dredged material can also be recovered or recycled.

About 3 mill. tonnes of sediment (calculated in dry matter) are dredged each year to maintain harbours and shipping lanes. Of these, so far around 90 per cent has been dumped at sea, while 10 per cent has been landfilled.

Many ports and harbours have experienced increasing problems in recent years in connection with the disposal of dredged material. This is primarily due to the enhanced knowledge about the presence of a number of organic, environmental toxins in the sediments - in particular TBTs in anti-fouling boat paint. The counties have therefore become more reluctant to permit dumping of dredged material.

Increased contents of acidifying substances in the sediments mean that more and more harbours have been denied permission to dump dredged material

[27] Statutory Order no. 650 of 29 June 2001 on landfills.

at sea. Instead, they have had to choose the more expensive solution of landfilling. Today, however, the methods used by counties to assess contents of organic toxins in dredged material vary greatly.

This very topical problem demands a solution that:

- will contribute to an environmentally appropriate management of dredged material
- will balance the economic aspects against the environmental aspects
- will ensure administration as uniformly as possible
- provides guidelines on good practice for management of dredged material on land
- is future-proofed.

In consultation with representatives from Danish Regions, Local Government Denmark, and the Association of Danish Ports, the Minister for the Environment is considering a new administration basis for management of dredged material, which will be ready by autumn 2003 at the earliest.

Measures:

- *developing a tool to help counties and landfill owners assess whether existing landfills can continue operation after 2009*
- *preparing a new administration basis*

E 11.2 Future initiatives

In order to assess whether existing landfills for dredged material can continue operations after 16 July 2009, the Danish EPA has completed a project that was to facilitate the assessment work of counties and landfill owners.

Further initiatives are pending the preparation of a new administration basis for management of dredged material.

E 11.3 Regulation

Under the Marine Environment Act, the counties[28] may, in most circumstances, grant permission for dumping of dredged material, if the material contains only insignificant amounts of contaminants. Dumping of dredged material at sea is covered by the Marine Environment Protection Act and Statutory Order[29]on dumping dredged material.

Sediments, which cannot be dumped at sea, recovered or recycled, must be brought on land and, today, are mainly placed in waste disposal sites near the coast. There are a number of waste disposal sites and so-called hosing sites, including a number of smaller sites for disposal of contaminated dredged material.

Landfilling of dredged material is covered, in most cases, by the Statutory Order on landfills[30], which constitutes part of the implementation of the EU Directive on landfill of waste[31]. This means that all new landfills must be designed and operated commensurate with the requirements of the Statutory

[28] Act no. 476 of 30 June 1993 on the protection of the marine environment.
[29] Bekendtgørelse nr. 975 af 19. december 1986 om dumpning af optaget havbundssediment (Statutory Order no. 975 of 19 December 1986 on dumping dredged material).
[30] Statutory Order no. 650 of 29 June 2001 on landfills.
[31] Council Directive 99/31/EC of 26 April 1999 on the landfill of waste.

Order. Existing landfills must comply with the requirements laid down in the Statutory Order - or should be made to do so - and must otherwise be closed down no later than on 16 July 2009, cf. also appendix D3.

It is uncertain, today, if any of the existing landfills for dredged material can continue operations after 16 July 2009, because of an insufficient data base for assessing whether the landfills will be able to comply with certain requirements of the Statutory Order on landfills, e.g. regarding membrane and percolate collection systems. This issue will be incorporated into the proposal for a new administration basis for management of dredged material.

E 11.4 Capacity

An estimated average of 3 mill. tonnes of sediments (calculated in dry matter) will have to be removed from harbours and shipping lanes annually. Of these, so far around 90 per cent has been dumped at sea, while 10 per cent has been landfilled.

Because the administration basis is currently being revised, it has not been possible to provide a qualified estimate as to the amounts of sediments that will have to be landfilled in future. In a worst-case scenario, the new administration basis could lead to a shortage of capacity, if larger amounts of sediments than previously have to be landfilled. A possible capacity shortage is, however, not likely to have effect until after 16 July 2009 when landfills for dredged material not complying with the Statutory Order will be closed down.

E 11.5 Environmental assessment

Sea-bed sediments mainly comprise sand, clay, and organic material. In most Danish waters sea-bed sediments are moved about to a great extent - also from dredging sites - and many ports and harbours serve has 'caches' for sediments, especially in the case of sediments of fine particulates, which contain most of the acidifying substances. Pollutants are also added to the harbour from varying local sources dependent on the type of harbour. Dumping of dredged material first of all leads to redistribution of the acidifying substances, and for a large part of the sediments, the substances are lead back to the marine environment.

In recent years ports and harbours have experienced incremental problems with management of contaminated dredged material. The problem became clear when more and more samples of the sediments in the South Funen archipelago showed a high content of TBTs (organic tin compounds in anti-fouling paints).

The problem is thus especially prevalent in Danish coastal waters. This is the reason why many counties have not granted harbours permission to dump their dredged material at sea, and why the harbours subsequently have been forced to manage the contaminated material otherwise - typically via landfilling - a substantially more costly option.

As to contents of acidifying substances, chemical analyses have identified several heavy metals in the dredged material exceeding background level concentrations (mercury, cadmium, lead, and copper, and to increasing extent dangerous substances such as TBTs and PAHs (poly aromatic hydrocarbons from incineration of fossil fuels)). The Danish EPA has carried out a number of projects in which dredged material was screened for 113 different hazardous substances. Of these, 34 substances were found in the sediments from all types of harbours, whereas the remaining substances were almost non-existent.

Certain heavy metals, TBTs and PAHs, pose a special problem. This is reflected in the occurrence of these substances among the acidifying substances in the sediments. The occurrence of these groups of substances makes sediments especially toxic. Apart from the substances mentioned, other environmentally dangerous substances were found among the 34 substances - for example nonylphenols and DEHPs (Di(2-ethylhexyl)phthalates)

In addition to being bioaccumulative, heavy metals are non-degradable and toxic to varying degrees. Heavy metals are found in varying concentrations in all types of sea-bed sediments, however, most often they are found in concentrations less than two times the local background level. The background level is the level which can be found in an area only subject to diffuse exposure to discharges from point sources.

TBT is a constituent in anti-fouling boat paints. Proven negative effects include androgenity and imposex in marine organisms at very low concentrations found in almost all coastal Danish waters and in the open parts of Skagerrak and the North Sea.

Today, large amounts of TBTs are accumulated in the sediments in Danish waters, just as new TBTs are added daily from larger ships in transit or ships sailing into Danish ports and harbours. An estimated 90 per cent of the TBTs added to the marine environment comes from ships, while the remaining 20 per cent can be attributed to dumping at sea.

Other organic substances which are dangerous to the environment - including PAHs - are found in varying concentrations in sediments in Danish harbours and harbour areas. PAHs are typically found in concentrations two times the background level. PAHs are mainly added via ambient air as fallout from incineration of fossil fuels and from sources such as oil spills etc. Generally, there is no clear connection between operations in a harbour and the sediments' content of dangerous organic substances.

E 11.6 Economic aspects

Estimated annual costs for disposal of dredged material amount to DKK 160 mill. These costs are incurred by ships via harbour and goods taxes, which in reality are fees, although they are termed taxes.

Changing the rules pertaining to disposal of contaminated dredged material, in the direction of prescribing more landfilling, will lead to increased costs. This area is entirely user-financed, and harbour taxes will therefore have to

be raised in step with increased costs. This will mean annual added costs of about DKK 60-110 mill. dependent on landfill option requirements.

The Ministry of Finance has notified the Danish EPA that the increase in harbour taxes due to a restriction of the rules on disposal of contaminated dredged material will not fall under the provisions regarding user financing under the Government's stop on tax increases. The argument is that taxes are raised due to increased costs in connection with a restriction of legislative requirements and not due to the introduction of new user financing or an increase in the user share of existing user financing.

E 11.7 Implications for national authorities

A new administrative basis for management of dredged material will be ready by autumn 2003 at the earliest. As follow-up to the new administration basis, the Danish EPA - in cooperation with the Danish Forest and Nature Agency - will prepare a draft statutory order (including guidelines) on management of dredged material. The draft statutory order and guidelines will be sent out for consultation in the beginning of 2004.

E 11.8 Implications for local authorities

Possible implications for local authorities cannot be assessed until after the new administrative basis has been prepared. Considering that many Danish ports and harbours are municipal-owned, restricted requirements for landfilling dredged material, and/or requirements, which lead to a greater amount of dredged material requiring landfilling, will lead to significant additional costs, which will be covered, primarily, via harbour taxes.

E.12. Ferrous packaging

Environmental problem	Metallic packaging is not adequately exploited as a resource.
Initiatives	Increased recycling of metallic packaging

Goals for 2008:

- *50 per cent recycling of ferrous packaging*

E 12.1 Status

The volume of ferrous packaging in Denmark in 2001 was 43,000 tonnes. Steel and tinplate packaging comprise a great part of the total volume.

In 2000, 8,400 tonnes of ferrous packaging was collected directly for recycling. The remaining amounts of ferrous packaging are led to waste incineration plants where the iron is separated from the slag and recycled as incinerated iron. How much iron is lost in this process has not yet been assessed. However, experiments from 2002 indicate that the loss of ferrous packaging is significant. For tinplate packaging, the estimated average loss is 76 per cent. The estimated minimum loss is 62 per cent and the estimated maximum loss is 90 per cent.

In 2002, collection of metallic packaging for beer and softdrinks was established via Dansk Retursystem. Amounts collected are not yet known. The scheme will contribute to the recycling of aluminium.

Most of Danish metallic packaging comes from households. In 2001, the total amount of metallic packaging from Danish households came to about 31,000 tonnes.

Several opportunities exist for improving the management of metallic packaging in Denmark and thus reach the goal of the EU Packaging Directive. These include increased separate collection of metallic packaging from industry and households, improved separation of metal from slag, and pre-separation of ferrous waste at waste incineration plants.

Measures:

- *separate collection of metallic packaging from households*
- *metallic packaging from industry assigned to recycling*
- *examination of opportunities for pre-separating waste and separating metal from slag*

E 12.2 Future initiatives

There will be more requirements concerning increased collection of ferrous packaging from households, e.g. via recycling sites or as part of existing schemes for bulky waste.

Examinations will be carried out into opportunities for pre-separating ferrous metals at waste incineration plants, and opportunities for improving the separation of ferrous metals from slag.

The obligation of industry to assign metallic packaging to recycling will be clarified in the Statutory Order on waste.

E 12.3 Regulation

Regulations pertaining to management and recovery of packaging waste have been laid down in Statutory Order no. 619 of 27 June 2000 on waste.

Requirements for beverages packaging have been laid down in Lov nr. 475 af 7. juni 2001 om ændring af lov om miljøbeskyttelse (Pant- og retursystemer) (Act no. 475 of 7 June 2001, amending the Environmental Protection Act (Deposit and Return Systems)), and Statutory Order no. 713 of 24 August 2002.

E 12.4 Capacity

Ferrous metal waste, except aluminium, is exported for recycling abroad. Shortage of capacity is not likely to become a problem at the reprocessing plants, to which Denmark exports ferrous metal waste.

E 12.5 Environmental assessment

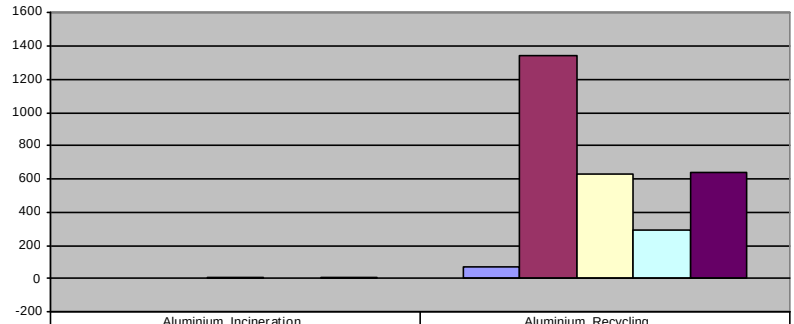
Increased recycling will save energy and metal resources. The reduction of ferrous metals in household waste will lead to less caking in furnaces at waste incineration plants and increased possibilities for recycling incineration slag.

Waste indicators

The new waste indicators for saving resources, energy and landfill requirements[32] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

b) Aluminium

Figure: Savings from incineration and recycling of one tonne of aluminium, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



	Aluminium, Incineration	Aluminium, Recycling
61 - Energy resources	0	67
62 - Other resources	0	1345
63 - Gr. energy, non-renew.	-1	632
64 - Gr. energy, renewable	0	288
65 - Landfilling of waste	-1	638

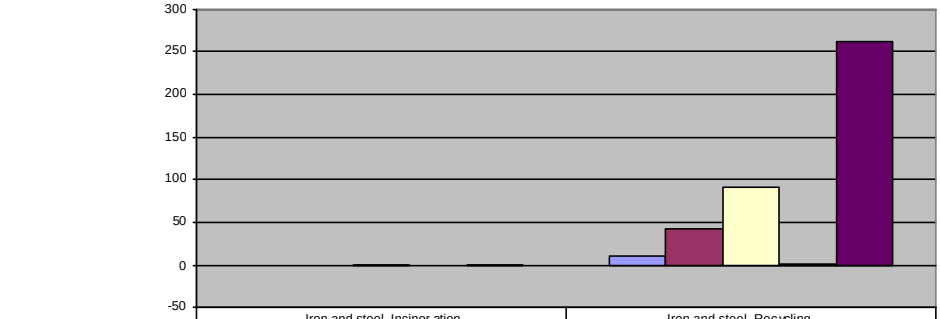
[32] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

The figure shows that recycling aluminium leads to significant savings in the indicator "other resources". Similarly, recycling leads to savings in gross energy and in waste amounts requiring landfilling. The incineration option does not represent possible savings, which is due to the fact that incineration of aluminium is not considered to yield an energy benefit. On the contrary, the incineration option consumes energy, as is also reflected in the value -1.

Iron and steel

The data basis for primary and secondary iron and steel is good, and the figure below therefore provides a picture of the savings gained from recycling one tonne of iron and steel.

Figure: Savings from incineration and recycling of one tonne of iron and steel, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



	Iron and steel, Inciner ation	Iron and steel, Recycling
61 - Energy resources	0	10
62 - Other resources	0	42
63 - Gr. energy, non-renew.	-1	91
64 - Gr. energy, renewable	0	1
65 - Landfilling waste	-1	263

The figure shows that great savings in waste for landfilling are achieved on recycling. Similarly, there are savings to be gained in total resources and non-renewable gross energy. The figure shows that incineration apparently does not lead to any savings; however, this is not correct. In practice, iron and steel that end up at incineration plants, will be separated from the slag and thus recycled. If this fact is included in the calculations, the figure would show savings from incineration similar to those gained from recycling.

E 12.6Economic aspects

The establishment of a collection scheme for ferrous packaging will mean additional costs for some local authorities. However, in most municipalities collection of ferrous metals already takes place via recycling sites or bulky waste schemes.

Metallic packaging may be collected together with the remaining fraction of ferrous waste. If metallic packaging is collected separately, it will mean expenses saved with regard to managing this type of packaging waste at waste incineration plants, and with regard to subsequent management of slag. It is therefore the assessment that only very limited additional costs are associated with collecting metallic packaging via recycling sites.

E 12.7 Implications for national authorities

Rules regarding collection of metallic packaging will have to be laid down.

E 12.8 Implications for local authorities

Local authorities must ensure that metallic packaging waste is collected via bulky waste schemes or similar schemes. Moreover, local authorities must ensure that metallic packaging waste from industry is assigned to recycling.

E.13. Soil

Environmental problem	Large amounts of waste contaminated to varying degrees with heavy metals or PAH or other organic compounds.
Initiatives	Prepare guidelines on recycling residual products and moving soil. Revise Statutory Order no. 655 of 27 June 2000 on recycling residual products and soil in building and construction work.

Aims for 2008:

- *recycling of soil contaminated with organic compounds to be covered by Statutory Order no. 655 of 27 June 2000*
- *prepare guidelines with clear, simple rules for recycling residual products and moving soil.*

E 13.1 Status

Every day large amounts of soil are managed in connection with building and construction work and remediating contaminated properties.

In accordance with the ISAG, in 2001 about 588,000 tonnes of stone and soil was recycled, but this amount does not include soil used in connection with building sound-absorbing barriers and other activities covered by Statutory Order no. 655 of 27 June 2000 on recycling of residual products and soil in building and construction work.

Therefore, there is only limited knowledge about the total amount of soil moved, and about how this soil is managed.

