Stiftelsen Østfoldforskning

Environmental Documentation of EPS Packaging

Summary

Hanne Lerche Raadal,
Mie Vold,
Tove Berge,
Ole Jørgen Hanssen

Østfold Research Foundation
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REPORT OVERVIEW

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Summary: This project has been carried out on behalf of EPS producers in Norway and has had the following aims: ***Assess the environmental benefit and economy of different scenarios for the disposal of used EPS fish containers.*** An environmental and economic assessment has been carried out using life-cycle assessment methodology (LCA) for the following three main scenarios:

1. Material recycling in Germany
2. Material recycling in Norway
3. Incineration with energy recovery locally

Based on the results from this study, the following main conclusions can be drawn:

- Material recycling is clearly the best waste treatment method for EPS packaging from an environmental point of view.
- Emissions from transport are negligible for the total environmental accounts for the value-chain for EPS fish containers.
- The costs of material recycling give this treatment method a competitive edge over energy recovery.
- Transport of non-pressed EPS is more significant for the total cost picture than whether the EPS fish containers are sent to material recycling or energy recovery.

An application will be made to continue the project work as an EU project with the 6th Framework Programme's Collective Research programme. Financial support for developing an application for an EU project has been obtained from The Research Council of Norway.

Key words: ***** EPS *****Waste management *****Environmental assessment ***** Cost assessment	**Confidentiality** **This page:** Open **This report:** Open	**Number of pages** **Report:** 24 **Appendices:** -

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Project Manager (sign) **Director of Institute for Environmental Protection (sign)**

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1 INTRODUCTION

This report is an English summary of the report *Environmental Documentation of EPS Packaging, Main Report* (Raadal et al. 2003). The work presented here has been carried out on behalf of EPS producers in Norway.

1.1 BACKGROUND

EPS containers have been used as standard packaging for fresh fish products since 1980, when they took over from wooden containers and fibre containers. Solid product development combined with the containers' unique qualities have contributed to the fact that the EPS container now has a market share of over 90% of Norwegian fresh fish sales. At the same time, Norwegian fresh fish is available on a daily basis in the most important fish eating markets in the world. EPS packaging is used mainly for containing and transporting whole, fresh salmon and salmon fillets.

The export of fresh salmon imposes particular special requirements on the packaging. These goods are delicate and temperature sensitive, so they must be protected against external effects like physical impacts and temperature changes. The temperature of the goods inside the EPS container must be between 0 and +2 degrees Celsius. The product is also moist, often without inner packaging and covered with ice that, when melted, should be able to run off the fish. If EPS is not used, the alternative outer-packaging can be cardboard containers (cardboard or corrugated cardboard) or re-usable plastic containers that are washed and disinfected before re-use. The type of packaging used is not a choice made by chance for producer, distributor or customer. The different types of packaging impose different challenges on the supply chain.

The need for analysis and documentation of the environmental impacts associated with the use and disposal of EPS containers has thus arisen.

1.2 AIMS

The project aims have been the following:
Assess the environmental benefit and economy of different scenarios for the disposal of used EPS fish containers.

1.3 ORGANISATION

The project has been organised with a reference group consisting of representatives from the different stakeholders in the EPS fish container value-chain. The reference group's role has been to supervise the project, as well as quality control of the data and assumptions that the assessments are based upon.

The reference group consisted of the following representatives:

- The Norwegian Plastics Federationet's EPS packaging group represented by Håvard Vartdal (Vartdal Plastindustrier), Sven Bekken and Jan Erik Kvingedal (BEWI Produkter)
- Plastretur's Dag Aursland
- Østfold Research Foundation.

Stakeholders from the whole value-chain for EPS fish containers have contributed with information and data.

2 METHODOLOGY

The nett environmental benefit is calculated with the help of life cycle assessment methodology (LCA according to ISO 14040-43). This is done by carrying out life-cycle assessments for the different systems. Emissions to air, water and land associated with the different activities in the system are collected in the form of an inventory data set and environmental impacts are calculated. Based on the same systems, data for the costs for the different actors and activities are gathered, and the systems total costs calculated. The results show the nett environmental benefit and costs for the different activities included in the different waste treatment alternatives.

The nett environmental benefit for recycling and recovery systems is calculated as the sum of the factors that are environmental burdens (transport, emissions from processes) and the factors that give environmental benefits (emissions avoided due to recycled materials/ recovered energy replacing new materials/alternative energy). This is summarised in Table 2.1.

Environmental Burden	**Environmental Benefit**
- Collection and transport of waste to recycling/recovery - Environmental burdens arising from the material recycling facility - Environmental burdens arising from incineration of waste	- Material recycling: replacement of virgin raw materials means that one avoids environmental burdens for extraction/production of these. - Energy recovery: replacement of energy means that one avoids the environmental burdens for extraction, production and use of for example fossil energy

Table 2.1: *Environmental Burdens and Environmental Benefits in a Recycling and Recovery System for Plastics.*

The sum of the total environmental burdens and environmental benefits is defined as the nett environmental benefit. In the case where this sum is negative, it means that the system gives a saving of emissions/environmental burdens (benefit, gain).

3 ASSUMPTIONS

Environmental benefits and costs are calculated for the following two different waste managements options for used EPS fish containers:

1. Collection, pressing and material recycling
2. Collection, pressing and incineration with energy recovery.

Figure 3.1 below shows the flow diagram for the waste management options for EPS.

