

# CO<sub>2</sub>-emission when distributing fish in reusable packaging, measured in comparison to EPS non-returnable packaging.

---

## Contents

Project content.....	3
Introduction.....	4
Comparison of CO <sub>2</sub> emission .....	5
Examples of calculation: .....	5
Example 1: .....	6
Example 2: .....	7
Conclusion .....	8
Assumptions: .....	9

## Project content

This report is a part of the project which SE Packing System A/S has been granted under the set-up “Knowledge coupon” (Videnkupon) by the Danish Agency for Science, Technology and Innovation (Forsknings- og Innovationsstyrelsen).

### **Briefly about the Knowledge coupon set-up**

The aim of the Knowledge coupon set-up is to inspire small and medium sized enterprises to use the opportunities and potentials, which lie in using the knowledge of the knowledge Institutes. At the same time the Knowledge coupon set-up should enhance the knowledge Institutes attention to the knowledge requirements of the small and medium sized enterprises and thereby ensure the quality and social relevance of the public research.

The Knowledge coupon must encourage all types of innovation in small and medium sized enterprises.

### **Basis Knowledge coupon:**

SE Packing System A/S has been granted a “Basis Knowledge coupon”. An enterprise can apply for a basis knowledge coupon if they need support to project cooperation with starting point in purchase of research-based knowledge from a knowledge Institute. The support can amount to DKK 100,000, which is paid to the knowledge Institute in the cooperation. The support can cover costs for counselling, sparring, education based on the latest research in connection with a specific development project in the enterprise and/or purchase of knowledge or development and innovation cooperation, which is based in research and development activities within the Institution. Basis knowledge coupon covers expenses connected with performance of one or more of following activities:

- Product development and quality improvement.
- Landing and implementation of new technologies.
- Innovation in the business development, including development of marketing strategies and cultivation of new national or international markets for the enterprises products, however not traditional, standard marketing activities, which can be acquired on the commercial market.
- Solving of technical problems and introduction to new technologies on the leading edge of the market.

### **Resume of the SE Packing System A/S project is described as follows:**

It is the aim of the project to develop one overall documentation system for the customers reverse logistic systems. The system should assist in evaluating the customer’s present solutions and contribute to suggesting real environmental improvements. The new system should at the same time asses the financial consequences. SE Packing System A/S think, that a system which illustrates the conditions about reverse logistics, finances and environment will convince many new customers to use the enterprises rental boxes (fish packaging).

The project includes,

1. A calculation tool, which can estimate the environmental influence of different fish packaging
2. A report, which describes the environmental influence of two different fish packaging.

## Introduction

Foodstuffs are in Denmark mainly distributed in non-returnable packaging, as it is with distribution of fish, most frequently in non-returnable boxes of Expanded Polystyrene (EPS). The use of non-returnable EPS boxes has many advantages in connection with transportation of foodstuffs. The EPS boxes are hygienic, has good isolation properties and low weight. The use of non-returnable packaging furthermore gives a simple logistic, without need of return transportation of packaging. On the other hand the use of non-returnable packaging result in use of energy and raw materials for production of larger amounts of packaging, than if reusable packaging was used.

SE Packing System A/S rent out reusable packaging to the fish industry and offers rental of fish boxes, where the logistic concerning delivery of empty boxes for the fish industry, collection of used boxes at the customers as well as cleaning of the used boxes is a part of the whole solution.

SE Packing Systems A/S has therefore given The Danish Technological Institute the task of drawing up a calculation tool which can estimate the difference in the CO<sub>2</sub>-contribution from distribution of fish in reusable packaging from SE Packing System A/S compared to distribution in traditional non-returnable EPS fish boxes.

The conclusions in the report are based on calculations from this calculation tool. The results can therefore solely be seen as examples of the differences in CO<sub>2</sub>-contribution in the specific cases and under certain conditions and the results can therefore not be transferred to other situations offhand.