With this background, elucidation work has been initiated to identify the amounts of soil currently being managed. The study will provide a snapshot picture of the conditions, but it will not give ongoing statistics showing developments in the area.

E 13.2 Future initiatives

Measures:

- *revision of Statutory Order no. 655 of 27 June 2000*
- *guidelines on recycling residual products and moving soil*

Work is being carried out on guidelines regarding recycling residual products and moving soil.

Statutory Order no. 655 of 27 June 2000 on recycling residual products and soil in building and construction work is to be revised so that it also covers soil contaminated with organic compounds.

E 13.3 Regulation

Contaminated soil is regulated by the Contaminated Soil Act no. 370 of 2 June 1999 and Statutory Order no. 655 of 27 June 2000 on recycling residual products and soil in building and construction work.

No tax is due on waste that is recycled. On the other hand, tax is usually due on waste that is taken to an approved enterprise. All enterprises that landfill soil and residual products must be registered and approved in accordance with the Waste Tax Act.

The most recent amendment to the Waste Tax Act has opened up for the possibility for limited amounts of contaminated soil to be used for day-to-day covering landfills and in temporary roads at landfill sites, without being subject to waste tax.

E 13.4 Capacity

In connection with preparation of regional plans, counties are able to designate sites for landfilling contaminated soil.

E 13.5 Environmental assessment

Contaminated soil can affect the ground water and humans living on or using the sites.

E 13.6 Economic aspects

It is not expected that initiatives will have economic consequences.

E 13.7 Implications for national authorities

The Danish EPA will prepare guidelines on recycling and moving soil and residual products, and the Agency will revise Statutory Order no. 655 of 27 June 2000 on recycling residual products and soil in building and construction work.

E 13.8 Implications for local authorities

The new regulations are expected to help municipal administration regarding recycling residual products and soil in connection with building and construction work.

E.14. Health-care risk waste

Environmental problem	Health-care risk waste is infectious.
Initiatives	No new initiatives.

E 14.1 Status

Aims for 2008:
- *status quo*

Health-care risk waste is generated in both the primary and the secondary health sectors. The characteristic feature of health-care risk waste is that it may be infectious by direct contact. According to the ISAG, 5,105 tonnes of health-care risk waste were generated in 2001. Health-care risk waste is classified as hazardous waste with reference to the fact that it is infectious.

Almost all health-care risk waste is generated in the service sector.

Waste is incinerated both at special incineration plants and at conventional plants in compliance with special conditions reducing the risk of contact with waste. In environmental terms, the incineration process is similar to incineration of, for example, domestic waste. Incineration means the waste becomes inactive, energy is recovered, the volume is reduced, and the waste becomes unrecognisable. The latter is very appropriate for waste tissue.

Disposal requires a relatively large amount of packaging. To the extent improved separation will reduce the amount of health-care risk waste, it will also indirectly reduce the total amount of waste and thus consumption of packaging will correspondingly be reduced.

Guidelines on health-care risk waste were issued in 1998[33].

E 14.2 Future initiatives

No new initiatives are envisaged for health-care risk waste.

E 14.3 Regulation

Health-care risk Waste management is regulated in the Statutory Order on waste. Health-care risk waste is hazardous waste, and in accordance with the Statutory Order on Waste, municipalities must therefore establish separate collection schemes for the waste.

[33] Guideline no. 4 1998, Management of health-care risk waste. This guideline replaces the previous Danish EPA Guideline no. 1/1984 on disposal of health-care risk waste.

E 14.4 Capacity

Disposal of health-care risk waste takes place at one special plant and seven conventional waste incineration plants.

E 14.5 Implications for national authorities

None.

E 14.6 Implications for local authorities

None.

E.15. Refrigeration equipment

Environmental problem	Refrigeration equipment contains environmental contaminants, including CFC,, that break down the ozone layer, as well as heavy metals and PCBs, which are extremely harmful to the environment and health.
Initiatives	In a revised statutory order on managing waste from electrical and electronic products, regulations will be added on managing refrigeration equipment.

E 15.1 Status

Aims for 2008:

- *95 per cent collection of all discarded refrigeration equipment*

The circular on municipal regulation of disposal of refrigeration equipment containing CFCs contains provisions that municipalities must lay down regulations on collection and environmentally appropriate management of end-of-life fridges and freezers containing CFCs.

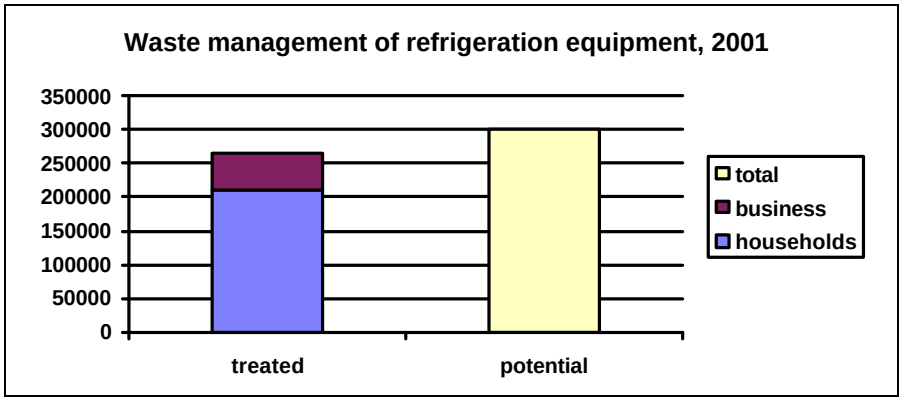
Refrigeration equipment manufactured before 1995 contains CFCs and other environmental-contaminant fractions.

The municipal regulations ensure that refrigeration equipment is collected and treated, and that environmental contaminants are extracted for special treatment. The recyclable fractions (iron and metal components) are separated for recycling.

There is a special scheme (see appendix E7) for other types of waste electrical and electronic products.

In 2001, end-of-life refrigeration equipment amounted to about 300,000 units. In 2001, 266,000 pieces of refrigeration equipment were collected and treated, corresponding to 89 per cent of the potential.

80 per cent of the refrigeration equipment collected is collected from households either through return schemes or through municipal bulky waste schemes. 15 per cent comes from institutions, trade and offices. The remaining 5 per cent is collected from industry.



E 15.2 Future initiatives

The regulations for waste management of electrical and electronic equipment will be incorporated in a revised statutory order on management of waste from electrical and electronic products, which is expected to be issued in 2004.

E 15.3 Regulation

Collection and management of refrigeration equipment containing CFCs is ensured by an agreement between the Minister and the organisations on disposal of refrigeration equipment containing CFCs, as well as a circular[34] on municipal regulation regarding disposal of refrigeration equipment containing CFCs.

The goal of the agreement is to collect at least 90 per cent of the total discarded refrigeration equipment for treatment in accordance with the requirements laid down in the circular.

At least 95 per cent of the content of the cooling agent CFC-12 must be extracted and collected. The frothing agent CFC-11 must be extracted at a rate of at least 80 per cent. All CFC-12 collected must either be recycled or destroyed. All CFC-11 must be destroyed. In addition, mercury switches and condensers (PCBs) must be extracted for environmentally appropriate management, see appendix E21.

E 15.4 Capacity

There is one special plant for treatment of refrigeration equipment. One-third of the refrigeration equipment collected is exported for treatment in Germany. Furthermore, refrigeration equipment is treated at about five other Danish enterprises which can extract CFCs from refrigeration equipment.

[34]Circular no. 132 of 13 June 1996 on municipal regulation on disposal of refrigeration equipment containing CFCs.

E 15.5 Environmental assessment

250,000-300,000 pieces of refrigeration equipment (corresponding to 12,500 tonnes) are treated in accordance with the circular. About 100 tonnes of condensers containing CFCs and PCBs are extracted and destroyed in an environmentally appropriate manner.

E 15.6 Implications for national waste authorities

None.

E 15.7 Implications for local waste authorities

None

E.16. Mineral wool

Environmental problem	Mineral wool is a local irritant and in certain circumstances it is carcinogenic.
Initiatives	The potential for recycling mineral wool will be examined, including development and identification of methods of recycling, as well as the potential of developing a market for recyclable mineral wool- The opportunities for environmentally and economically appropriate landfilling of mineral wool waste will be investigated.

E 16.1 Status

Aims for 2008:

- *increased recycling of mineral wool*
- *ensure environmentally appropriate and economically-effective disposal/recycling*

Mineral wool is primarily used in the building and construction sector, but it is also widely used by nurseries as a growth medium.

There are no recent studies of the annual consumption or accumulated amounts of mineral wool in Denmark. Consumption is estimated at 40,000 tonnes per year for stone wool and glass wool together.

Waste arises from the building and construction sector through cut-offs when cutting wool to shape in new construction and from demolition and conversion of existing buildings.

Mineral wool was included in the official list of hazardous substances in 1999. Mineral wool must now be classified as hazardous waste. However, the Danish EPA has recommended that municipalities wait for guidelines on the management of mineral wool waste in order to ensure uniform practices in the area. Therefore it is likely that some waste mineral wool is currently sent for waste treatment with mixed building and construction waste.

There is not sufficient knowledge about the amount of used mineral wool from nurseries that ends as waste or is recycled by the nursery in other purposes.

A small amount of waste mineral wool is sent to waste treatment as hazardous waste, primarily by incineration. Mineral wool is not suitable for incineration, and the reason it is incinerated is presumably that it is contaminated with other hazardous substances that can be incinerated at special incineration plants.

E 16.2 Future initiatives

Measures:

- *study of the potential for recycling mineral wool*
- *study of the possibilities of environmentally and economically appropriate landfilling*

There is a need for greater knowledge about management of mineral wool waste. Initiatives will be started to examine the potentials and barriers for recycling waste mineral wool either as a replacement for virgin raw materials or for alternative purposes. Following the studies, suitable methods can be developed for recycling.

Furthermore there will be studies of how mineral wool, which is not suitable for recycling, can be landfilled in an environmentally and economically appropriate manner.

E 16.3 Regulation

Mineral wool is regulated by the Statutory Order on Waste[35] and classified as hazardous waste.

Moreover, a guideline has been prepared on how mineral wool should be classified and how it should be managed as waste.

E 16.4 Capacity

There is not sufficient knowledge of the possibilities to recycle mineral wool and the capacity available. Because of its classification, mineral wool must be landfilled at special landfills for hazardous waste.

E 16.5 Environmental assessment

Mineral wool comprises a health problem when it is managed as waste. It is classified as hazardous waste because of its local irritant and carcinogenic effects.

More modern mineral wool (manufactured after 2000) can, however, only be regarded as a local irritant because the design of the fibres in the wool has been changed so that they do not give rise to carcinogenic effects. The local-irritant effect still provides grounds to classify mineral wool as hazardous waste.

From a resource and environmental perspective there are indications that it is appropriate to recycle mineral wool fibres.

E 16.6 Economic aspects

It is not possible to forecast the profitability of recycling mineral wool products before new technologies have been developed.

Taxes and fees for landfilling mineral wool could be changed as a result of changes in landfilling practices.

[35] Statutory Order from the Ministry of the Environment no. 619 of 27 June 2000.

Before implementing special regulations for management of waste mineral wool, an environmental and economic analysis of possible consequences will be carried out.

E 16.7 Implications for national authorities

The studies of landfilling possibilities could mean that regulations regarding landfilling waste mineral wool will have to be changed.

E 16.8 Implications for local authorities

Municipalities must be aware that there may be special regulations for landfilling waste mineral wool.

E.17. Organic domestic waste

Environmental problem	Organic domestic waste constitutes a resource that can be utilised through incineration, biogasification or composting. Local conditions determine how the organic domestic waste is utilised optimally both environmentally and economically.
Initiatives	Focus on management technologies with a view to minimising collection costs. Development of pretreatment technologies with a view to reducing separation of the organic proportion incinerated. Development of a tool that can help make a local assessment of whether incineration, biogasification or composting is the most adequate solution environmentally and economically. This way the municipalities will have a chance to assess whether or not to initiate local two-tier collection of the organic part of domestic waste and to make a decision in this respect. Initiate studies regarding central separation of total domestic waste with a view to recycling the organic part. Work with valuing environmental effects that have not yet been valued.

E 17.1 Status

Aims for 2008:

- *organic domestic waste is treated locally on the basis of an assessment of what is optimal environmentally and economically*

Organic domestic waste constitutes a resource that is today primarily incinerated and only to a lesser extent utilised through composting or biogasification.

Biogasification is the form of recycling of organic domestic waste that has the highest priority because both energy content and fertiliser content of the waste are utilised. Composting, including home composting, is still a suitable treatment option for recovery of the fertiliser content of the waste.

Organic domestic waste is defined as vegetable and animal food waste and other easily degradable organic material. The total amount of organic waste constitutes approx. 50 per cent of total domestic waste[36]. In 2001, around 60,000 tonnes of organic domestic waste were recycled through biological

[36] In 2001, the amount of organic domestic waste was estimated at just less than 700,000 tonnes.

treatment[37] corresponding to approx. 5 per cent of domestic waste. Of this amount, almost 40,000 tonnes were treated at central biogasification or composting plants while the rest was home-composted. In pretreatment in central treatment, between 15 and 40 per cent of the collected amount is separated depending on the treatment technology. In 2001, this entailed almost 55,000 tonnes organic domestic waste being collected separately.

Residues from the biological treatment of organic domestic waste are subject to the same requirements as sludge from public wastewater treatment plants with regard to contents of heavy metal and xenobiotic substances in connection with agricultural use, see appendix E 29.

On the basis of the content of heavy metals and xenobiotic substances, it is assessed that there will not generally be problems with treated organic domestic waste complying with limit and cut-off values. In addition, studies show that the composting process speeds up the degradation of xenobiotic organic substances.

In recent years, a large number of detailed tests and studies have been carried out illustrating various aspects of recycling organic domestic waste, primarily through biogasification. The technical basis for assessment of relevant aspects of collection, management and recycling of organic domestic waste has thus been significantly improved.

E 17.2 Future initiatives

Measures:

- *focus on collection costs and development of pretreatment technology for management of organic domestic waste*
- *clarify the significance of local conditions for waste management of organic domestic waste*
- *initiate studies regarding separation of total domestic waste*

The aim is to clarify what local conditions determine whether it is more appropriate to use incineration, biogasification or composting with regard to the organic part of domestic waste. The Ministry of the Environment intends to develop a tool to assist the municipalities in their assessment. In this way, the municipalities will have a chance to assess which method of waste management of organic domestic waste is optimal with regard to environmental economics and make a decision in this respect. Relevant players will be invited to take part in the work.

In order to achieve an environmental assessment of the different uses of the organic part of the waste, it is necessary to work for a further valuation of a number of the side effects resulting from incineration or recycling respectively.

So far, studies have shown that particularly the two-tier collection and pretreatment are very cost-intensive and crucial to the profitability of recycling organic waste. Therefore, the aim is to minimise collection costs and to develop pretreatment technology.

As an alternative, the possibilities for central separation of total domestic waste with a view to recycling the organic part will be studied. The study will

[37] Approx. 24,000 tonnes for home composting (evaluations of home composting schemes and mapping of the composition of domestic waste) and 37,000 tonnes for treatment at central plants (statistics on treatment of organic waste from households 2001). The amounts treated at central plants were approx. 27,000 tonnes at composting plants and 10,000 tonnes for biogasification.

focus on potential health and safety problems in a central separation plant and on the quality of the separated material.

E 17.3 Regulation

Under the Statutory Order on Waste (no. 619 of 27 June 2000), the municipalities must arrange collection of domestic waste from households in built-up areas with a constant inhabitant count of more than 1,000. In municipal regulations, local councils may permit home composting of the vegetable fraction of domestic waste.

E 17.5 Economic aspects

Experience shows that it is relatively cost-intensive to establish two-tier collection of domestic waste with a view to recycling the organic fraction. The national additional expense thus exceeds the cheaper treatment at biogasification and composting plants as well as the environmental advantages that it has been possible to price so far.

Recycling of degassed or composted organic domestic waste in agriculture requires very clean biomass. The pretreatment technologies already known meet the requirement for clean biomass, but pretreatment is expensive, and a large part of the waste is filtered out in the pretreatment facilities and this has great influence on the energy balance.

E 17.6 Environmental assessment

A comparison of the energy benefit from biogasification and incineration of the organic fraction of domestic waste at a national level shows that biogasification yields a smaller energy benefit in relation to incineration. The calculations include transport, process energy, energy generation and energy consumption for substitution of chemical fertiliser. Apart from the extensive separation process in pretreatment, the reason is that biogas potential in collected organic domestic waste is smaller than previously assumed and that energy recovery at incineration plants has been significantly improved over the last 3-5 years.