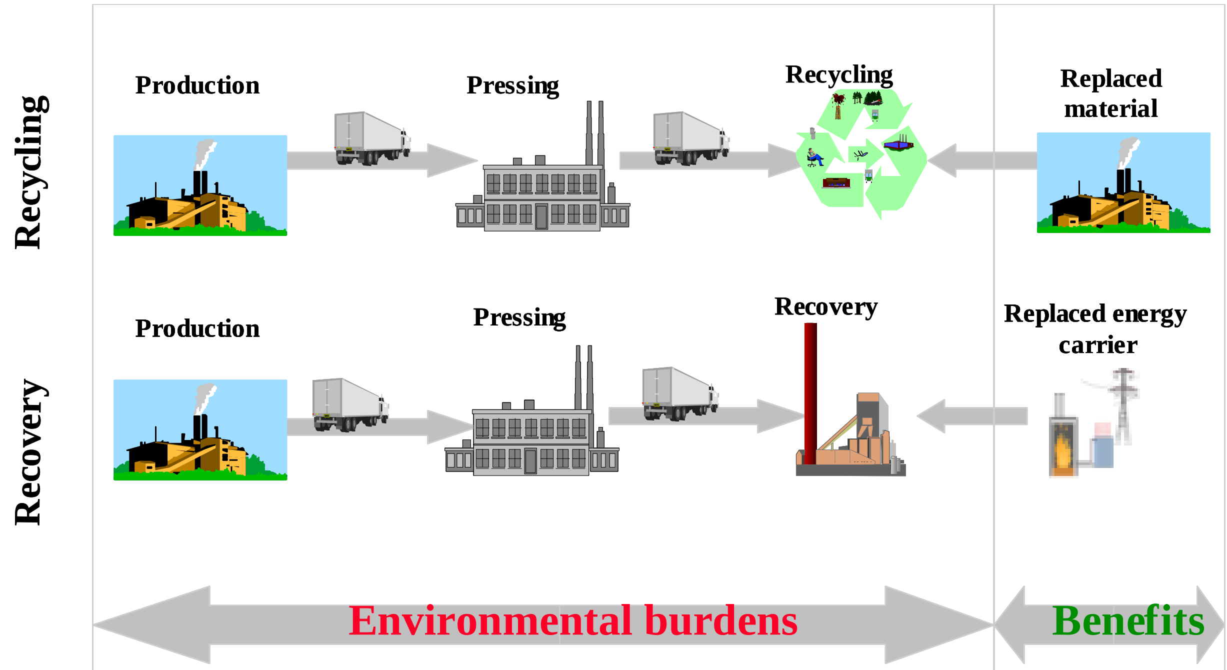


Figure 3.1: *Flow diagram for calculation of the environmental benefits and costs of waste treatment for EPS fish containers.*

Both systems ’start’ with production of expandable polystyrene (PS) and further processing to produce EPS containers. After use it is assumed that the containers are collected and pressed locally before they are transported to material recycling or incineration.

The results are presented per functional unit, which in this study is defined as:

Necessary production and collection in order to finally dispose of 1000 kg fish containers.

In 2002 material recycling of EPS occurred both in Norway and in Germany. In order to be able to show the differences between the two locations for the material recycling process, both of these alternatives are assessed. The scenarios for material recycling are also compared with a scenario for energy recovery. This energy recovery scenario consists of incineration of EPS with energy recovery in a local waste incineration plant in Norway.

This means that the following three main scenarios are assessed:

4. Material recycling in Germany
5. Material recycling in Norway
6. Incineration with energy recovery locally

In order to shed light on the importance of transport on the results, all three main scenarios are assessed using two alternative transport distances for collection. The bases for all three scenarios are two realistic collection points in Norway (Sotra in Hordaland county and Eide in Møre and Romsdal county) with the associated relevant transport distances. It is assumed that the containers are collected and pressed locally before (respectively) transportation to material recycling in Germany, material recycling in Norway and incineration with energy recovery locally.

The fish containers are produced by a Norwegian producer. The production process is always located in the vicinity of the customer in order to minimise the transport distance for the new containers. The containers are produced from balls of expandable polystyrene, filled with pentane. The pentane expands when heated and thus expands the polystyrene (EPS). Increased pressure and temperature mean that the EPS balls stick together and produce the desired shape with moulding.

The balls of expandable polystyrene are produced partly on the continent and partly in Norway. Figure 3.2 below shows that 40% of the balls are assumed to be produced in Norway and 60% in Europe. The associated transport distances and modes of transport for the different production locations are also shown in Figure 3.2.

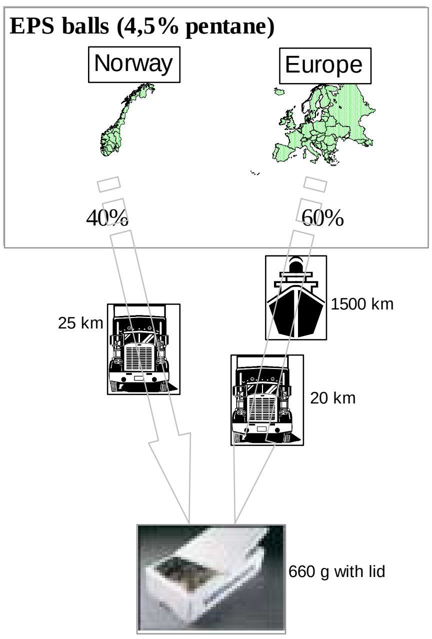


Figure 3.2: *Flow diagram for production locations and associated transport of polystyrene balls for production of EPS fish containers.*

The user phase for the fish containers is not included in this assessment because this phase of the life cycle does not have any effect on the waste management of the product.

Further, it is assumed that the EPS fish containers are collected, pressed and sent to material recycling or energy recovery. In the following sections of Chapter 3, the three main scenarios, with their alternatives are described in more detail.