With regard to energy, it cannot generally be ascertained that incineration is better than biogasification or vice versa. Local conditions such as collection systems, volumes collected, pretreatment, etc. influence greatly which treatment option should be preferred from an environmental point of view.

Residues from biogasification of 1 tonne organic domestic waste have fertilising values in the range of 3-8 kg nitrogen, 0.5-1.1 kg phosphorous and 1.2-2.6 kg potassium.

Generally, composting does not yield an energy benefit, which is an important factor in the environmental assessment. Local and, in particular, home composting may, however, still be beneficial, and composting is often cheaper than biogasification.

The environmental impacts of the different treatment options for organic domestic waste include a number of positive effects attached to the use of compost and waste treated with biogasification which are not currently possible to include in the assessment. This is either because it is difficult to ascertain the effect or because the effect is not easily priced.

Waste indicators

The new waste indicators for saving resources, energy and landfill requirements[38] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

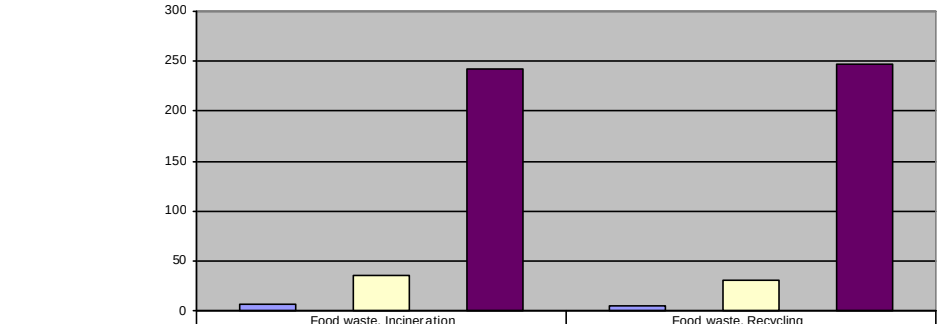
The figure shows the savings achieved through incineration and recycling (biogasification) respectively.

In the LCA data used for biogas production, 4.5 MJ per kg organic waste is credited to natural gas supply. This figure includes both the calorific value of the gas and the value of the nitrogen fertiliser in the degassed biomass. The value of the biomass as a soil-improving material may be significant but difficult to quantify and has not been included.

In incineration of organic waste, a recovery figure of 4 MJ has been employed, and this is credited to other energy supply from waste incineration, ie. with a certain proportion as electricity generation.

Reuse of food waste has not been included, since in 2002, it was prohibited to use food waste as animal feed. Reuse is therefore not a possible treatment option for food waste today.

Figure: Savings from incineration and recycling in biogas production of one tonne food waste, compared to landfilling the same amount (in mPR, mPE or 10mPE).



	Food waste, Incineration	Food waste, Recycling
61 - Energy resources	6	5
62 - Other resources	0	0
63 - Gr. energy, non-renew.	35	31
64 - Gr. energy, renewable	0	0
65 - Landfilling waste	243	248

It appears from the figure that recycling through biogasification yields a slightly smaller energy benefit than does incineration.

[38] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

Therefore, the balance is also affected by the assumption employed about energy recovery from waste incineration plants. A sensitivity calculation with halved energy recovery in waste incineration therefore gives savings from biogasification rather than incineration.

There are, however, several conditions not included in the calculation; slag and ash from the incineration process and the soil-improving characteristics of recovery of degassed biomass from biogas plant.

The figure shows the result that if the organic domestic waste is treated through biogasification (recycled), the energy saving is slightly smaller than for incineration. This does, however, require that the benefit from incineration is as high as assumed, since the sensitivity calculation with a halved energy benefit in incineration gives the opposite result.

The recently completed LCA study of treatment of food waste through incineration and biogasification (Danish EPA, 2003) shows the same trend. Slightly different assumptions have, however, been used for eg. energy recovery. The indicator calculations shown are based on the assumption that energy recovery from incineration is 4 MJ/kg and that this is used for generation of electricity and heat. However, if the assumptions for the yield from incineration are changed, the picture will also change.

E 17.7 Implications for national authorities

The Ministry of the Environment will initiate the development of a model for local assessment of which method of waste management of organic domestic waste is optimal environmentally and economically.

E 17.8 Implications for local waste authorities

The municipalities will assess locally which method of waste management of organic domestic waste is optimal with regard to environmental economics.

E.18. Organic waste from industry except animal waste and food waste from industrial kitchens

Environmental problem	Organic waste is a resource that should be utilised to an optimum extent.
Initiatives	Status quo

E 18.1 Status

Aims for 2008:

- *recycling of no less than 90 per cent*

Organic waste is generated both in industry and in industrial kitchens. Much waste from industry is homogeneous by-products and is therefore not included in the ISAG (Information System for Waste and Recycling, see appendix B).

In industry, just less than 8.5 million tonnes of organic waste are generated each year. The waste is biologically degradable waste such as waste from abattoirs, dairy waste, fisheries waste, etc., and often has a low dry matter content[39]. Animal waste primarily from slaughterhouses and the fisheries industry constitutes 1.0-1.5 million tonnes per year and is dealt with in appendix E 1.

To date, most of the waste has been recycled. Some of the waste is used directly as fertiliser on agricultural soil and some substitutes raw materials. The remaining one-tenth is used in biogas production[40]. Only about 1 per cent has been incinerated or landfilled. There are generally no disposal problems with residues of vegetable origin.

E 18.2 Future initiatives

None.

[39] Miljøprojekt nr. 397 og 398, 1998: Organisk restprodukter i industrien, del 1 og 2 (Environmental Project Nos. 397 and 398, 1998 on organic residues in industry, parts 1 and 2 - only available in Danish).

[40] It appears from the study (data from 1992-1994) that an annual approx. 8.4 million tonnes organic residues are produced in industry. Of this, 99 per cent are recycled (47 per cent for substitution of raw materials, 8 per cent for biogas production and 44 per cent is used directly as fertiliser on agricultural soil). Less than 1 per cent (52,000 tonnes) is incinerated or landfilled. The study mapped all residues from industry - even the ones that are not normally registered as waste.

E 18.3 Regulation

Recycling organic waste for agricultural purposes is regulated in the Statutory Order on sludge. [41]

E 18.4 Capacity

With regard to the fraction of the waste not recycled in other production, the waste may be used for agricultural purposes, possibly through a biogas plant, if the waste has great biogas potential.

E 18.5 Environmental assessment

No significant changes in environmental aspects are expected for non-animal organic waste products and residues from industry.

E 18.6 Implications for national authorities

None.

E 18.7 Implications for local authorities

Local authorities will maintain their present efforts.

[41] Bekendtgørelse nr. 49 af 20. januar 2000 om anvendelse af affaldsprodukter til jordbrugsformål (Statutory Order no. 49 of 20 January 2000 on use of waste products for agricultural purposes).

E.19. Ozone-depleting substances in waste fractions

Environmental problem	Ozone depletion
Initiatives	Implementation of regulations pursuant to an EU directive on special treatment of preinsulated district heating pipes.

Goals for 2008:

- *collection and destruction of no less than 50 per cent of ozone-depleting substances in waste*
- *collection and destruction of no less than 80 per cent of the CFC content in discarded district heating pipes*

E 19.1 Status

In the 1990s, international regulations were implemented on phasing-out of the use of ozone-depleting substances through the Montreal Protocol and the EC Regulation on substances that deplete the ozone layer.

Current regulations include bans on the use of all CFCs and HCFCs. These substances have been used for many years in foam production of polyurethane, which is used as insulation material in fridges, freezers, refrigerated display cases, district heating pipes and refrigerated containers.

In 1996, regulations were laid down regarding collection and reprocessing of fridges and freezers with a view to environmentally appropriate handling of the CFC content. Furthermore, a voluntary agreement was made on collection of CFCs during repair and discarding of large refrigeration systems (the KMO scheme).

In 2002, CFCs and HCFCs in waste were analysed. The analysis shows that from 2007 discarded district heating pipes will be the waste fraction that contains the largest amount of CFCs. According to the analysis, the CFC volume in discarded district heating pipes was 57 tonnes in 2002, and the annual volume will continue to increase until 2018 when it will be approx. 250 tonnes. After this, discards of district heating pipes with CFCs will fall gradually, and in 2040 CFCs will constitute approx. 50 tonnes per year.

Ozone-depleting substances are also used in construction foam, insulation panels, insulated aluminium doors and building insulation. Apart from aluminium doors, it is not assumed possible to establish special collection and treatment systems for these fractions.

E 19.2 Future initiatives

Measures:

- *lay down regulations regarding waste management of district heating pipes and doors containing ozone-depleting substances*

In accordance with the EU Regulation on substances that deplete the ozone layer, special regulations will be laid down regarding waste management of preinsulated district heating pipes containing CFCs or HCFCs.

A study will be carried out of the possibilities for separate management of other waste fractions containing ozone-depleting substances. The study will also look into the extent to which district heating pipes are dug up after the end of their useful life.

E 19.3 Regulation

Waste management of refrigeration equipment is regulated by the circular on municipal regulation of disposal of refrigeration equipment containing CFCs.

The voluntary KMO scheme was established in 1992 and includes environmentally appropriate handling of refrigerants from large refrigeration systems.

Waste management of other waste fractions containing ozone-depleting substances is regulated in the Statutory Order on Waste.

E 19.4 Capacity

It is assessed that existing plants will have sufficient capacity for reprocessing discarded district heating pipes. There may, however, prove to be a need to modify these plants depending on the treatment requirements laid down.

E 19.5 Environmental assessment

Collection and destruction of the total amount of ozone-depleting substances in the waste are expected to increase from approx. 30 per cent to approx. 50 per cent.

E 19.6 Economic aspects

There is great uncertainty as to the number of district heating pipes dug up after the end of their useful lives. Therefore, there is a need for a study of this before the costs of special treatment of district heating pipes containing ozone-depleting substances can be determined.

E 19.7 Implications for national authorities

The Statutory Order on Waste must be amended or a special statutory order on management of waste containing ozone-depleting substances must be prepared.

E 19.8 Implications for local authorities

None, except for supervision of compliance with the regulations.

E.20. Paper and cardboard

Environmental problem	Paper and cardboard waste constitutes an important resource and should be recycled.
Initiatives	Paper collection must be maintained at the 2004 level.

Goals for 2008:

- *60 per cent recycling of all cardboard and paper waste*[1]
- *60 per cent recycling of cardboard and paper packaging waste*
- *maintain 60 per cent recycling of recyclable paper and cardboard waste from households*
- *maintain 75 per cent recycling of recyclable paper and cardboard waste from enterprises and public and private institutions*

E 20.1Status

In 2001, consumption of paper and cardboard was calculated at 1,360,000 tonnes. In the period 1997-2000, paper consumption has been at the same level.

In 2001, 721,000 tonnes of paper and cardboard were collected, corresponding to 53 per cent of paper consumption[42]. The amount collected increased steadily from 1990 to 2001.

The amount of paper and cardboard suitable for recycling is smaller for households than for all the other sectors together. Tissue and soiled packaging (approx. 200,000 tonnes) is seen more frequently in household waste and is not suitable for recycling. The goal for households of 60 per cent recycling of recyclable paper and cardboard waste corresponds to approx. 48 per cent of the total amount of paper and cardboard waste in households. The goal for enterprises of 75 per cent recycling of recyclable paper and cardboard waste corresponds to approx. 68 per cent of the total amount of paper and cardboard waste from industry.

According to the ISAG, 192,000 tonnes of paper and cardboard waste from households and 516,000 tonnes from enterprises, institutions, trade and offices were collected in 2001[43]. Municipalities that do not have collection schemes have reported their total collected amounts for 2001 to the Danish EPA.
If ISAG figures are added for municipalities with collection schemes, a total of 237,000 tonnes paper and cardboard were collected from households in 2001. This corresponds to 59 per cent of the potential for recyclable paper and cardboard from households.

The remaining volume of paper and cardboard waste of approx. 639,000 tonnes is primarily taken to waste incineration plants and energy recovered. There are approx. 262,000 tonnes of paper and cardboard in the residual waste of households. Approx. 46 per cent of this is estimated to be suitable for recycling.

[42] Statistics on collected waste paper and cardboard 2001.
[43] It should be noted that according to the ISAG less cardboard and paper has been collected (a total of 70,935,000 tonnes) than appears from the Statistics on collected waste paper and cardboard 2001.

E 20.2 Future initiatives

It may become necessary to increase the volume of packaging waste from paper and cardboard used for recycling in order to reach the goal of 55 per cent recycling of all packaging waste in 2008. This may necessitate the introduction of collection schemes for cardboard from households. This will be clarified in the white paper to the Danish Parliament in 2005 mentioned in appendix E 8.

E 20.3 Regulation

The regulations regarding collection and recycling of paper and cardboard can be found in the Statutory Order on Waste[44]. Under the Statutory Order on Waste, the municipalities are under an obligation to ensure recycling of transport packaging of paper and cardboard from enterprises and public and private institutions. This duty is to be seen as an extension of the agreement on transport packaging between the Ministry of the Environment and the Confederation of Danish Industries, the Danish Plastics Federation, and the Danish Packaging Industry in 1994.

The municipalities are under an obligation to collect a number of types of paper for recycling from private built-up areas with more than 1,000 inhabitants. This must be done by means of fixed collection equipment. Furthermore, the municipalities must collect other paper and cardboard including cardboard packaging from private built-up areas with more than 1,000 inhabitants. However, the municipalities do not have to meet these requirements if they collected 40 and 55 per cent respectively in 2001 and 2002 of recyclable paper and of cardboard potential from households. In future, the municipalities only have to meet the above requirements if the volume collected is less than 55 per cent of recyclable paper and cardboard potentials in two successive calendar years from 2003 onwards.

E 20.4 Capacity

Marketing possibilities for collected waste paper are good both on the national as well as the international market, but prices vary.

Today, around 20 enterprises in Denmark deal in waste paper, and four enterprises that consume collected waste paper recycle this into new products.

The treatment capacity is adequate for recycling of all collected waste paper.

E 20.5 Environmental assessment

Recycling waste paper is environmentally superior to manufacturing new paper. Increased recycling of paper will give a total CO_2 reduction and reduced impacts from wastewater discharges. In addition, the volume of

[44] Statutory Order no. 619 of 27 June 2000 from the Ministry of Environment and Energy on waste.

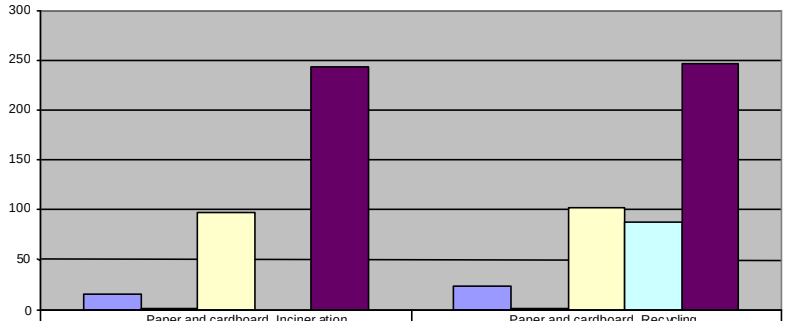
domestic waste to be treated at incineration plants is limited and this frees capacity.

Waste indicators

The new waste indicators for saving resources, energy and landfill requirements[45] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

The figure below shows the savings from using incineration and recycling respectively of 1 tonne of paper and cardboard compared to landfilling 1 tonne of paper and cardboard. The five columns for each treatment option thus show the savings for energy resources, other resources, gross energy and landfilling of waste. So, the higher the columns are the greater the saving achieved compared to a landfilling solution.

Figure: Savings from treatment of 1 tonne of paper and cardboard by incineration and recycling respectively. The values are: mPR per tonne for the two resource factors, mPE per tonne (1 PE=160 GJ) for the two energy indicators and 10 mPE per tonne (1 PE=403 kg) for the landfill factor



	Paper and cardboard, Incinerat ion	Paper and cardboard, Recycling
61 - Energy resources	16	23
62 - Other resources	1	1
63 - Gr. energy, non-renew.	98	103
64 - Gr. energy, renewable	0	87
65 - Landfilling waste	243	247

Thus it appears from the figure that the greatest saving in renewable gross energy is achieved by recycling 1 tonne paper and cardboard instead of incinerating it, and this is also reflected in the indicator for energy resources. For the other three indicators, the saving from recycling is only marginal.