3.1 MATERIAL RECYCLING IN GERMANY

It is assumed that pressed EPS is transported to Germany for material recycling at Fischer Kunststoff- und Sekundärrohstoff-Recycling. The material is cut up, melted and regranulated as polystyrene. The process takes place without washing, which means that the regranulate can have an odour that can limit the areas of use for this product. It is important to note that odour is not considered a problem at the recycling company (Fischer). The reason for this can be that the fish containers can be mixed with other, ’clean’ EPS packaging such that a dilution of the regranulate from fish containers occurs, thus reducing any odour. It is beneficial that EPS fish containers are mixed with other types of EPS from a technical point of view also. EPS from fish containers becomes a very thin fluid when melted, so mixing this with other EPS means that a thicker fluid, with wider application possibilities, is produced. This means that is beneficial for a large recycling company to receive different types of EPS packaging. If there are several options for application of the regranulate material, the producer can adjust the production process so that it is possible to meet different customers/producers different requirements.

Regranulate is used as a raw material for videocassettes, garden furniture, covers for PC’s, food mixers and CD-covers, to name but a few examples.

The costs for collection are assumed to be covered by the stakeholder that generates the waste, while the costs for pressing and transport to Germany, as well as the treatment costs for material recycling are assumed to be covered by Plastretur.

The scenario for material recycling in Germany, described above, is calculated for two alternatives. Two collection locations are examined, and these are described in the rest of the study as:

1. Eide - Material recycling Germany, and
2. Sotra - Material recycling Germany

Figure 3.3 below shows the flow diagram for the two alternatives for material recycling in Germany.

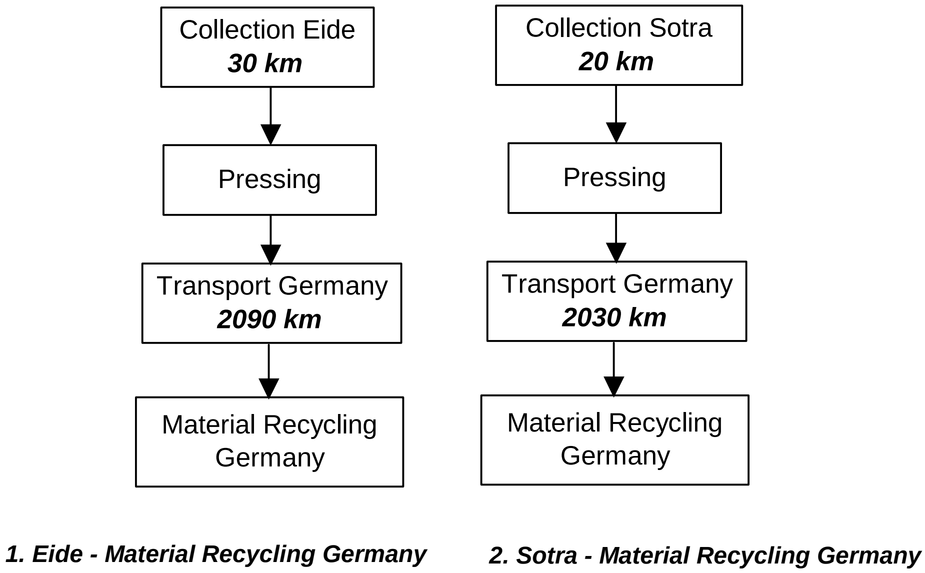


Figure 3.3: *Flow diagram for the scenarios for material recycling in Germany.*

3.2 MATERIAL RECYCLING IN NORWAY

It is assumed that pressed EPS is transported to material recycling in Rogaland (Stavanger). It is also assumed that the recycling process in Rogaland is virtually the same as the process in Germany, with the same use of energy and resources (the energy model is thus changed to that relevant for the Norwegian energy mix). This is not completely correct, as the material recycling process in Norway includes washing (Plastretur, 2002). Collection of specific data for energy and resource consumption for this process has not been possible, so this assumption had to be used, as it was the best available data at the time this study was performed. Use of this assumption can affect the system's total energy and resource consumption, as well as the potential applications for the regranulate produced. Including a washing process in the material recycling process means that the regranulate can be suitable for use in more products than if a washing process is not included (as is the case in Germany). The assumptions used lead to some uncertainty that must be considered when interpreting the results.

The costs for collection are assumed to be covered by the stakeholder that generates the waste, while the costs for pressing and transport to Rogaland, as well as the treatment costs for material recycling are assumed to be covered by Plastretur.

The scenario for material recycling in Norway is calculated for the same two alternative collection locations as for the German case. These are described in the rest of the study as:

3. Eide - Material recycling Norway, and
4. Sotra - Material recycling Norway

Figure 3.4 below shows the flow diagrams for the two alternatives for material recycling in Norway.

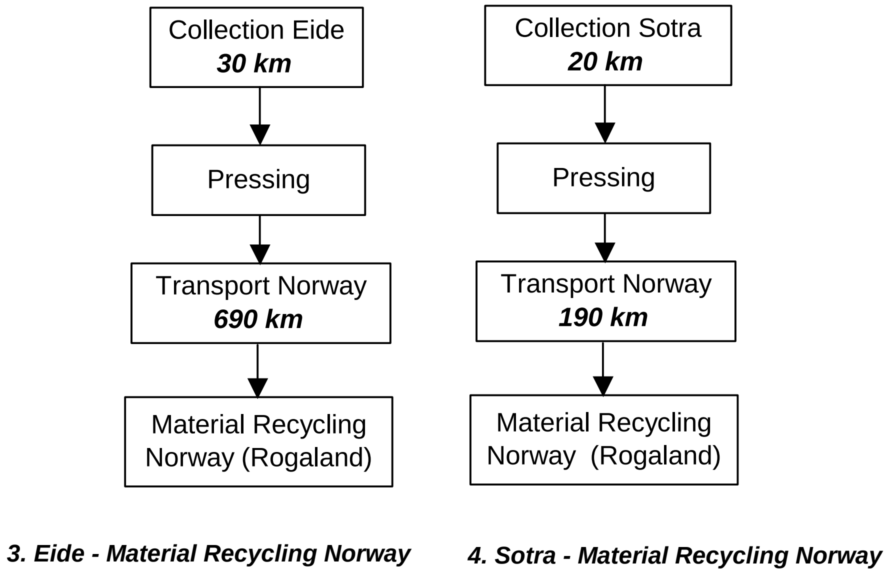


Figure 3.4: *Flow diagrams for the scenarios for material recycling in Norway.*

3.3 INCINERATION WITH ENERGY RECOVERY LOCALLY

It is assumed that pressed EPS is transported to the nearest local waste incineration facility for energy recovery. The stakeholder that generates the waste covers the costs for collection, pressing and incineration. Data for treatment costs for incineration are collected from the relevant incineration facilities and are valid for 2002.