The crediting of the energy from waste incineration is an important condition for this conclusion. A sensitivity calculation assuming a halved energy benefit in incineration shows increased saving in recycling. The reason that the energy benefit in incineration may be smaller in future is that it is to be expected that the efficiency of the total electricity generation system is constantly improving and to an increasing extent based on renewable energy.

However, there are significant differences in the energy and environmental advantages in recycling different paper types. In particular, a total assessment of what the individual waste paper qualities in practice replace is still needed.

[45] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003

A project has been initiated and the results will give a differentiated picture of what paper qualities can be recycled with the greatest energy and environment advantage.

E 20.6 Economic aspects

Maintaining the goal of 60 per cent recycling of paper and cardboard is not expected to lead to extra costs.

E 20.7Implications for national authorities

The Danish EPA will assess whether there is a need for further initiatives regarding paper and cardboard packaging.

E 20.8 Implications for local authorities

In future planning, the municipalities must provide ongoing information on collection schemes and separation requirements in order to maintain the level of paper collection.

E.21. PCBs and PCTs

Environmental problem	PCBs/PCTs are hazardous to human health and the environment.
Initiatives	Assess whether environmental or health effects arise in connection with using, renovating, or demolishing buildings containing PCBs.

E 21.1 Status

Aims for 2008:

- *status quo with regard to the goal that oils containing PCBs/PCTs (>0.05 per cent by weight) in transformers should be phased out before 2000*
- *assessment of whether there are environmental or health effects from using, renovating, or demolishing buildings containing PCBs*

PCBs are a group of chlorinated biphenyls, and PCTs are a group of chlorinated terphenyls. These substances do not readily decompose and accumulate in the food chain. PCBs and PCTs are teratogenetic, carcinogenic, and are suspected of demonstrating hormone-like effects on reptiles and mammals. High concentrations of PCBs and PCTs have been found in fat tissues of, for example, polar bears, seals, and birds of prey.

PCBs are one of the 12 substances on the Stockholm Convention list of substances where a stop on production, use and consumption should be ensured as well as environmentally sound destruction.

PCBs and PCTs have been used as refrigerants and insulation fluids in electrical equipment such as transformers and condensers. Furthermore they have been used in heat pumps, gas turbines, hydraulic systems, glue, fire inhibitors, sealing and filling compounds etc.

Special measures have been initiated in Denmark and internationally to phase out the use of the substances. There has been a ban in Denmark on importing and selling PCBs/PCTs, as well as equipment containing these substances since 31 October 1986.

Furthermore, since 1 January 1995 the use of PCB/PCT-containing condensers and transformers above a certain limit (total weight > 1 kg or effect > 2kW) has been banned. Therefore, large transformers (>5 l PCB) do not exist in Denmark. Small condensers and transformers may be used until the end of their useful life.

Since 1 January 1999 there has been a requirement that transformers with a PCB concentration above a certain limit (>0.05 per cent by weight) should be decontaminated as soon as possible.

PCBs were used in fillers and sealing materials for sealed glazing units for window panes between 1950 and 1976. Studies indicate that consumption of PCBs in fillers during the period was 110 tonnes PCBs and 200 tonnes PCBs in sealing glues.

The technical lifetime of fillers is usually 25 years. In practice fillers are replaced less often and a screening survey indicates that there is still a large amount of old filler remaining in existing buildings. According to estimates, 75 tonnes of PCBs remain in fillers today.

Similarly, surveys from Norway and Sweden show that only few sealed window panes are replaced. It is estimated that 160 tonnes PCBs remain in sealed double-glazing.

E 21.2 Future initiatives

Measures:

- *examine whether there are environmental and health effects in connection with using, renovating, or demolishing buildings containing PCBs*

A study will be initiated to examine whether there are environmental and health effects in connection with using, renovating, or demolishing buildings containing PCBs. The project will focus on assessing PCBs in house dust, indoor air, and soil close to buildings, as well as making comparisons with other sources and TDI values for selected PCBs.

E 21.3 Regulation

In the Statutory Order on waste, PCB/PCT waste is regulated as hazardous waste. As a consequence, local authorities are responsible for collecting such waste.

In 1998 a Statutory Order on PCBs, PCTs and substitute substances was issued[46]. The Statutory Order entered into force on 1 January 1999.

In the Statutory Order on electrical and electronic products[47] condensers containing PCBs are further regulated.

E 21.4 Capacity

In Denmark, Kommunekemi A/S is the only enterprise authorised to destroy PCB/PCT condenser and transformer oils with a PCB/PCT content above 50 ppm.

E 21.5 Environmental assessment

New requirements will ensure controlled disposal of remaining PCBs/PCTs.

E 21.6 Economic aspects

If the project on PCBs in building and construction waste gives rise to changes in legislation, an environmental-economic analysis will be carried out of the consequences.

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[46] Statutory Order no. 925 of 13 December 1998 on PCBs, PCTs and substitutes for these
[47] Statutory Order no. 1067 of 22 December 1998 on management of waste from electrical and electronic products

E 21.7 Implications for local authorities

In parallel to the decontamination of transformers with PCB-containing oils, local authorities must collect waste.

E.22. Plastic

Environmental problem	Plastic waste constitutes a non-renewable resource that can be utilised better than it is at present.
Initiatives	Increased recycling of transport packaging and certain sales packaging from business and households.

E 22.1 Status

Goal for 2008:

- *increase recycling of plastic packaging to 22.5 per cent*

The Danish plastic requirement in 2000 amounted to about 604,000 tonnes, and waste amounts were around 345,000 tonnes. According to estimates, the amount of plastic in waste was lower than consumption because plastic is part of products with a long lifetime such as water, sewage, and district heating pipes, electricity and telephone cables, and components in wind turbines. Consumption of plastic and the amount of waste increased by about 40 per cent between 1996 and 2000.

Consumption of plastic packaging in 2001 has been calculated at some 150,000 tonnes. This amount has remained constant from 1997-2000[48].

In 2001, 43,000 tonnes of plastic were collected and recycled in Denmark. This figure includes both production and packaging waste that is reprocessed in Denmark. About 21,000 tonnes of plastic packaging was collected for recycling, and about 10,000 tonnes of this amount was exported for recycling abroad[49].

Plastic comprises about 9 per cent of the contents of households' dustbins. This corresponded to about 155,000 tonnes in 2001, and of this the most dominant fraction was plastic packaging. The recyclable proportion of the plastic packaging amounted to about 27,000 tonnes. More or less all plastic ending in domestic waste goes to waste incineration plants where heat and electricity are produced.

It is likely that there is a lot of the plastic in the combustible part of the waste from business enterprises (institutions, trade and offices, as well as manufacturing industries), but there are no analyses of the plastic content in these fractions. Estimates indicate that about 280,000 tonnes of plastic are incinerated each year.

Finally there is plastic in three environmental contaminant waste fractions – PVC, electronic products, and end-of-life vehicles. See appendices E 23, E 7, and E 5.

[48] Packaging supply in Denmark 2001.
[49] Statistics for plastic packaging 2001

Denmark has primarily aimed at meeting the minimum requirement of 15 per cent recycling contained in the Packaging Directive of 2001 by recycling transport packaging plastic from business, as there are typically large, clean and more homogenous fractions. In contrast plastic waste from households occurs in small, soiled amounts comprising many types of plastic. In 2001, transport packaging plastic amounted to about 50 per cent of the total supply of packaging.

Denmark expected to meet the minimum requirement in the Packaging Directive so that no less than 15 per cent of plastic packaging was recycled in 2001. Data for 2001 show that Denmark recycled 14 per cent in 2001; just under the goal for 2001.

In 2001, the Danish Parliament adopted a report on recycling plastic packaging, in which the goal was 22 per cent recycling by 2004. However, this assumes high price levels and constant amounts, and that a number of initiatives are started.

At the moment there are negotiations on revising the Packaging Directive. It is expected that the new goal for recycling plastic packaging will be 22.5 per cent in 2008. This corresponds 35,000 tonnes, on the basis of the amounts of waste plastic packaging in 2000.

In 2002 a collection scheme for single-use bottles for carbonated soft drinks was established via Dansk Retursystem. Recycling of these bottles will contribute to meeting the goal with about 1,000 tonnes.

A lot of waste plastic is not suitable for recycling and is therefore incinerated with energy recovery. Therefore, it should be considered whether it would be more beneficial to separate mechanically this type of plastic waste with a view to energy recovery of the calorific value in the plastic at special plants so that the only loss of resources is the conversion from oil into plastic. In 2002 a project was initiated to assess the environmental conditions involved in the various forms of energy recovery from plastic.

Measures:

- *enterprises and municipalities to have greater focus on separating plastic film for recycling*
- *the sector organisations for waste producers to be able to establish nationwide collection schemes*
- *enterprises to separate plastic containers for recycling*
- *compulsory schemes for collection of plastic containers and bottles from households*

E 22.2Future initiatives

Increased separation of transport packaging film from industry, building, trade, etc.
Municipalities will prioritise supervision by seeing that transport packaging is collected for recycling.

Waste producers will play a greater part in organising effective schemes. It will be easier for sector organisations representing waste producers/chains to establish collection schemes covering the whole of Denmark. Legislative changes will be examined so that amended legislation in 2004 can allow new schemes to work from 2005.

It is most appropriate environmentally and economically that enterprises with large amounts carry out separation. Estimates indicate that about 42,000 tonnes plastic foil waste comes from enterprises with more than 10 employees each year[50]. Therefore there will be more focus on enterprises with large amounts in industry, trade and service.

It may be necessary to extend the requirements for collection to smaller enterprises. A project currently in progress is examining collection systems for transport packaging made of plastic from small and medium-sized enterprises.

Increased separation of other plastic packaging from industry, trade, etc.
In 2002, a project was initiated to assess the potential to recycle and reuse plastic drums and containers from business with special focus on identifying relevant sectors. Environmental and economic aspects will also be investigated. When the project is completed in mid 2003, a decision will be made regarding the types of packaging to be separated.

Compulsory schemes for collecting plastic containers and bottles from households.
From 1999 to 2001 three projects were completed to assess whether it is possible to collect plastic bottles and containers from households for recycling and achieve good quality plastic in the recycled material. Assessments were made of the potential, collection systems, separation criteria, and sales possibilities, including a collection trial in Nyborg[51].

In addition an environmental assessment has been completed of recycling compared with incineration of plastic bottles and containers from households. It is environmentally appropriate to recycle, if the product can easily be emptied from the packaging[52].

Finally, an environmental economic assessment of recycling compared with incineration of plastic bottles and containers has been completed [53]. Two

[50] Working report no. 20, 2002.
[51] Environmental Project no. 637, 2001 www.mst.dk/udgiv/Publikationer/637/2001-2001-87-7944/html/default.htm (only in Danish).
[52] Environmental Project no. 657, 2002 http://mst.dk/udgiv/publikationer/657/2002-2002-87-7944/html/ (only available in Danish).
[53] Environmental Project no. 695, 2002 http://mst.dk/udgiv/publikationer/695/2002-2002-87-7972/html/. (only available in Danish).

collection systems for recycling were compared; a voluntary bring scheme to containers, and collection at recycling stations. The results showed that it is most expensive in terms of socio-economics to establish a bring scheme in containers, cheaper to collect at recycling stations, and cheapest to incinerate this type of packaging. Recycling is particularly affected by the costs of manual separation.

On the basis of these surveys, from 2005 municipalities will be subject to providing citizens with the possibility to separate relevant packaging and deliver it for recycling, for example to a recycling site, as this is the cheapest recycling option.

If the amount of plastic collected for recycling does not increase at a satisfactory rate in the future, consideration will be afforded as to whether to introduce compulsory municipal collection schemes for plastic transport packaging, or producer responsibility for plastic transport packaging.

E 22.3 Regulation

According to the Statutory Order on Waste, the municipalities [54] are obliged to ensure recycling of plastic transport packaging from business enterprises. This duty is further to the 1994 agreement on transport packaging between the Ministry of the Environment, the Confederation of Danish Industries, the Danish Plastics Federation, and the Packaging Industry.

Easier access for sector organisations to establish nationwide collection schemes and a forthcoming recycling scheme for plastic bottles and containers from households and business will require a change in the legislation.

E 22.4 Capacity

Assessments indicate that the capacity necessary to reprocess plastic transport packaging is available in Denmark. Since 1999 there has been an increasing export of plastic packaging waste to the Far East.

At present there is no capacity to reprocess plastic bottles and containers in Denmark, but there is capacity in other European countries and in the Far East.

E 22.5 Environmental assessment

Plastic is normally manufactured on the basis of oil, which is a non-renewable resource. The conversion of oil into plastic is very energy intensive. The consumption of oil is close to 2 kg per 1 kg plastic manufactured. Recycling of plastic, replacing virgin plastic with recycled plastic, will therefore give a significant environmental benefit.

It is difficult to recycle plastic as there are many different types of plastic. Recycling of plastic at a high environmental level therefore requires that

[54] In section 36 with effect from 1 July 1998.

plastic is separated into pure fractions. Much waste plastic is generated by many small waste producers, especially households, which makes separation and collection difficult and resource consuming.

When plastic is incinerated, the energy that was used for the conversion of oil into plastic is lost. Energy utilisation of plastic in conventional waste incineration plants is poor, as electricity generated only corresponds to 20 to 25 per cent of energy fed in through the calorific value of the plastic.

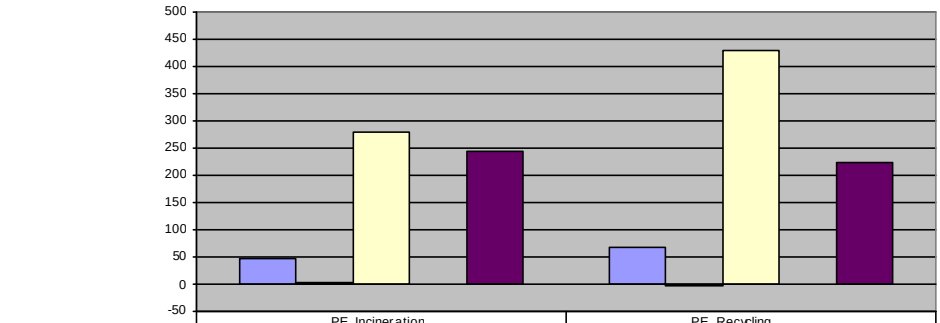
Waste indicators

The new waste indicators for saving resources, for energy and for landfill requirements[55] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with one tonne of waste being landfilled.

Polyethylene (PE)

The figure below shows the savings for the five indicators through incineration and recycling respectively of one tonne polyethylene compared with landfilling the same amount.

Figure: Savings from incineration and recycling of one tonne of polyethylene (PE - should not be confused with the units in the figure, mPE or person equivalents), compared to landfilling the same amount (in mPR, mPE, and 10 mPE).



	PE, Incineration	PE, Recycling
61 - Energy resources	47	67
62 - Other resources	3	-3
63 - Gr. energy, non-renew.	279	430
64 - Gr. energy, renewable	0	0
65 - Landfilling waste	244	224

There is a resource and energy saving from recycling compared with incineration. In contrast, there is a slightly smaller saving in the landfill factor through recycling. This is because of a certain amount of waste from the recycling process, which the calculations assume is landfilled.

Recycling polyethylene (PE) provides energy savings. A more detailed lifecycle study [56] shows that, with regard to energy, it is only worth collecting pure plastic waste from households. Not surprisingly, a sensitivity analysis shows that the advantages of recycling become relatively greater as energy

[55] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen I Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

[56] Environmental Project no. 657, 2002 http://mst.dk/udgiv/publikationer/657/2002-2002-87-7944/html/(only available in Danish).

benefits from waste incineration fall. Energy benefits from incineration therefore determine the type of plastic fractions it is worth recycling.

E 22.6 Economic aspects

Increased collection of transport packaging from enterprises is not expected to lead to higher net costs for enterprises. Enterprises will incur extra costs for separation, but there will be a small income from plastic waste and a saving in costs of treatment at incineration plants and waste taxes.

If it is necessary to collect from enterprises with only small amounts of waste, there will be extra costs for enterprises.

A compulsory collection scheme for plastic bottles and containers at recycling sites will cost the public an extra DKK 1.9 million.

E 22.7 Implications for national authorities

Legislation will be changed.

Collection of plastic packaging will be closely monitored so that further initiatives can be implemented if necessary.

E 22.8 Implications for local authorities

In their future planning, local authorities will have to take into consideration that from 2005 there will be a requirement to give citizens the opportunity to deliver certain plastic bottles and containers for recycling, for example at recycling sites.

Assignment of transport packaging and other plastic packaging from business will have high priority.

E.23. PVC

Environmental problem	PVC contains a number of environmental contaminants causing environmental problems in waste management. On incineration, the chlorine content in waste can contribute to the formation of dioxins. It is therefore important to keep the content of chlorine in waste as low as possible. As PVC waste is a source of chlorine, as far as possible this fraction must be kept away from incineration plants.
Initiatives	Determine amounts of PVC being marketed and the potential amounts of waste. Prepare draft requirements for managing PVC waste. Prepare criteria for exemptions from the PVC tax. Exempt chemical treatment plants from the waste tax in order to promote new recycling technologies. Substitute PVC products which end in waste incineration plants. Ensure that PVC products containing lead and cadmium are separated for either chemical treatment or landfilling. Complete an environmental and economic analysis of treatment methods for PVC waste.

Aims for 2008:

- *ensure environmentally sound treatment of PVC waste so that resources are exploited, and problems with additives are eliminated*
- *keep PVC waste away from waste incineration plants*
- *ensure that the environmental problems from mechanical recycling are minimised*

E 23.1 Status

A focused effort will be made for environmental problems related to PVC. Additives harmful to health and the environment will be phased out, and waste containing chlorine will be kept away from waste incineration plants, including waste with PVC. Appropriate treatment methods will be established for PVC waste.

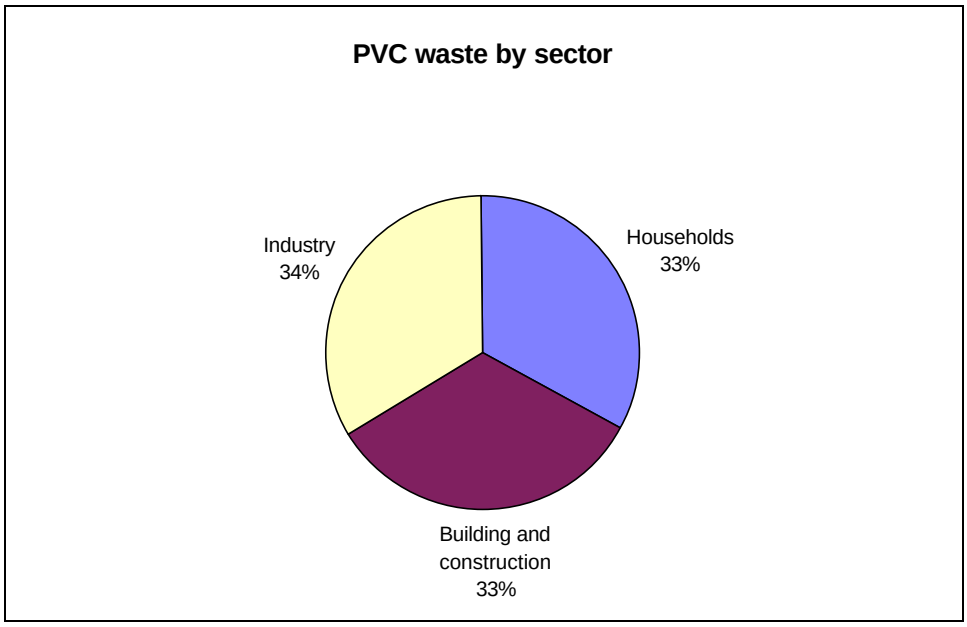
Estimates show that about 34,000 tonnes of PVC waste were generated in 2002[57]. PVC waste is generated in the building and construction sector, the business sector (trade and office as well as industry), and households, each accounting for around one third.

Amounts of PVC waste from the building and construction sector are expected to increase. From the other sectors, amounts will decrease.

[57] The primary sources are the building and construction sector (about 10,000 tonnes per year), business, including end-of-life vehicles (about 14,000 tonnes per year), and households (about 10,000 tonnes per year).

The WUPPI A/S company collects recyclable PVC waste. In 2002, 1,100 tonnes were collected, corresponding to 3 per cent of the total amount of waste, and 16 per cent of the potential waste amount that could be recycled.

Raw PVC is not manufactured in Denmark. PVC contains various additives such as colorants, stabilisers, anti-static agents, fire inhibiting substances, fillers and plasticisers. Different environmental aspects are connected to the different additives.



In April 2001, new regulations were introduced for managing PVC waste. These mean that recyclable PVC waste must be separated for recycling, while the rest must be landfilled. However, it is not possible to separate all PVC, and therefore between 50 and 60 per cent of PVC waste ends in Danish incineration plants. Incineration of PVC in plants with dry and semi-dry cleaning systems forms acid, and this is subsequently neutralised by adding lime. This increases the amount of flue-gas cleaning waste for landfilling. In general it is assumed that 1 kg PVC leads to the formation of 0.4-1.7 kg flue-gas cleaning product. Heavy metals (lead and cadmium) become concentrated in the product after incineration.

Today, mechanical recycling is a possibility for a number of products made of hard PVC. The occurrence of additives previously used such as lead and cadmium inhibit mechanical recycling. Today it has been decided that the use of lead and cadmium must be phased out in the manufacture of new products. There may be a short-term exemption on sales of products containing lead.

Alternative treatment methods have been developed that exploit resources and eliminate problems from additives.

E 23.2 Future initiatives

Measures:

- *determine amounts of PVC being marketed and estimate the potential amounts of waste*
- *prepare requirements for managing PVC waste*
- *exempt products being managed in an environmentally sound manner from the PVC tax*
- *prepare guidelines for mechanical recycling of PVC products containing lead and cadmium*
- *exempt chemical treatment plants from the waste tax*
- *assess the possibilities to promote use of alternative products to the products that end in waste incineration plants*
- *carry out an environmental and economic analysis of waste PVC treatment*

A working group will be set up to determine the amounts of PVC being marketed and design a model for calculating the expected waste amounts. Waste amounts will be estimated up to 2020.

Efforts must ensure that PVC waste is managed in an environmentally appropriate manner. This could be by preparing requirements for collecting and treating PVC waste, and by exempting products managed in an environmentally sound manner from taxes. The Ministry of the Environment will contact the Ministry of Taxation with a view to exempting the relevant treatment plants from the registration duty.

Preparation of future regulations for managing waste PVC will ensure that PVC waste containing lead and cadmium is separated for either chemical treatment or landfilling. Any dispensation to sell products containing lead will be prepared with guidelines on how recycling of regenerated PVC containing lead can take place.

In order to promote use of new technology to treat waste PVC, there will be work to amend the legislation regarding taxes on waste and raw materials[58] so that the new plants are exempt from waste taxes.

It is not possible to keep PVC completely away from incineration plants. In 2002, the Danish Environmental Protection Agency completed an analysis of alternatives to building products made of softened PVC. The Danish EPA will assess other areas regularly in order to examine possibilities to promote the use of alternatives to the products that end at waste incineration plants.

An environmental and economic study has been initiated on managing PVC waste. The analysis will assess the extra costs involved in mechanical recycling and chemical treatment compared to landfilling. Completion of the study is expected in 2003.

E 23.3 Regulation

The Minister for Environment and the Danish Plastics Federation made an agreement in 1991 on the management of PVC waste.

The overall goal of the agreement has been to keep PVC away from waste incineration plants. The agreement lays down specific targets for building materials, packaging, and other products, as well as heavy metals and fire inhibitors[59].

Non-recyclable PVC waste has so far been regulated in the general provisions in the Statutory Order on waste.

In April 2001, new regulations were issued for managing PVC waste. The regulations ensure that recyclable PVC waste is separated for recycling, while the rest is landfilled.

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[58] Act on a tax on waste and raw materials, Consolidated Act no. 570 of 3 August 1998.
[59] See the PVC report.

At the same time as the regulations were issued, a list was sent to all municipalities of the products the Danish EPA considers are suitable for recycling, and those which are suitable for landfilling.

In order to make identification of PVC products easier, the Danish EPA has issued a handbook on PVC.

E 23.4Environmental assessment

Separation of PVC with a view to avoiding delivery to waste incineration plants of this waste fraction will lead to a reduction in amounts of flue-gas cleaning waste. Furthermore, reduced delivery of PVC waste to incineration plants will also lead to improved quality of slag for recycling.

However, it is assessed that it is impossible to identify some PVC waste. This waste will still be delivered to incineration plants.

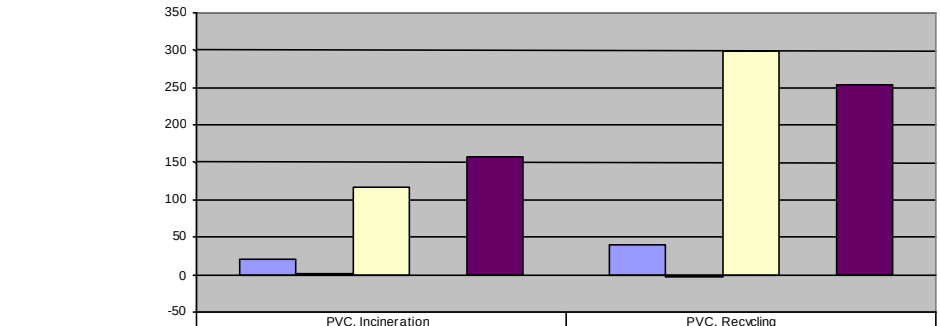
New plants for chemical treatment of PVC waste will help improve exploitation of resources, and they will eliminate the problems of environmentally harmful additives.

Waste indicators

The new waste indicators for saving resources, for energy and for landfill requirements[60] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with one tonne of waste being landfilled.

The figure below shows the savings from incinerating and recycling one tonne of PVC.

Figure: Savings from incineration and recycling of one tonne of PVC, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



	PVC, Incineration	PVC, Recycling
61 -Energy resources	20	39
62 - Other resources	1	-3
63 - Gr. energy, non-renew.	117	300
64 - Gr. energy, renewable	0	0
65 - Landfilling waste	158	254

The figure shows that the savings in total resources (energy resources and other resources in total) and savings in gross energy consumption are greatest from recycling. As with other types of plastic, it has not been possible to

[60] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

obtain specific data for recycling PVC, and PE data has been applied for recycling. Therefore, as with PE a significant amount of waste regarding recycling has been included, and the correctness of this should be investigated more closely for the specific plastic material for recycling. Some landfill space is saved through recycling PVC, as incineration leads to the formation of large amounts of flue-gas cleaning products for landfilling.

The result of the indicator calculation is therefore that there is a significant saving in energy and landfill space from recycling PVC, calculated per tonne.

E 23.5 Economic aspects

An environmental and economic study has been initiated on managing PVC waste. The analysis will assess the extra costs involved in mechanical recycling and chemical treatment compared to landfilling. Completion of the study is expected in 2003.

E 23.6 Implications for national authorities

When suitable treatment methods have been developed, new requirements for management of PVC waste will be issued.

E 23.7 Implications for local authorities

Local authorities are to ensure that non-recyclable PVC waste is assigned to landfilling.

When suitable treatment methods have been developed, new requirements for management of PVC waste will be issued.

E.24. Residues from biofuels

Environmental problem	Bioash contains nutrients that should be recycled for agricultural purposes, taking account of the content of the ash, particularly cadmium.
Initiatives	Reassessment of the current regulations for recycling bioash for agricultural purposes.

Aims for 2008:

- *at least 75 per cent of bioash to be recycled for agricultural purposes*

E 24.1Status

In 2000 a statutory order on recycling bioash was issued. This makes it possible to recycle the contents of nutrients, primarily potassium and phosphorus, in fertilizers for agricultural land and forests. A specification in an environmental project on separation and recycling ash from biofuel plants (2003) shows that in 2000 about 32,300 tonnes of bioash were produced, of which about 64 per cent was recycled on agricultural soil and in forests.

Most of content of heavy metals in bioash is found in fly ash, and therefore initiatives have been established at power stations where the content of potassium in fly ash is washed out and recycled for agricultural purposes, while the remaining residues containing heavy metals are landfilled.

Up to 2030 it is expected that the amount of bioash will increase to up to 70,000 tonnes per year as a result of the Action Plan for Biomass.

E 24.2Future initiatives

Measures:

- *reassessment of the current regulations*

The Statutory Order on Bioash will be revised to include the most recent knowledge about the availability of nutrients in hardened bioash.

E 24.3Regulation

Recycling of bioash is regulated by Statutory Order no. 39 of 20 January 2000 on use of ash from gasification and incineration of biomass and biomass waste for agricultural purposes – called the Bioash Statutory Order.

E 24.4 Capacity

Provided bioash is of adequate quality, it can be recycled without capacity problems in agricultural purposes. Alternatively the ash can be landfilled.

E 24.5Environmental assessment

No significant changes in environmental aspects are expected.

E 24.6 Implications for national authorities

The Statutory Order on bioash will be revised.

E 24.7 Implications for local authorities

No significant initiatives are expected by municipalities.

E.25. Residues from waste incineration plants

Environmental problem	Residues contain heavy metals which, by leaching, threaten groundwater.
Initiatives	Optimise separation of waste fractions containing heavy metals from the waste stream. Optimise the incineration process so that leaching of xenobiotic substances in slag is minimised. Separate slag with particularly high content of heavy metals immediately after the incineration process. Prepare an action plan for future management of flue-gas cleaning products manufactured in Denmark on the basis of an environmental and economic calculation.

E 25.1 Status

Aims for 2008:

- *85 per cent recycling of slag taking the groundwater into account*
- *ensure a Danish solution for management of flue-gas cleaning products*

Residues from waste incineration contain heavy metals.

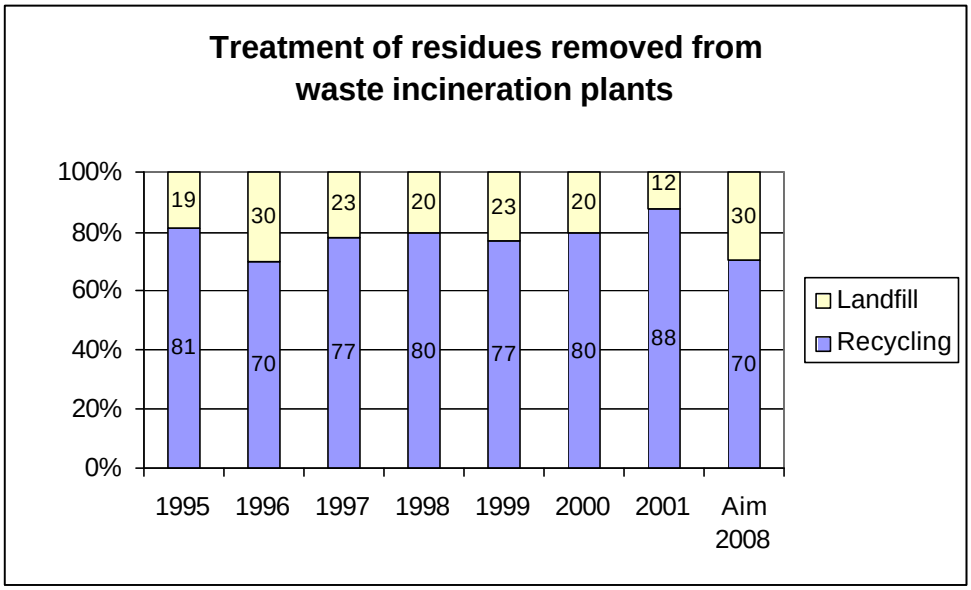
Residues cover slag and flue-gas waste, including fly ash.

In 2001, 87 per cent of slag was recycled while the rest was landfilled. The flue-gas waste will be exported and landfilled in Norway and Germany until a permanent Danish solution is established.

Requirements for recycling of other residues from waste incineration must be adjusted to take account of groundwater. The objective of recycling residues from waste incineration plants has been achieved[61], as 75 per cent of residues from waste incineration plants was recycled in 2001.

In 2001, 465,600 tonnes of slag and 73,825 tonnes of flue-gas cleaning waste were generated. Flue-gas cleaning waste contains large amounts of environmental contaminants, and it results in very high leaching of salts and heavy metals when water flows through it. Flue-gas cleaning waste is classified as hazardous waste.

[61] The objective for 2000 was to recycle 53 per cent of the total volume of residues from waste incineration plants. A specific objective has been set to recycle 65 per cent of slag.



Slag and flue-gas cleaning waste are generated at 31 waste incineration plants and Kommunekemi A/S, as well as the special incineration plant SWS.

Slag from waste incineration is primarily recycled in building and construction works. Present criteria for recycling must be adjusted so that groundwater resources are protected, since the criteria do not cover organic compounds.

In 2001, 139,000 tonnes flue-gas cleaning waste from waste incineration plants and temporary landfills were exported for landfilling in Norway or Germany. The flue-gas cleaning waste is exported because there are no existing satisfactory methods for stabilising or reprocessing flue-gas cleaning waste, and landfilling in Norway or Germany is deemed to be much more environmentally appropriate than temporary landfilling in Denmark.