The scenario calculations are performed for the same two alternative collection locations as for the scenarios described above, and are described in the rest of the study as:

5. Eide – Energy recovery locally, and
6. Sotra - Energy recovery locally

EPS collected in Eide is sent to the waste incineration facility at Tafjord (Tafjord Kraftvarme). Here district heat is supplied to a district heat network as a result of energy recovery from the waste incineration process. It is assumed that 100% of the energy produced from the incineration facility is utilised and that the energy carrier this replaces is oil. 100% utilisation of the energy produced is better than the actual utilisation rate, but has been chosen to represent a so-called 'best case' for waste incineration in Norway.

EPS collected in Sotra is sent to Bergen Inter-County Waste Management Company (BiR) waste incineration facility. This incinerator produces electricity. Production of electricity has an energy efficiency of about 30% and replaces average Norwegian electricity. This represents the so-called ’worst case’ for waste incineration in Norway.

By simulating a ’best’ and a ’worst’ case for waste incineration, the results can show the two general extremes for waste incineration in Norway. Figure 3.5 below shows the flow diagram for the two alternatives for energy recovery.

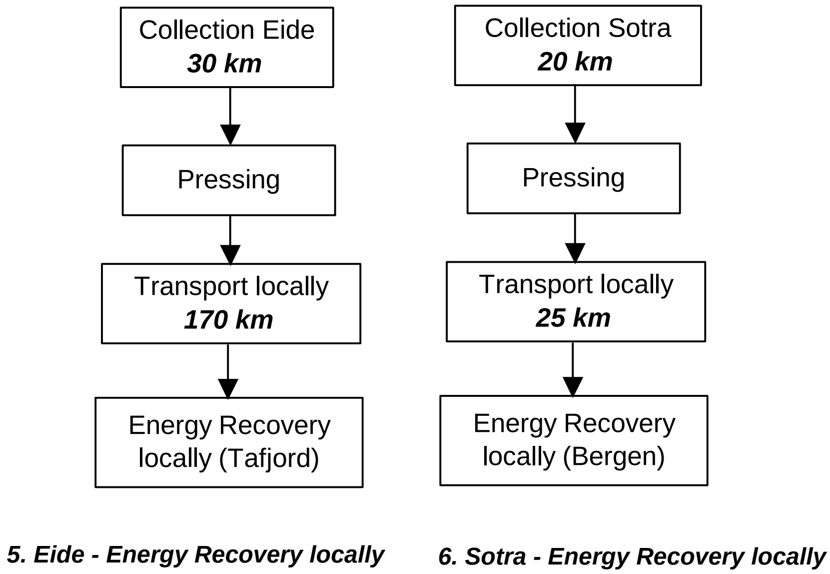


Figure 3.5: *Flow diagram for the scenarios for energy recovery locally.*

3.4 SUMMARY, SCENARIOS

The following three main scenarios are assessed:

A. Material recycling in Germany
B. Material recycling in Norway
C. Incineration with energy recovery locally

For each main scenario there are two alternatives with different collection locations in Norway (Sotra in Hordaland and Eide in Møre and Romsdal).

This means that the following six alternatives are assessed:

1. Eide - Material recycling Germany
2. Sotra - Material recycling Germany
3. Eide - Material recycling Norway
4. Sotra - Material recycling Norway
5. Eide - Energy recovery locally
6. Sotra - Energy recovery locally

4 MAIN RESULTS

The following environmental effect categories are assessed:

- Global warming potential (emissions of greenhouse gasses)
- Acidification potential
- Fossil energy consumption

In addition, the costs for collection and waste management for the different alternatives are assessed.

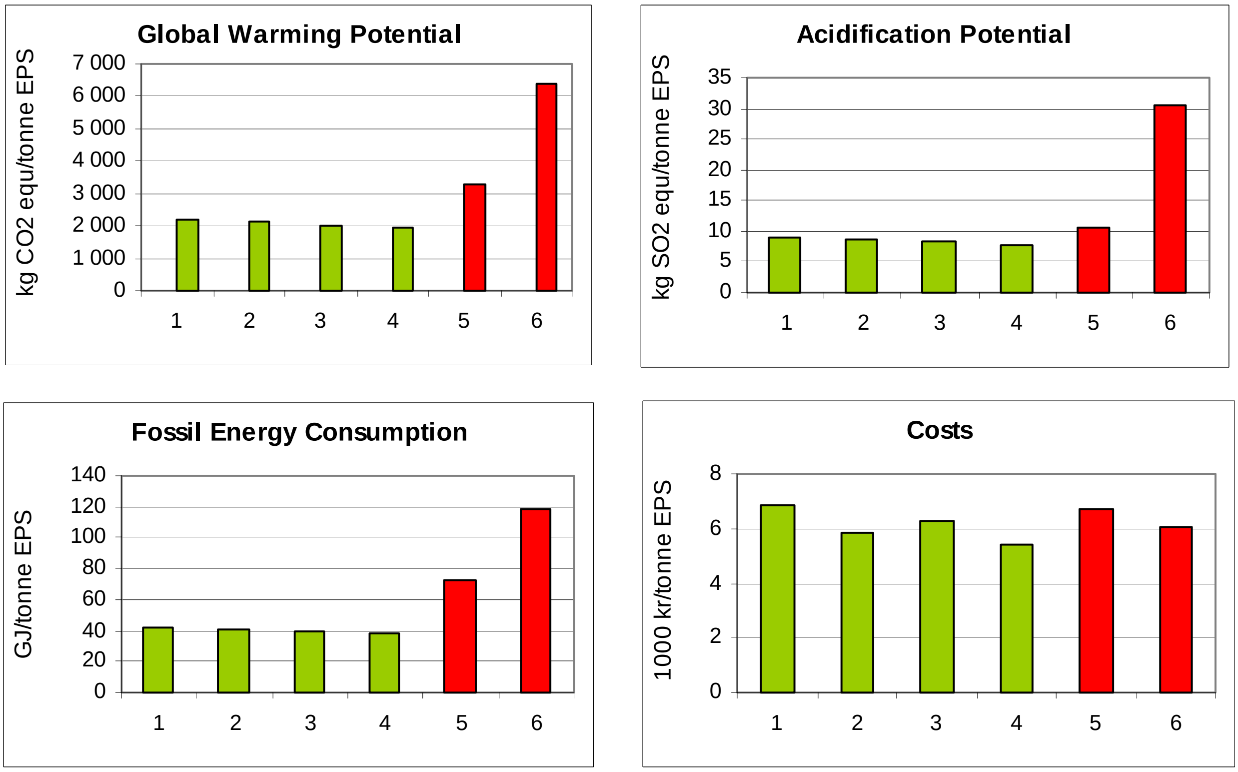
Table 4.1 below shows examples of different emissions that contribute to the environmental effects and the potential environmental effects these can give.

Environmental impact category	**Example of emissions**	**Potential environmental effects**
Global warming potential (global climate change/ GWP)	CO_2 N_2O CH_4 CF_4/C_2F_6	Temperature increase in the lower part of the atmosphere that can give rise to climate changes, something that can, in turn, lead to serious consequences for Earth, in the form of a changed/more extreme climate, increased desertification, raised sea levels due to glaciers melting, etc.
Acidification potential	SO_2 HCl NO_x	Fish death, death of forests, corrosion damage, damage to buildings, the release of heavy metals with effects on animals, vegetation and health.
Total energy consumption (resource consumption)	No emissions, but consumption of energy resources in the form of potential energy, solar, wind, tidal and fossil energy.	No direct effects, but changes in the consumption of the different energy carriers can give changes in the other environmental effect categories.

Table 4.1: *Connection between the relevant environmental impact categories, examples of relevant emissions and potential environmental effects.*

Environmental and cost assessments are performed for all of the six alternatives that are described above (Chapter 3.4).

Figure 4.1 shows the results for global warming potential, acidification potential, consumption of fossil resources and costs for the different alternatives. The green bars represent the material recycling alternatives, while the red bars represent the energy recovery alternatives.



Key	
1	Eide - Material recycling Germany
2	Sotra - Material recycling Germany
3	Eide - Material recycling Norway
4	Sotra - Material recycling Norway
5	Eide - Energy recovery locally
6	Sotra - Energy recovery locally

Figure 4.1: *Global warming potential, acidification potential, consumption of fossil resources and costs for the different alternatives.*

The figure shows that, environmentally, material recycling is clearly better than energy recovery. This is shown by the fact that all of the alternatives with material recycling give lower emissions than the best energy recovery alternative. This is the case for all three of the environmental effect categories assessed (global warming potential, acidification potential and consumption of fossil resources). It is also interesting to see that there are very small differences between the different material recycling alternatives. This means that pressed EPS can be transported to Germany for material recycling without significant negative effects on the environmental accounts.

The figure also shows that the energy recovery alternative ’Eide - Energy recovery locally’ gives significantly better results than ’Sotra - Energy recovery locally’. This is due to the much higher rate of energy utilisation and the type of energy carrier that is replaced (see the description of ’best’ and ’worst case’ in Chapter 3.3).

The cost assessment shows that the total costs for collection, transport and treatment vary between about 5500 and 7000 kr/tonne EPS. ’Eide – material recycling in Germany’, ’Eide – material recycling in Norway’ and ’Eide – energy recovery locally’ have the highest costs, all over 6500 kr/tonne. This is mainly because these alternatives have the longest local transport before pressing.

It is also of interest that the material recycling alternatives with the shortest local collection route (Sotra) have the lowest total costs. This confirms that the transport costs before pressing are the most important for the total costs. This means that one of the most important measures for reducing the total costs is that the EPS containers are pressed at as early a stage as possible.

4.1 ENVIRONMENTAL ASSESSMENT

In order to show the reasons for the large differences in the nett environmental benefits between the material recycling and energy recovery scenarios, as well as the differences between the two energy recovery scenarios, the nett environmental benefits for global warming potential are presented in Figure 4.2. The results are shown split up according to the following activities in the value chain:

’Production of container’	Environmental impacts associated with raw material extraction, transport and production of fish containers.
’Transport’	Environmental impacts and costs associated with all transport for collection and transport of EPS containers to material recycling or incineration.
’Treatment’	Environmental impacts and costs associated with pressing, material recycling and incineration.
’Avoided’	Avoided/saved environmental impacts due to the fact that new material or other energy carriers are replaced/avoided.
’Total’	Total environmental impact/benefit for the different environmental effect categories, the sum of the activities described above.