Methods have been developed for stabilising flue-gas cleaning waste but the methods are not deemed to be environmentally or economically competitive in the long term with the reprocessing technologies expected to be developed within the next few years.

At foreign plants, good results have been achieved with regard to stabilising flue-gas cleaning waste. The tests have shown that it is possible to recycle zinc and lead. The minerals in flue-gas cleaning products have also been recovered as slag that can be recycled for building and construction works.

Measures:

- *Statutory Order no. 655 of 27 June 2000 to be extended to cover limit values for organic substances*
- *reduce leaching of xenobiotic substances from slag*
- *filter out fractions with particularly high contents of heavy metals from the remaining slag*
- *prepare an action plan for a permanent solution to management of flue-gas cleaning products produced in Denmark*

E 25.2 Future initiatives

On 1 January 2001, Statutory Order no. 655 of 27 June 2000 on recycling of residual products and soil in building and construction work entered into force, and this Statutory Order regulates recycling of slag from waste incineration plants.

The purpose of the Statutory Order is to ensure recycling of residues with due respect for groundwater resources. To ensure this, the Statutory Order will be extended to cover limit values for organic substances.

Recycling slag from waste incineration plants is dependent upon the risk of leaching of heavy metals and salts from the slag. Increased recycling of slag is thus dependent upon the content of these substances in the slag and on how the substances are bound in the slag. In addition to this, the slag is not a homogeneous waste stream, which is why separation of the slag immediately after it comes out of the ovens may increase the recycling potential.

It is expected that recycling slag from waste incineration plants can be increased when it becomes possible to register the effect of the regulations on separation of the waste fractions containing heavy metals, namely PVC, impregnated wood and electrical and electronic products. Recycling other fractions containing heavy metals may become relevant, but not until they have been analysed environmentally and economically.

In 2002, studies were initiated with the purpose of determining the incineration conditions under which xenobiotic substances are best bound in the slag and whether the slag can be separated according to heavy metal content immediately after coming out of the ovens.

On the basis of the stabilisation tests made, it is assessed that stabilising flue-gas cleaning products and subsequently landfilling them in Denmark is not the optimal solution with regard to the environment and economy in the long term.

At global level, reprocessing technologies have been developed that, on the basis of results so far, look very promising with regard to the environment as well as economically. Also within the field of "development of Danish reprocessing technologies" positive results are anticipated within the next few years (1 to 2 years).

On the basis of this, the Danish EPA will, in 2003, prepare an action plan for future management of flue-gas cleaning products in cooperation with waste incineration plants. The action plan will contain time limits for the solution of the problems with flue-gas cleaning products. If possible, Denmark will solve its own problems with flue-gas cleaning products, and one element of the action plan will be to establish environmentally appropriate reprocessing methods so that flue-gas cleaning products may be recycled.

When environmentally appropriate reprocessing methods have been established, specific regulations regarding management of flue-gas cleaning products from waste incineration plants will be prepared.

E 25.3 Regulation

According to general rules on waste[62] local authorities must assign slag to disposal, and they are responsible for collecting flue-gas cleaning waste.

Recycling of slag is regulated by Statutory Order no. 655 of 27 June 2000 on Recycling of Residual Products and Soil in Building and Construction Work.

Exports of flue-gas cleaning products for landfilling in Norway and Germany are covered by bekendtgørelse nr. 971 af 19. november 1996 om import- og eksport af affald (Statutory Order no. 971 of 19 November 1996 on imports and exports of waste).

E 25.4 Capacity

It may become necessary to landfill increasing amounts of slag, due to revised regulations regarding recycling.

E 25.5 Implications for national waste authorities

The counties are permitted to omit to plan for establishment of national coastal landfills when environmentally appropriate reprocessing methods are being developed.

E 25.6 Implications for local waste authorities

The municipalities must, in their future planning, take into account the changed conditions for management of residues from waste incineration plants, including the future management of flue-gas cleaning products.

If Statutory Order no. 655 of 27 June 2000 on Recycling of Residual Products and Soil in Building and Construction Work results in landfilling of a larger volume of slag, the municipalities must include increased landfilling capacity in their planning.

[62] Statutory Order no. 619 of 27 June 2000 from the Ministry of Environment and Energy on waste.

E.26. Residues from power plants fired by coal, oil or natural gas

Environmental problem	The residues contain trace elements that are harmful to health and the environment. The residues constitute a large amount of resources that should be recycled instead of taking up capacity at landfills.
Initiatives	Prepare requirements for recycling of residues in order to secure groundwater resources.

E 26.1Status

Aims for 2008:

- *99 per cent recycling of the bottom ash and fly ash produced in coal-fired power plants*

Today, energy generation at power plants is based on either coal, oil, natural gas or biofuels. During the process, a number of residues are generated which can be recycled for various purposes.

According to Energy 21, the use of coal for energy generation will be more or less phased out within the next 30 years. Phasing-out will be done as energy generation based on biofuels becomes more widespread. As a consequence, the generation of residues from coal-fired power plants will drop in this period, whereas amounts of residues from bio-based power plants will increase.

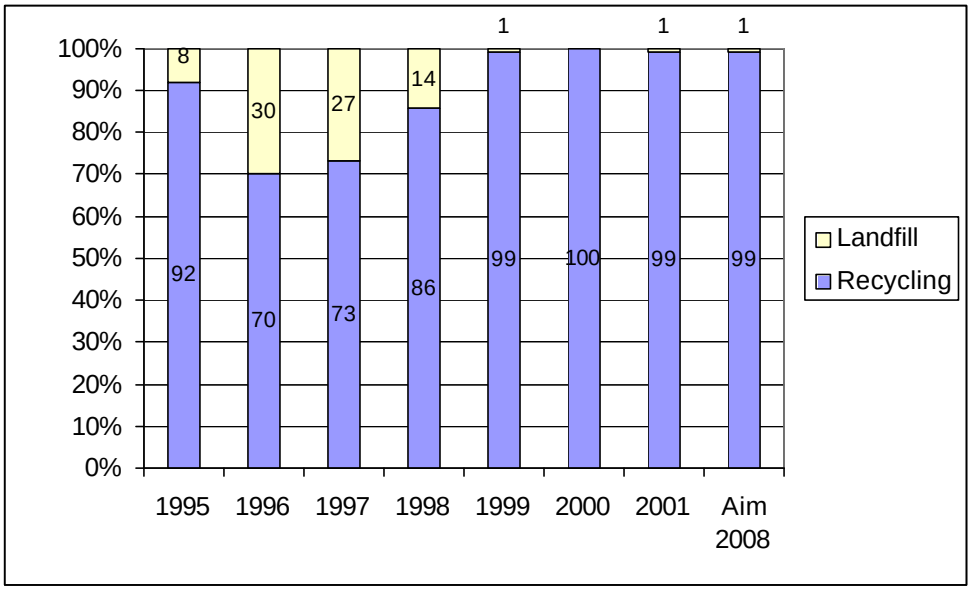
Hardly any residues are generated at oil and natural gas-fired power plants.

Residues from coal-fired power plants
Residues from coal-fired power plants are slag, fly ash, gypsum, TASP and sulphuric acid. Residues from coal-fired power plants contain a number of heavy metals that may limit recycling.

In 2001, 1.21 million tonnes residues were produced and this corresponds to the figure for the year before.

The goal for recycling of residues from coal-fired power plants has been achieved.[63]. In 2001, 99 per cent were recycled, and the previous objective was 90 per cent recycling in 2004.

The following figure shows the development of treatment of residues from coal-fired power plants.



A good 70 per cent of recycled residues in 1997 was used in industrial production as recyclable materials (see table below).

The remaining residues are recovered in connection with building and construction work in the form of fills under buildings, roads and squares, filling-up piping trenches etc. The residues may also be recovered as fill for harbour filling or building of coalyard barriers.

Recycling in 2001 of residues from coal-fired power plants ('000 tonnes),	Fly ash	Slag/ bottom ash	Gypsum	TASP	Sulphuric acid	Total
Cement	303		64.7			367.7
Concrete	237.4					237.4
Porous concrete	5.8					5.8
Asphalt	26.1					26.1
Roofing felt/concrete blocks		7.3				7.3
Fill (S. O. 655)		8.3				8.3
Fill (Environmental Protection Act, Part V approval)	115.5	20.6				136.1
Granulates				2.2		2.2
Fertiliser		6.3				6.3
Fill				12.4		12.4
Gypsum boards			278.1			278.1
Miscellaneous			2.5			2.5
Exports, recycling	0.26	21.5				21.76
Desulphurisation				48		48
Refining	3					3
Landfilled	6.2	1.8	4.7	2.5		15.2
For storage	39	5.5	6.7			51.2
Total	**736.2**	**71.3**	**356.7**	**65.1**	**8**	**1229.5**

Only 1 per cent of residues were landfilled.

When landfilling, coastal landfilling is preferred out of consideration for the groundwater.

Measures:

- *requirements for recycling of residues*

E 26.2 Future initiatives

Statutory Order no. 655 of 27 June 2000 on Recycling of Residual Products and Soil in Building and Construction Work will be extended to cover limit values for organic substances. The purpose of the Statutory Order is to protect groundwater resources through recycling.

E 26.3Regulation

Recycling of slag and fly ash from coal-fired power plants is regulated by Statutory Order no. 655 of 27 June 2000 on Recycling of Residual Products and Soil in Building and Construction Work.

A waste tax was introduced on residues on 1 January 1998. The purpose was to ensure constant motivation to reduce the amount of residues and alternatively to recycle them.[64]

E 26.4 Environmental assessment

In the long term, energy generation based on coal will be phased out. This will reduce amounts of residues from coal-fired power plants.

E 26.5 Implications for national waste authorities

The revision of Statutory Order no. 655 of 27 June 2000 regulating recycling of residual products and soil will safeguard the groundwater in recycling of residual products.

E 26.6 Implications for local authorities

In their future planning, local authorities are to take into consideration changed conditions for management of residues from coal-fired power plants.

If the revision of Statutory Order no. 655 of 27 June 2000 on recycling of residual products and soil results in landfilling of a larger volume of residues it will affect municipal planning.

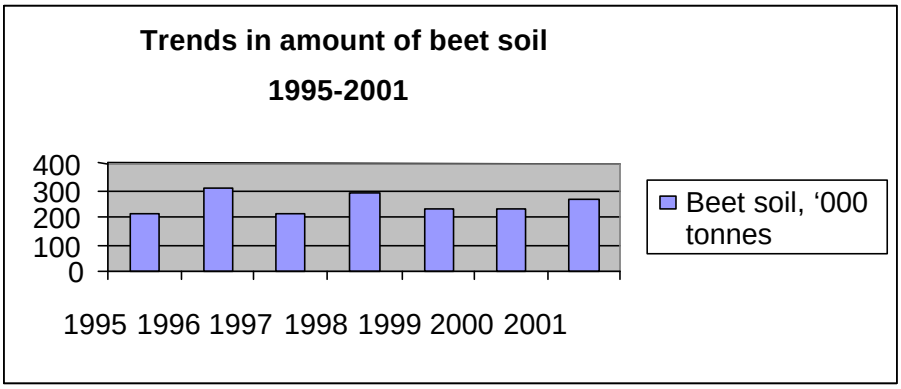
E.27. Beet soil

Environmental problem	Disposal of large volumes of beet soil
Initiatives	No new initiatives have been planned.

E 27.1 Status

Beet soil is the residual fraction that remains when beets are washed and cleaned before sugar production.

The figure below shows the trend in the volume of beet soil from 1995 to 2001. In 2001, 264,000 tonnes beet soil were produced. This constitutes approx. 10 per cent of the total waste generated by Danish industry.



In the mid-1990s, the Danish EPA subsidised two projects to reduce the volume of beet soil through the Technology Programme for Soil and Groundwater Pollution.

E 27.2 Future initiatives

No new initiatives have been planned.

E 27.3 Regulation

Disposal of beet soil in beet soil deposits is covered, in most cases, by the Statutory Order on Landfills. This means that counties will have to assess whether or not the existing beet soil deposits at sugar factories meet (or may be brought to meet) the requirements of the Statutory Order on Landfills. If this is not possible, the existing beet soil deposits must be closed down no later than on 16 July 2009. For more on the Statutory Order on Landfills, please see appendix A 2.3.1 and appendix D 3.

Beet soil landfilled in beet soil deposits is exempt from waste taxes. This exemption was specified in the most recent amendment to the Waste Tax Act and entered into force on 1 January 2003.

E 27.4Capacity

Provided that beet soil can still be landfilled in beet soil deposits at sugar factories, the landfill capacity at sugar factories is sufficient for the next many years. However, if the current beet soil deposits cannot be approved for continued operation after 16 July 2009, new landfill capacity will be required. This may be obtained by establishing new landfills at sugar factories or by landfilling the beet soil at local landfills (eg. on Funen and Lolland-Falster).

E 27.5Environmental assessment

As can be seen from the above figure, 200,000-300,000 tonnes beet soil are landfilled annually in beet soil deposits at sugar factories. The reason the beet soil is landfilled instead of being returned to agriculture is the desire to avoid risks of infecting agricultural soil with plant-disease pathogens from the previous years' harvest. The beet soil remains in the soil deposits. The problem with this approach is the very large volumes of beet soil to be landfilled each year, including the more rigorous requirements expected for landfilling of beet soil under the requirements for design and operation in the Statutory Order on Landfills.

E 27.6Economic aspects

If it is decided that the beet soil in future must be landfilled at landfills that comply with the requirements of the Statutory Order on Landfills, this could have major financial consequences for sugar factories.

E 27.7Implications for national authorities

None.

E 27.8Implications for local authorities

The regional authorities (the counties) administrate the regulations in the Landfill Directive and must therefore assess requirements for landfilling of beet soil in the future.

The supervisory authority and the sugar factories should continue to work for a reduction in the volume of beet soil.

E.28. Shredder waste

Environmental problem	Shredder waste has a high content of environmental contaminants. It is classified as hazardous waste and constitutes a large part of the industrial waste landfilled today.
Initiatives	Development of new treatment methods for extraction of heavy metals.

E 28.1 Status

Aims for 2008:

- *30 per cent recycling and better utilisation of the shredder waste resources*
- *reduction in the volume of shredder waste for landfilling*

Shredder waste arises in the form of production waste at enterprises shredding various metal-containing products, such as cars and white goods. The majority of shredder waste is landfilled today.

Shredder waste has a high content of environmental contaminants (heavy metals, PCBs). The treatment of waste from shredder plants must be improved, and the possibility of developing new treatment techniques must be investigated.

In 2001, the production of shredder waste constituted 92,000 tonnes which were landfilled.

It is aimed to recover 30 per cent of shredder waste in 2008 in a way that ensures that heavy metals are recovered and the energy is utilised.

In 2002, a Danish project to optimise the shredding process was completed. This project resulted in a considerable reduction in the content of heavy metals in shredder waste, particularly copper and iron.

Trials of reprocessing shredder waste at special plants, primarily gasification plants, have caused large problems in the past. In recent years, however, many resources have been invested in the development of new technology to treat shredder waste and other heavy metal-containing waste fractions, in an environmentally appropriate manner. In order to participate in this development, the Council for Recycling and Cleaner Technology subsidised a study of industrial-scale plants at global level and if they can be adapted to Danish waste conditions. The project was completed in January 2003. The study showed that there are two plants operating in Japan and that several interesting plants are being established.

In addition, several pilot tests have been carried out with regard to development of a Danish reprocessing method.

In 2001, all shredder waste was landfilled.

Measures:

- *development of methods for reprocessing fractions containing heavy metals*
- *collection and dissemination of knowledge*
- *requirements for management of shredder waste*
- *requirements for enterprises that handle shredder waste*
- *full-scale tests with new treatment technology*

E 28.2 Future initiatives

The results of the projects are so promising that, in the course of 2003-2004, they are expected to form the basis of a realistic decision on which technique for treatment of shredder waste is most adaptable to the Danish waste structure.

The technologies are structured as a series of thermal processes ending with a process at such a high temperature that zinc and lead evaporate and can be separated from the exit air while the other metals are separated as an alloy that has to be landfilled. In a subsequent process, zinc and lead can be recycled. The slag from these high-temperature processes contains so few heavy metals that it can be recycled in connection with building and construction work.

Some of the processes where the energy of the shredder waste is recovered in connection with reprocessing of flue-gas cleaning products look particularly promising.