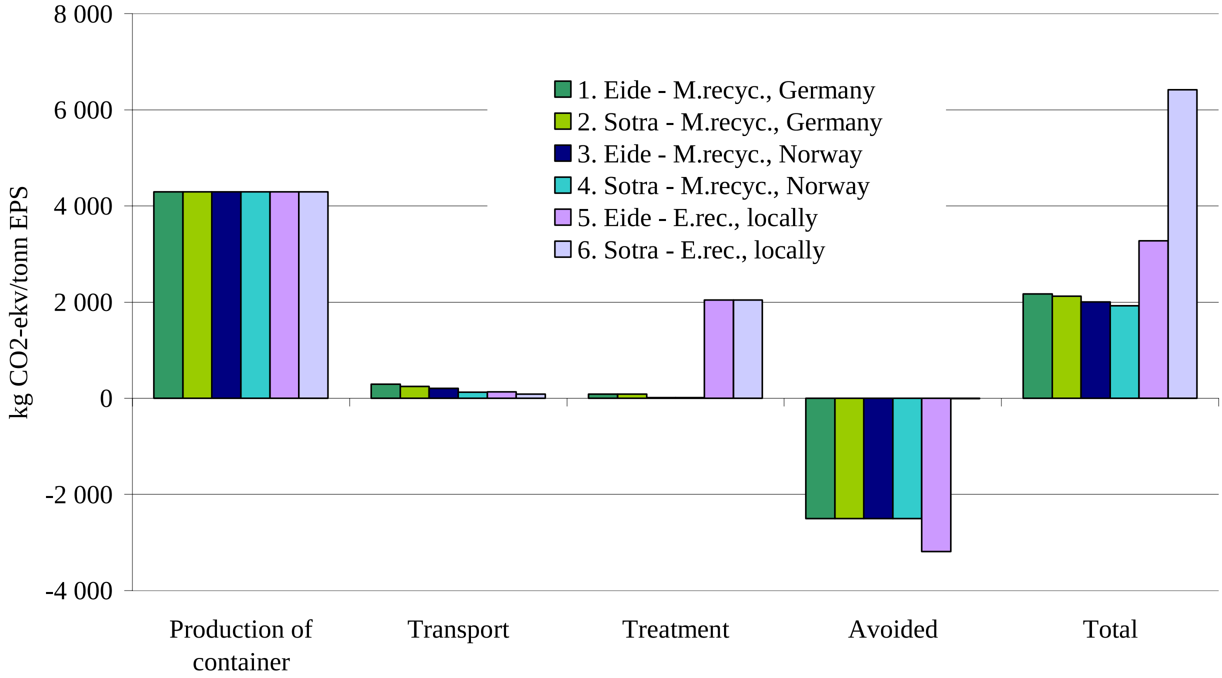


Figure 4.2: *The contributions of the assessed alternatives to global warming potential, split up according to the different activities in the value-chain.*

Figure 4.2 shows that the differences in nett environmental benefits between the material recycling and energy recovery alternatives are mainly due to the emissions from the actual material recycling and energy recovery processes ('Treatment'). The emissions from material recycling are close to negligible, while the emissions from incineration of EPS are approximately 2000 kg CO_2 per tonne EPS. This is because EPS is a fossil-based material and therefore has high CO_2 emissions when incinerated. In addition, the emissions avoided as regranulate replaces virgin granulate are over 2000 kg CO_2 per tonne EPS, while the avoided emissions with the best and worst energy recovery alternatives are approximately 3000 and 0 kg CO_2 per tonne EPS respectively. This means that the nett emissions of greenhouse gasses for the best and worst energy recovery alternatives are about 50% points and 200% points larger than for material recycling respectively.

The figure also shows that the total contribution to global warming potential from transport is almost negligible in relation to the systems' nett emissions of greenhouse gasses. This means that, from an environmental perspective, it is not significant whether pressed EPS is transported to Germany for material recycling, as long as it replaces plastic that would otherwise have been produced from virgin materials.

From Figure 4.2 we can also see the large difference between the two energy recovery alternatives ('best' and 'worst case'). The alternative 'Sotra - energy recovery locally' (worst case) gives rise to about double the amount of emissions of greenhouse gasses than the other alternative. This is because the heat produced by the two incinerators is produced with different efficiencies and replaces different energy carriers (see the more detailed description in Chapter 3.2.1). The utilisation of heat to produce electricity (Sotra) gives the least environmental benefits for two reasons:

1. Electricity production means low energy efficiency (about 30%), and
2. Norwegian electricity that is replaced/avoided is a relatively 'clean' energy carrier, as it is mainly based on hydropower.

The energy efficiency of heat from incineration used for district heat (Eide) has considerably better environmental benefits for two main reasons: a higher rate of energy recovery and that the energy carrier assumed to be replaced is oil, which is a fossil energy carrier.

Production of fish containers is the same for all of the scenarios, men is included in order to show the impacts from this activity in relation to the nett environmental benefits for the whole value-chain (the life-cycle).

Despite the fact that transport contributes little to the total environmental impacts, the environmental impacts from transport are shown in more detail in Figure 4.3 below. This is done in order to show how the emissions of greenhouse gasses are distributed over the different transport stages in the different systems.