Initiatives that follow and support the development of better treatment methods that can utilise the resources of the shredder waste will be promoted as much as possible. When the treatment technique is ready, regulations will be prepared, on the basis of a socio-economic report, for the future management of shredder waste

E 28.3 Regulation

Management of shredder waste has so far been regulated by the general rules in the Statutory Order on Waste and in environmental approvals of enterprises using shredder plants in reprocessing composite products. The enterprises reprocessing the products are iron and metal recycling enterprises. These enterprises are on the list of particularly polluting enterprises issued pursuant to the Danish Environmental Protection Act as item K2. Car breaking enterprises are on the same list under item K5.

In addition, the implementation of the EU directives on waste in the form of motor vehicles and waste electrical and electronic equipment is expected have important influence of the operation of shredder plants and the content of environmental contaminants in waste.

E 28.4 Capacity

It is estimated that sufficient capacity is available for landfilling shredder waste, but in the light of developments in the area, it is expected that it will take between 6 and 7 years before there is sufficient reprocessing capacity.

E 28.5 Environmental assessment

Environmental impacts from reprocessing shredder waste will be a reduction of waste for landfilling and thereby reduced risk of leaching to groundwater, increased recycling of the contents of metals in shredder waste, and utilisation of the energy in the organic waste fraction.

E 28.6 Implications for national authorities

When an applicable treatment method is ready and it is socio-economically profitable, regulations about management of shredder waste will be issued.

In the coming planning period, efforts will be made to prepare guidelines for green product design and to exploit the possibilities offered by the Danish Electronics Panel, which has been established under the Product-Oriented Environmental Strategy.

E 28.7 Implications for local waste authorities

When the Statutory Order on management of shredder waste has been issued, municipalities will assign waste to plants complying with requirements for management of shredder waste.

E.29. Sludge from municipal wastewater treatment plants

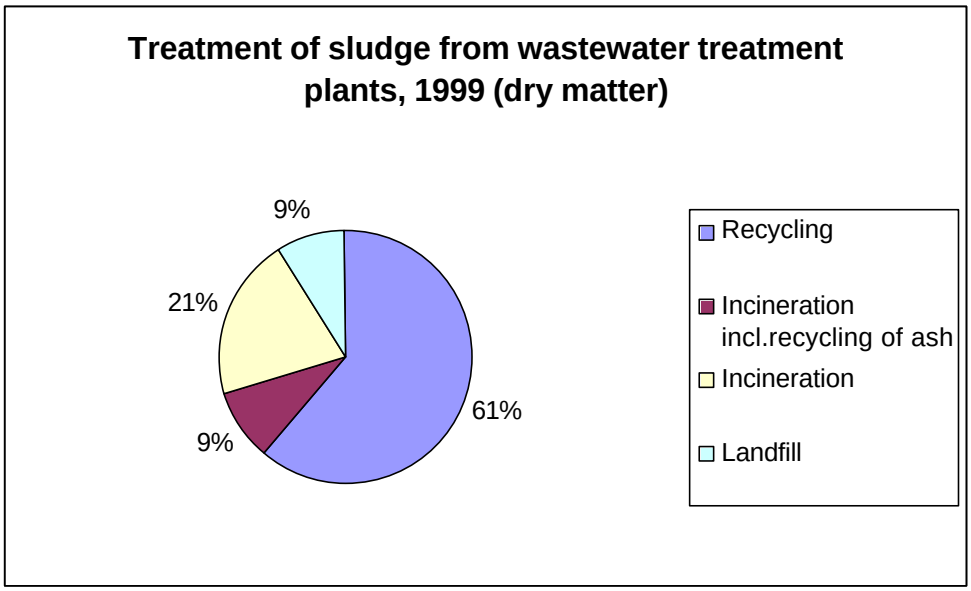
Environmental problem	Sewage sludge is a resource that is not utilised sufficiently today.
Initiatives	General phase-out of xenobiotic substances.

E 29.1Status

Aims for 2008:

- *50 per cent recycling for agricultural purposes*
- *25 per cent incineration of sludge and recycling of ashes in industrial processes*
- *20 per cent incineration*
- *5 per cent landfilling*

In 1999, about 157,000 tonnes of sludge (dry matter) was generated at municipal wastewater treatment plants. Of this, 61 per cent was recycled, fulfilling the previous objective of 50 per cent recycling in 2004. In addition, 9 per cent was incinerated and the ashes recycled in industry, 21 per cent was incinerated, and 9 per cent landfilled.



There are certain requirements regarding contents of xenobiotic substances in sludge applied to farmland. These requirements entered into force in 1997 and were tightened in 2000 and 2002[65]. The new requirements have led to a decrease in recycling of sludge for agricultural purposes over the years.

The present high rate of application of sludge to farmland is not expected to be upheld due to increased pressure on soil from livestock manure, so that

[65] Miljø- og Energiministeriets bekendtgørelse nr. 49 af 20. januar 2000 om anvendelse af affaldsprodukter til jordbrugsformål (Statutory Order no. 49 of 20 January 2000 on the use of waste products for agricultural and related purposes).

municipalities are having difficulties finding acreages for recycling. The trend is geographically dependent. It is expected that in the forthcoming years, more sludge will be used in thermic processes in industry, such as manufacturing of sandblasting agents and cement. In these processes the sludge is incinerated and the inorganic part, typically 30-40 percent of the sludge's dry matter content, is integrated in the products and thus recycled.

The aim for 2008 is therefore to recycle 50 per cent of the sludge and incinerate 25 per cent in industrial processes whereby inorganic elements of the sludge are utilised. In 2008, it is expected that no more than 20 per cent of the sludge will be incinerated and that no more than 5 per cent will be landfilled.

The quality of sludge and possibilities of increased recycling are expected to improve by reducing the use of xenobiotic substances. The content of certain chemical substances in the sludge, for which limit and cut-off values have been laid down, is expected to be reduced further.

The Ministry of the Environment does not consider incineration processes which recycle ashes, e.g. sandblasting and cement manufacturing, as recycling; rather such use constitutes disposal and intelligent exploitation/recycling of inorganic leftovers. It is the Ministry's opinion that a full recycling of the sludge includes exploiting the content of nutrients in the sludge.

E 29.2 Future initiatives

Measures:
- *a general phase-out of xenobiotic substances*

No initiatives are planned in the area of sludge from municipal wastewater treatment plants.

E 29.3 Regulation

Recycling of sludge on farmland is subject to regulation under the Statutory Order on sludge, [66] and the Statutory Order from the Ministry of Food, Agriculture and Fisheries on supervision of the quality of municipal sewage sludge and composted household waste etc. applied to farmland[67]. The Statutory Order on sludge lays down limit values for a number of heavy metals and cut-off values for organic xenobiotic substances NPE, DEHP, LAS, and certain PAHs.

E 29.4 Capacity

According to estimates, there will be enough capacity for incinerating at least 30 per cent of the sludge amounts via industrial processes, and at least 50 per cent of the sludge will have a quality suitable for application on farmland.

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[66] Bekendtgørelse nr. 49 af 20. januar 2000 om anvendelse af affaldsprodukter til jordbrugsformål (Statutory Order no. 49 of 20 January 2000 on use of waste products for agricultural purposes).

[67] Bekendtgørelse nr. 56 af 24. januar 2000 om tilsyn med spildevandsslam m.m. til jordbrugsformål (Statutory Order no. 56 of 24 January 2000 on supervision of sewage sludge etc. for agricultural purposes).

E 29.5Environmental assessment

In the long term, contents of xenobiotic substances in sludge are expected to fall allowing for the continued use of the sludge for agricultural purposes. In addition, the sludge's content of nutrients, especially phosphorous, which is a limited resource, can be recycled.

As to sludge which is not recycled via application to farmland, it is important that the inorganic contents (ashes) can be recycled in industrial processes such as the manufacturing of sandblasting agents.

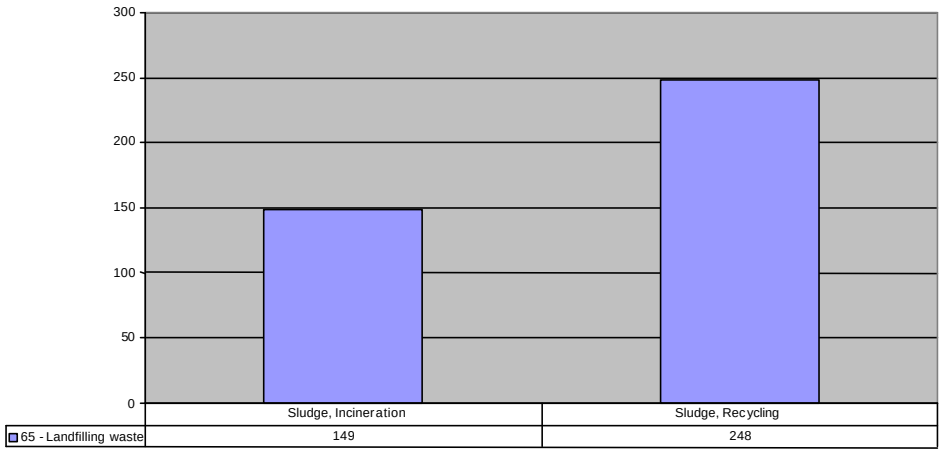
Waste indicators

The new waste indicators for saving resources, for energy and for landfill requirements[68] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

Data for the crediting of the fertilizer value of the sludge is missing. Upon incineration of sludge, the incineration process is considered energy neutral. This is because sludge has a high content of water and therefore, contrary to organic household waste, has to dry before it can be incinerated.

The figure below shows what can be saved in landfill requirements for waste by choosing the treatment options of incineration and recycling respectively.

Figure: Savings from incineration and recycling of one tonne of sludge, compared to landfilling the same amount (in mPR, mPE, 10 mPE).



The figure shows that great savings in landfill requirement are achieved on recycling. This is because the total sludge amount contains about 50 per cent slag/ashes, which upon incineration of the sludge would require landfilling. Upon recycling, the same slag amount is recycled - which is also the case with slag from waste incineration plants, unless the slag is contaminated. In this case, the landfill factor is not detailed enough to provide a comprehensive picture of the different consequences of the two treatment options.

[68] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen I Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

Apart from the landfill factor, there is the loss of fertilizer value, which, however, has not been included in the calculations due to lack of data. It is not possible from the calculations to assess whether incineration or recycling are the most advantageous option, since this rests, in particular, on the content of toxic residual substances in the sludge.

E 29.6 Implications for national authorities

None.

E 29.7 Implications for local authorities

None.

E.30. Used oil

Environmental problem	*Used oil is hazardous waste, and the fractions originate primarily from around 10,000 mechanics workshops and 200-300 dismantling plants*
Initiatives	*None*

Aims for 2008:

- *regeneration of at least 90 per cent of total collected amounts of used oil*

E 30.1 Status

Used oil is collected, and at least 75 per cent is reprocessed via regeneration. The remainder is recovered via incineration. The mineral industry has established a scheme, ensuring highly efficient collection of used oil.

Used oil is collected from, for example, mechanics, transport companies, industry, the military, and private car owners. The collection of used oil is carried out by private enterprises. From collection, the used oil is delivered to regeneration plants, which manufacture base oil and a fuel product similar to heavy fuel oil.

Upon regeneration of used oil, 2,000-3,000 tonnes of water and distillation residues are produced. Distillation residues are sold to Aalborg Portland A/S for recovery in cement production.

In addition, waste oil is collected from shipping (slop oil). Such waste is primarily delivered to municipal transfer stations and transferred on to Kommunekemi A/S for destruction. In 1997, Kommunekemi A/S received a total of 13,217 tonnes of waste oil.

The mineral industry's scheme creates economic incentives to collect and recover used oil with great efficiency

E 30.2 Future initiatives

None.

E 30.3 Regulation

The Statutory Order on waste includes regulations on used oil management. Used oil is hazardous waste, and local authorities are obliged to establish collection schemes for such waste under the Statutory Order on waste.

Local authorities must notify any exemption from the duty of enterprises to deliver used oil to municipal collection schemes for hazardous waste.

E 30.4 Capacity

Used oil is reprocessed at a Danish regeneration plant and at additional regeneration plants abroad. The Danish regeneration plant has substantially more capacity than Danish requirements. The plant therefore also reprocesses used oil from other Scandinavian countries.

E 30.5 Environmental assessment

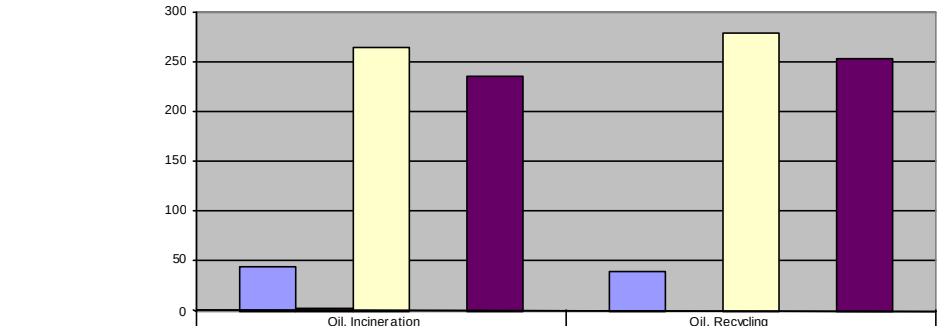
Waste indicators

The new waste indicators for saving resources, for energy and for landfill requirements[69] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

The advantage of re-refining used oil is not having to spend resources on extraction of crude oil, desulphurisation, and refinement. However, recycling costs around 25 per cent extra energy compared to refining crude oil. LCA data is available for these specific processes, and has been included in calculations.

Thus, the figure below shows a minor savings potential for recycling. However, this difference is not decisive taken into account the uncertainty of the data.

Figure: Savings from incineration and recycling of one tonne of oil.



	Oil, Incineration	Oil, Recycling
61 - Energy resources	44	40
62 - Other resources	3	0
63 - Gr. energy, non-renew.	264	278
64 - Gr. energy, renewable	0	0
65 - Landfilling waste	235	253

The figure shows a minor energy advantage from recycling the oil when the energy from incinerating the oil is credited. If energy recovery from waste incineration is not optimal, recycling the oil proves clearly the best option, both from an energy and a resource perspective.

E 30.6 Implications for national authorities

None.

E 30.7 Implications for local authorities

None.

[69] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

E 31 Foundry waste

Environmental problem	*Foundry waste contains chemicals, and this is a barrier to recycling. Today, this waste type comprises a large part of waste from industry that goes to landfills.*
Initiatives	*Development of recycling methods.*

E 31.1 Status

Aims for 2008:

- *80 per cent recycling of foundry waste*
- *10 per cent waste reduction*

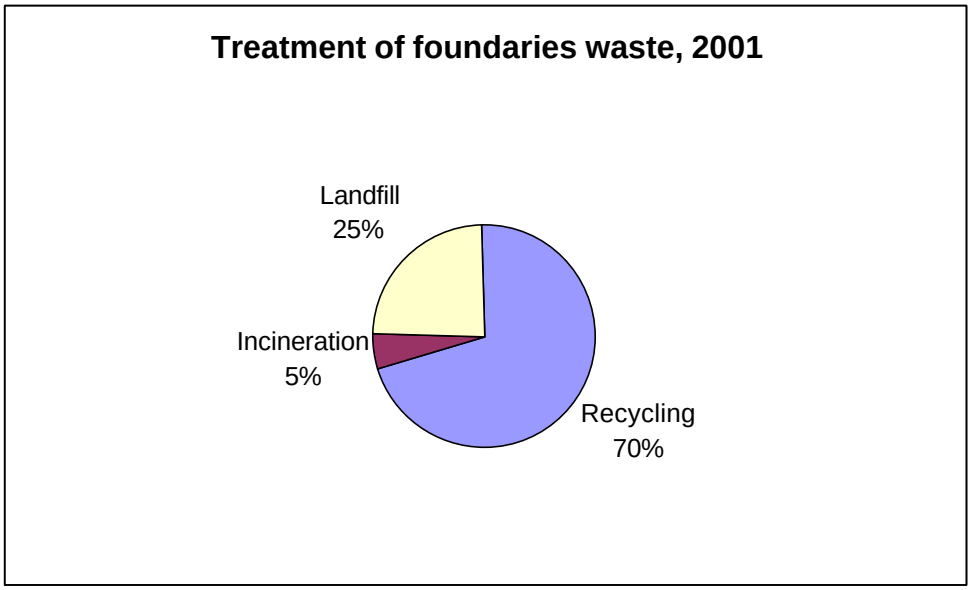
Foundry waste comprises a large part of waste from industry led to landfill. Adequate recycling solutions have now been developed for this waste type and are becoming more and more common in the sector. However, solutions for around 25,000 tonnes/year are still required.