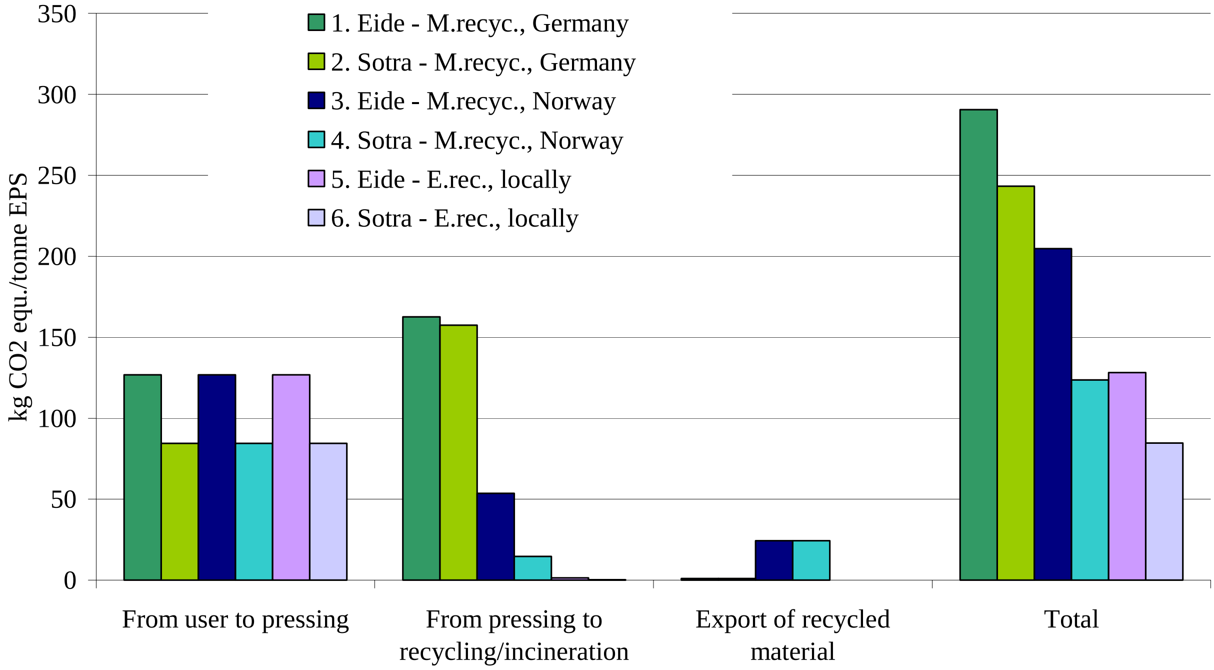


Figure 4.3: *Contribution to global warming potential distributed through the different transport stages for the alternatives assessed.*

The figure shows that transport for alternatives with material recycling in Germany, not surprisingly, gives the largest contribution to global warming potential, shown in the bars for ’From pressing to recycling/incineration’.

In addition, one can see that the energy recovery alternatives lead to the lowest transport emissions. This is due to the fact that these alternatives have the shortest transport distances.

Further, it can be seen that transport from pressing to material recycling in Germany leads to greenhouse gas emissions that are about three times greater than for transport to recycling in Norway. However, the increased impact from transport to Germany is, to some degree, ’eaten up’ by the export of regranulate for material recycling in Norway (the regranulate is assumed to be transported to the European market).

Figure 4.3 also shows that transport of pressed EPS from Norway to Germany (ca 2000 km) contributes only about 25%-points greater emissions of greenhouse gasses than local transport of ’non-pressed EPS’ (about 30 km). In addition, it can be seen that emissions of greenhouse gasses for collection and transport of ’non-pressed EPS’ (shown in the bars for ’From user to pressing’) increases by 50%-points with an increase in transport distance of only 10 km (20 km in total, as empty return transport is assumed). This again confirms that the most important factor for minimising greenhouse gas emissions from the transport of EPS is that the material is pressed as early as possible in the value-chain.

It is important to emphasise that the contribution to global warming potential from transport is relatively small in relation to the total environmental accounts for the whole system (see Figure 3.6).

A similar distribution of environmental benefits and impacts over the life-cycle was also obtained for the environmental effects: acidification potential and consumption of fossil resources.

4.2 COST ASSESSMENT

The cost assessment covers the activities associated with waste management itself. This means that the costs for production of the container, replaced/avoided materials and energy are not included.

The following costs are included:

- Costs for transport
  - from consumer to pressing
  - from pressing to recycling/incineration
- Costs for waste treatment:
  - pressing
  - material recycling in Germany
  - material recycling in Norway
  - waste incineration

The cost assessment is based on the actual costs in the form of running costs and financial support from Plastretur (see Chapter 3).

Figure 4.4 shows the costs for the waste system in total and the distribution of these costs for transport and treatment.