The foundry industry covers almost 40 foundries (10 iron foundries, the rest metal foundries) with between one and 300 employees. In 2001, 85,000 tonnes of foundry waste were generated.

Environmental problems related to foundry waste primarily derive from discarded foundry sand, amounting to 75,000 tonnes per year. Such sand contains chemicals which are used in the production of moulds. Around 5,000 tonnes of slag are generated each year. Furthermore, around 400 tonnes of furnace filter dust are generated annually. This residue product constitutes hazardous waste.

The larger foundries have introduced environmental management, and are working on waste mapping and waste minimisation. The outcome of this work has led to a reduction in waste amounts of around 10 per cent by the help of an environmental review of the enterprise. This reduction could probably be reduced by a minimum of a further 10 per cent.

Good treatment methods have been developed, so that, for example, black sand can be recycled, and zinc and lead can be extracted from filter dust. The sector is currently looking into possible ways of recycling the slag from melding furnaces and foundry ladles. Thus, from a technical perspective, large parts of waste generated at foundries can be recycled today.



Measures:

- *improved treatment methods for chemically-bound foundry sand*
- *environmental management*

E 31.2 Future initiatives

Initiatives supporting the development of recycling methods for chemically-bound foundry sand will be promoted. Results and developments will be evaluated regularly.

Technically, large parts of waste generated by the sector can be recycled today. All foundries in Denmark must therefore make efforts to recycle waste. This will be ensured in co-operation between the Danish Environmental Protection Agency and the foundry industry.

E 31.3 Capacity

Spent black sand is suitable for application as foundations in construction works and is expected to replace virgin sand in products.

Moreover, a lot of spent foundry sand is used in connection with manufacturing cement and other building materials.

Recycling capacity is available for the large fractions, and furnace filter dust is reprocessed at enterprises in Germany and Sweden.

The need for landfill capacity will decrease over time, as the rate of recycling increases.

E 31.4 Environmental assessment

Environmental impacts from recycling of foundry sand and filter dust from furnaces are expected to be almost similar to the use of virgin raw materials, whereas recycling of slag will have a minimal impact.

E 31.5 Economic aspects

The introduction of environmental management at foundries will allow for recycling of larger parts of waste. Increased recycling will entail savings for enterprises, as

- no tax is due on waste that is recycled. Such savings would amount to DKK 335 x 60,000 tonnes = approx. DKK 22.5 mill. and
- minor expenses in connection with raw materials procurement.

E 31.6 Implications for national authorities

Foundry sand is used for cover at landfills, and in their planning local authorities will therefore have to take into consideration that, in the long term, less waste of this type will be available.

E 31.7 Implications for local authorities

A decreasing landfill requirement for waste from foundries can be of importance to municipal planning.

E 32 Tiles

Environmental problem	*Tiles constitute a significant proportion of the total waste from building and construction, and will take up landfill capacity if it is not recycled.*
Initiatives	*Efforts must ensure that tiles are recycled in an environmentally appropriate manner.*

E 32.1 Status

Aims for 2008:
- *ensure high recycling of tiles*
- *ensure that recycling of tiles takes place appropriately in relation to the environment*

Concrete and tiles comprise the most significant part of building waste and could replace about 5 per cent of the total Danish gravel and stone consumption.

In 2001, tiles comprised 8 per cent of the total amount of waste from building and construction.

Tiles can be recycled e.g. as gravel for paving stones, whereas their use as a bearing course in roads with heavy traffic is less appropriate, as the water-absorbing ability of the tiles can give cause to broken road surfaces due to freeze-thaw cycles. As in the case of concrete, distances to landfills and gravel quarries will determine how attractive it is to recycle tiles.

The number of tiles led to treatment plants as a pure waste fraction is shown in the table below.

Tonnes	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Recycling				123,000	126,000	227,000	271,280

Source: Waste Statistics

E 32.2 Future initiatives

Measures:
- *alter rules on management of tiles*

In the long term, management of tiles will be included in a statutory order on recycling residual products and soil.

E 32.3 Regulation

Tiles in building and construction waste are managed primarily through the circular "Circular on municipal regulations on separation of building and

construction waste with a view to recycling", 1995, as well as the circular "Utilisation of pure, separated building waste for building and construction purposes", 1990.

The circular states that municipalities are to prepare a regulation for managing building and construction waste. Municipalities have two options in developing the scheme:

- In the first option waste can either be assigned to recycling on-site or to a reprocessing plant.

- In the second option waste can either be assigned to recycling on-site or the local council may decide that waste that is not recycled on-site is covered by a collection scheme for recyclable building and construction waste.

In accordance with the circular from 1990, there is a free choice for recycling of pure fractions of tiles. This means that recycling of pure fractions of tiles does not require authorisation under section 19 of the Danish Environmental Protection Act.

E 32.4 Capacity

There is considered to be adequate treatment capacity in Denmark.

E 32.5 Environmental assessment

By amending the Statutory Order on recycling of residual products and soil in building and construction work to include tiles, there will be a more uniform set of regulations ensuring the recycling, on equal terms, of a number of larger waste fractions.

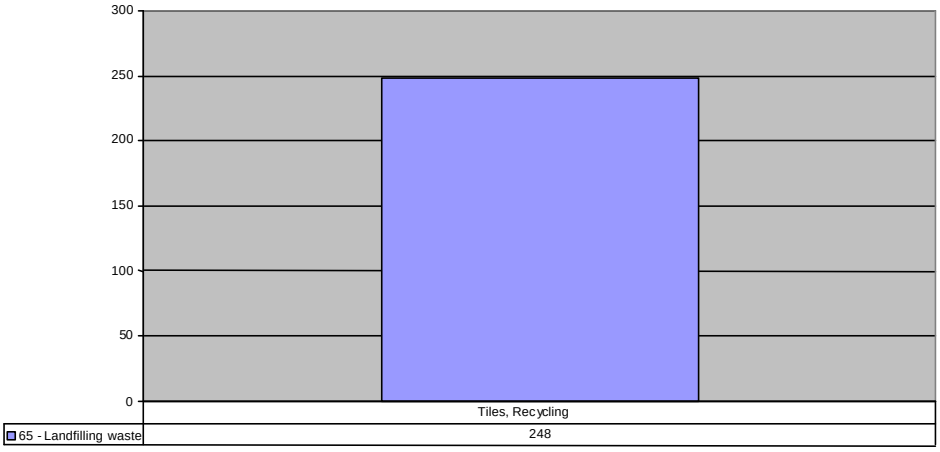
Waste indicators

The new waste indicators for saving resources, energy and landfill requirements[70] which are presented in chapter 2 have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with 1 tonne of waste being landfilled.

Savings in waste amounts requiring landfilling upon recycling of waste tiles are shown in the Figure below.

[70] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

Figure: Reduction from recycling 1 tonne of tiles compared to landfilling the same amount (in mPE).



The energy needed for crushing tiles before recycling them as filling has not been included in the calculations. Conversely, the energy needed for extracting sand and stone has also not been included, which must therefore be offset in the calculation. The result will probably be close to zero.

The figure simply shows that for each tonne of tiles recycled as filling material, 2.5 PE (=1 tonne) of waste for landfilling is saved.

E 32.6 Economic aspects

An environmental economic assessment will be carried out of the consequences of allowing recycling of tiles to be subject to the Statutory Order on recycling of residual products and soil.

E 32.7 Implications for national authorities

The basis for preparing new guidelines for recycling tiles must be laid down.

The national authorities will be responsible for preparing the new guidelines and for carrying out the environmental-economic assessments of impacts.

E 32.8 Implications for local authorities

In their supervision, the municipalities must ensure compliance with the regulations and guidelines for recycling tiles.

E 33 Wood

Environmental problem	*Impregnated wood contains a number of environmental contaminants which cause problems in disposal. The amount of impregnated waste wood will be increasing.*
Initiatives	*Ensure that only wood impregnated with chromium, copper and arsenic-containing agents is handled as waste not suitable for incineration. The capacity for incineration of hazardous waste in the form of creosote-treated wood must be increased.* *When appropriate treatment methods for impregnated wood have been developed, the wood must be collected and treated*

	separately. *Ensure recycling of 15 per cent wood packaging waste under the Packaging Directive in 2008.*

E 33.1 Status

Impregnated wood

Aims for 2008:
- *utilise energy and raw material resources in impregnated waste wood*

Impregnated wood has been treated with impregnators containing, for example, chromium, copper, arsenic (CCA), tin, and creosote.

Impregnated wood containing heavy metals causes problems in incineration, as substances are not decomposed but remain in slag and flue-gas waste. Wood impregnated with arsenic is classified as hazardous waste.

Creosote-treated wood (for example railway sleepers, wood from wharfs) can be decomposed in incineration, as creosote is destroyed. This requires, however, that such wood is pretreated (shredded), ensuring complete incineration, and that the incineration temperature is sufficiently high.

Sources of impregnated waste wood are primarily bulky waste and the building and construction sector. Since April 2001, it has been mandatory to dispose of all impregnated wood via landfilling, except wood impregnated with creosote. Wood impregnated with creosote is classified as hazardous waste and can be incinerated in approved plants.

Better treatment methods are being developed that utilise the resources (energy, chromium and copper) in the impregnated wood.

In the coming years, an increasing volume of impregnated wood that needs to be disposed of as waste is expected. It is estimated that since the 1960s approx. 4 million tonnes impregnated wood have been used (accumulated) and that, in 2010, it will be necessary to dispose of approx. 100,000 tonnes impregnated wood[71].

Wood packaging

Goals for 2008:
- *recycling of 15 per cent of wood packaging waste*

When the Packaging Directive was revised, a goal of 15 per cent recycling of wood packaging in 2008 was adopted in the common position. Most EU countries today have systems for recycling wood packaging for eg. chipboard.

The supply amount of wood packaging in 2000 was estimated at approx. 150,000 tonnes. Most of this consists of return pallets and disposable pallets. The waste volume is probably smaller, but it is difficult to gather data for the volumes. The volume of wood packaging waste treated in the traditional waste treatment system is very small. Part of the wood packaging waste is energy-recovered in private wood-burning stoves. However, this volume is not known. Arisings of wood packaging waste will be extremely important for possible further initiatives required to achieve the goal of 55 per cent recycling of all packaging waste in 2008.

Denmark has no experience with collection of wood packaging for recycling as eg. chipboard. So far, only one Danish chipboard manufacturer has been identified

that will be technically capable of recycling wood packaging. Some countries include repairs of reused pallets as recycling. In Denmark, approx. 23,000 tonnes of pallets are repaired each year.

Measures:

Impregnated wood

- *requirements for treatment*
- *further development of new methods for treatment of impregnated waste wood*
- *information*
- *statements of volumes and economic assessment*

Wood packaging

- *volumes and economic aspects*
- *agreement on recycling of transport packaging*
- *amendment of the Statutory Order on Waste*

E 33.2 Future initiatives

Efforts must ensure that:

- separation is optimised in relation to treatment options (creosote/arsenic/metals/other/non-impregnated) so that energy and resources can be utilised as efficiently as possible;
- the capacity for incineration of creosote-impregnated wood (hazardous waste) is increased;
- attempts are made to optimise estimates of waste volumes;
- a socio-economic assessment is prepared in support of treatment requirements;
- requirements for treatment of wood impregnated with chromium, copper and arsenic are included in the Statutory Order;
- guidelines are prepared to ensure recovery of the energy from wood that is not impregnated with chromium, copper and arsenic.

Initiatives for the development of methods to recycle heavy metals from impregnators must be promoted.

An assessment must be made of how Denmark can reach the goals of 15 per cent recycling of wood packaging and 55 per cent recycling of all packaging waste in 2008 in pursuance of new EU regulations in the easiest and most cost-effective manner.

- Analysis of the volume of wood packaging waste and potential consignees
- Wood packaging to be included in the agreement on recycling of transport packaging
- Requirements for separation of wooden transport packaging from industry to be included in the Statutory Order on Waste

E 33.3 Regulation

Since April 2001, all impregnated wood must be separated as waste not suitable for incineration, ie. disposed of at landfills. However, wood impregnated with creosote can be incinerated.
Wood impregnated with arsenic and creosote is classified as hazardous waste and must be handled as such.

E 33.4 Environmental assessment

Today, impregnated wood is primarily disposed of by landfilling.

Incineration plants must continue to be held free of impregnated wood containing chromium, copper and arsenic in order to ensure a continued reduction in the content of heavy metals in slag and flue-gas cleaning waste.

When this waste is landfilled, the potential energy and resources are lost. A new treatment method that can ensure energy recovery and make it possible to recycle impregnators must be promoted.

[71] This estimate assumes an average lifetime of 40 years for the wood.

Neither the European Commission nor the Member States have made environmental assessments of advantages and disadvantages of recycling versus incineration of wood packaging.

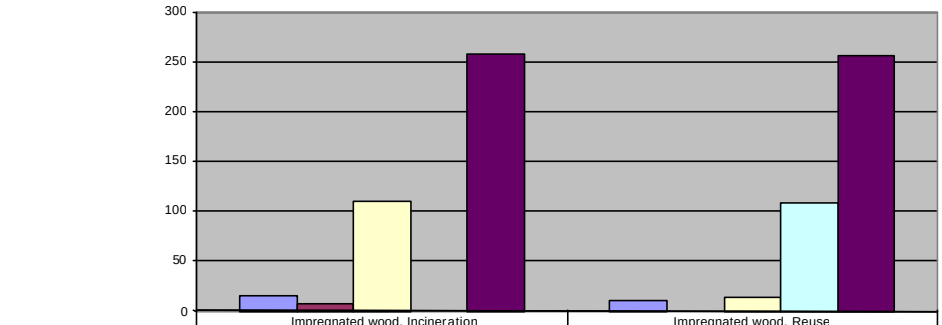
Waste indicators

The new waste indicators for saving resources, energy and landfill requirements,[72] which are presented in chapter 2, have been calculated on the basis of the amount of the relevant waste fraction and the factors shown below. The factors show savings per tonne for the relevant treatment option compared with one tonne of waste being landfilled.

Impregnated wood

The figure below shows the savings through incineration and recycling respectively of one tonne impregnated wood compared with landfilling the same amount. There are no LCA data to illustrate the process of removing an impregnator, so the figure does not show future possibilities, but only status quo.

Figure: Savings from treatment of 1 tonne impregnated wood by incineration and recycling respectively. Figure: Savings should be seen in relation to landfilling one tonne impregnated wood (in mPR, mPE and 10 mPE).



	Impregnated wood, Incineration	Impregnated wood, Reuse
61 - Energy resources	16	11
62 - Other resources	8	0
63 - Gr. energy, non-renew.	110	14
64 - Gr. energy, renewable	0	108
65 - Landfilling waste	258	256

The figure shows that savings for the total resource consumption (energy resources and other resources) are larger when incinerating than when recycling one tonne impregnated wood. If the two indicators "renewable energy" and "non-renewable energy" are added together, there is a small advantage in recycling. The savings with regard to the volume of waste to be landfilled are almost the same for the two treatment options. However, incineration of impregnated wood will not become relevant until it is possible to remove the environmental contaminants before or during the incineration process.

In the long run, it will probably be possible to incinerate impregnated wood if processes can be developed to effectively remove environmental contaminants before or during the incineration process.

[72] Ole Dall: Ressourcebesparelser ved affaldsbehandlingen i Danmark (Resource savings from waste treatment in Denmark), Danish EPA 2003.

E 33.5 Economic aspects

A socio-economic assessment of the treatment of impregnated wood will be carried out. In the next few years, no considerable extra costs of disposal of impregnated wood are expected. At present, it is not possible to evaluate costs of treatment in future technologies.

Neither the European Commission nor the Member States have made an environmental-economic analysis of recycling versus incineration of wood packaging.

When the volume of wood packaging waste has been mapped, an economic analysis will be made with regard to how Denmark can reach the goals of 15 per cent recycling of wood packaging and 55 per cent recycling of all packaging waste in the most cost-effective manner.

E 33.6 Implications for national authorities

The Statutory Order on Waste will be revised. The requirement for separation of all impregnated wood is to be relaxed so that wood that is not impregnated with chromium, copper and arsenic can be sent to incineration. Treatment requirements for wood impregnated with chromium, copper and arsenic will be introduced on the basis of technical possibilities and a socio-economic assessment.

Arisings of wood waste must be analysed in 2004. The Statutory Order on Waste must be revised so that it requires that wood packaging (particularly pallets) is recycled.

E 33.7 Implications for local authorities

In their planning, municipalities must take into consideration that impregnated wood is to be separated according to treatment options.

Moreover, wood packaging waste must be recycled.