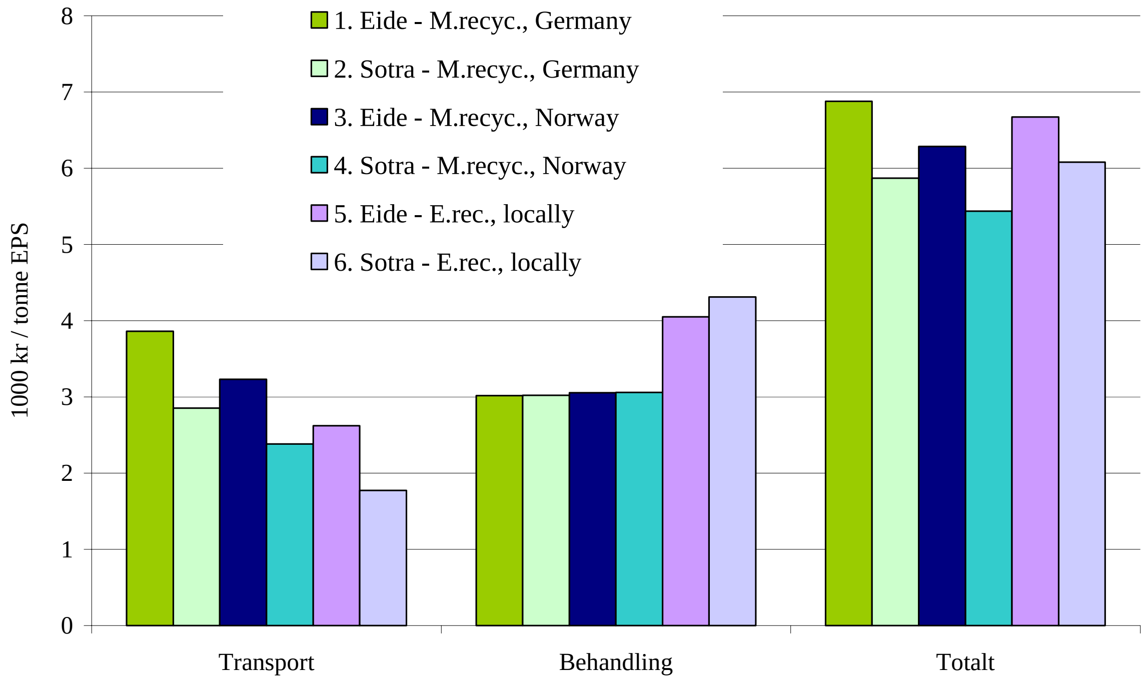


Figure 4.4*: Costs for waste treatment of EPS.*

The figure shows that the costs for the different alternatives vary between about 5500 and 7000 kr per tonne EPS.

It is interesting to see that energy recovery has generally lower transport costs and higher treatment costs than material recycling. It should be noted that pressing is also included in the energy recovery alternatives.

It is also interesting to notice that the material recycling alternatives with the shortest local collection routes (Sotra) give rise to lower total costs than energy recovery, independent of whether material recycling occurs in Norway or in Germany.

This confirms the results that show that costs for transport before pressing are the most important for the total cost picture, such that the most important potential for reducing the total costs is that the EPS containers are pressed at so early a stage as possible.

5 CONCLUSIONS

Based on the results from this study, the following main conclusions can be drawn:

- Material recycling is clearly the best waste treatment method for EPS packaging from an environmental point of view.
- Emissions from transport are negligible for the total environmental accounts for the value-chain for EPS fish containers.
- The costs of material recycling give this treatment method a competitive edge over energy recovery.
- Transport of non-pressed EPS is more significant for the total cost picture than whether the EPS fish containers are sent to material recycling or energy recovery.

This means that it is important to ensure good systems for waste management and the transition to material recycling where this is not the waste treatment method used today.

6 Continuation of the Project

Based on the results from this study, the reference group is in agreement that an application should be made to continue the work as an EU project within the 6th Framework Programme's Collective Research programme. The Research Council of Norway has given a positive reply to an application for 'project establishment support' for developing an application for an EU project (letter of consent from NFR 16/09/03).

6.1 Aims and Benefits

The temporary title for the project is 'Best practice and best technology for recycling of expanded polystyrene (EPS) from seafood packaging', which has the following main aim:

> *Ensure that the largest possible amount of Norwegian exported EPS fish containers are, in the future, sent to waste management systems that are as environmentally efficient and cost effective as possible (material recycling).*

The deadline for an application to the Collective Research programme's stage 1 is the 8th of April 2004. Qualification here will lead to a new deadline for the second stage, which is in the middle of September 2004.

Carrying out such a project will have the following benefits for the different actors in the EPS fish containers value-chain:

Actor	Benefits
Producers of raw materials and containers	Increased competitive edge, avoid possible future regulations/taxes by being in the forefront (precautionary principle), fulfil EU requirements for material recycling.
Customers of exported goods	Documentation, secure knowledge about the best waste management alternatives, and practical guidance for the right waste management choices.
Plastics Federations in different European countries	Increased knowledge, fulfilment of national and international agreements/targets.
European Plastic Recycling Organisation (EPRO)	Fulfil national and international agreements.
Authorities/EU	Fulfil agreements/targets

6.2 ACTIVITIES

An overview of the main activities that are proposed in the EU project is given in the following:

1. *Document the status for the current solutions.*
   Carrying out a more detailed survey of the present situation for:
   - Customer requirements for packaging
   - Wastes management solutions (including BAT (best available technology)) and market and sales potential for EPS-packaging.
   - Conditions (regulatory, market and other relevant conditions imposed on the system).
2. *Assess future development potential*
   - Future market and sales opportunities for EPS packaging
   - Future conditions (regulatory, market and other relevant conditions imposed on the system).
   - Future export from Norway
3. *Technology development*
   Assess technology development for material recycling and pressing.
4. *Dissemination of Knowledge*
   Develop a website/datasheet for ’Best practice for waste management of EPS fish containers in different markets’. This shall be distributed to all actors in the EPS fish containers value-chain.

6.3 RELEVANT COLLABORATION PARTNERS

It is proposed that the project is organised via established networks within plastic recycling companies in Europe and the EPS sector, as well as through customer – supplier relationships between Norwegian seafood companies and customers in Europe.

The most central collaboration networks will be between:
- Plastic recycling companies in Europe, through the organisation EPRO;
- EPS industrial association within the plastics industry in Europe;
- EPS producers in Norway, seafood exporters and important customers in relevant countries;
- Collection companies and recycling companies in relevant countries.

It is assumed that the most relevant collaboration partners will be from Denmark, Germany, France, Spain, Poland and Lithuania/Latvia.

In Norway, the most relevant collaboration partners are:
- The Norwegian Plastics Federation's EPS packaging group;
- EPS packaging producers (e.g. Vartdal Plast, BEWI etc.);
- Large Norwegian seafood companies, like Domstein, Lerøy, Marine Harvest, etc.;
- Østfold Research Foundation (STØ) (to perform the environmental R&D work).

It is proposed that Plastretur has the responsibility for co-ordinating the project, and ensuring contact with the network of plastic recycling companies in Europe. Østfold Research Foundation will be responsible for the technical quality of the R&D work, and be responsible for the methodology required for analyses and calculations of environmental and economic benefits. It is proposed that contact is established with a German recycling company. This company will, together with Norwegian expertise, work on the R&D for process development for EPS recycling.

7 REFERENCES

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