## Comparison of CO<sub>2</sub> emission

In the comparison of the CO<sub>2</sub> contribution from distribution of fish in respectively non-returnable boxes of EPS and reusable boxes of HDPE is included the contribution from following areas:

	EPS non-returnable boxes	HDPE reusable boxes
Production of boxes	■	(■)
Transportation of boxes between box supplier and fish supplier	■	■
Transportation of filled boxes from fish supplier to customer	■	■
Transportation of empty boxes to the receiving station for waste	■	(■)
Transportation of empty reusable boxes to wash		■
Wash of empty reusable boxes		■

Figure 1: CO<sub>2</sub>-contribution from processes in the logistics chain for fish boxes

Figure 1 show where the differences in the CO<sub>2</sub>-emission from distribution of fish in non-returnable fish boxes come from. It should be noted, that as the reusable boxes from SE Packing System A/S as an average are used 60 times before they are scraped, the CO<sub>2</sub>-emission from production and transportation of raw materials, production of boxes, transportation of empty boxes to receiving station as waste, as well as incineration of empty boxes could be calculated as 1/60 of the CO<sub>2</sub>-emission for the concerned processes per box.

The primary difference in emission of CO<sub>2</sub> by use of reusable boxes compared to non-returnable boxes therefore lay in the reduced energy consumption, and the from this deflected reduction in CO<sub>2</sub>-emission, which is connected to the production of the boxes. This reduction should be compared with the increased CO<sub>2</sub>-emission which is connected with return transportation of the used boxes from customer to washing plant at SE Packing System A/S, as well as the CO<sub>2</sub>-emission connected with the energy consumption for washing the boxes. Finally there can also be more transport between SE Packing System A/S and the fish distributors, as there is often local manufactures of non-returnable fish boxes of EPS, and the boxes from SE Packing System A/S always come from their location in Skagen.

## Examples of calculation:

As the CO<sub>2</sub>-emission is the sum of emission connected with the production, transportation and possibly the wash of boxes, the total influence of the CO<sub>2</sub>-emission by changing from non-returnable EPS boxes to reusable boxes from SE Packing System A/S will be the sum of influences from all transports for each distributor.

The calculation tool, which the Danish Technological Institute has drawn-up, has been used for two (2) calculation examples in this report, in order to give an indication of the possible reduction of CO<sub>2</sub>-emission from distribution of fish, by use of reusable fish boxes from SE Packing System A/S instead of the traditional EPS-fish boxes. SE Packing System A/S can subsequently use the calculation tool from the Danish Technological Institutes to calculate the CO<sub>2</sub>-contribution from distribution of fish for each customer case, with starting point in the distances between the suppliers of fish boxes, fish distributor and customer.

**Example 1:**

An example of box flow between box supplier, fish supplier and customer:

Conditions (geography):

Box supplier, EPS-boxes:

Ålesund, Norway

Fish supplier:

Ålesund, Norway

Customer:

Bremerhaven, Germany

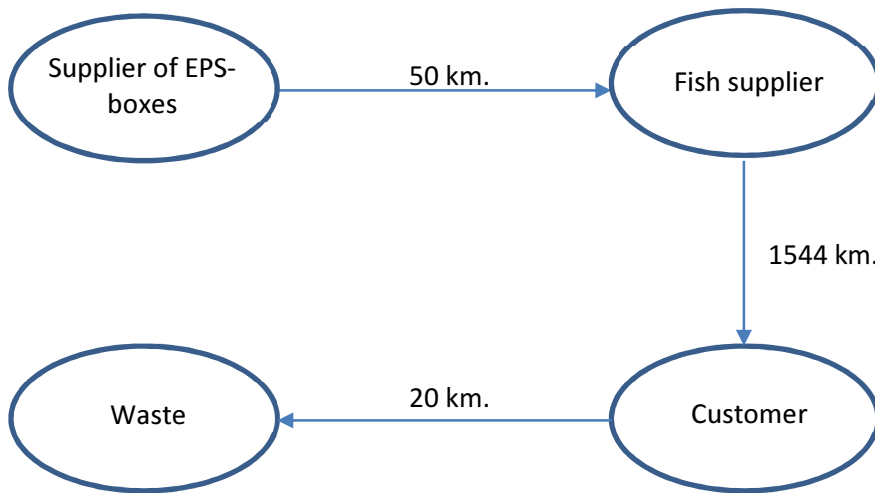


Figure 2: Example 1: Box flow with distances, EPS non-returnable boxes

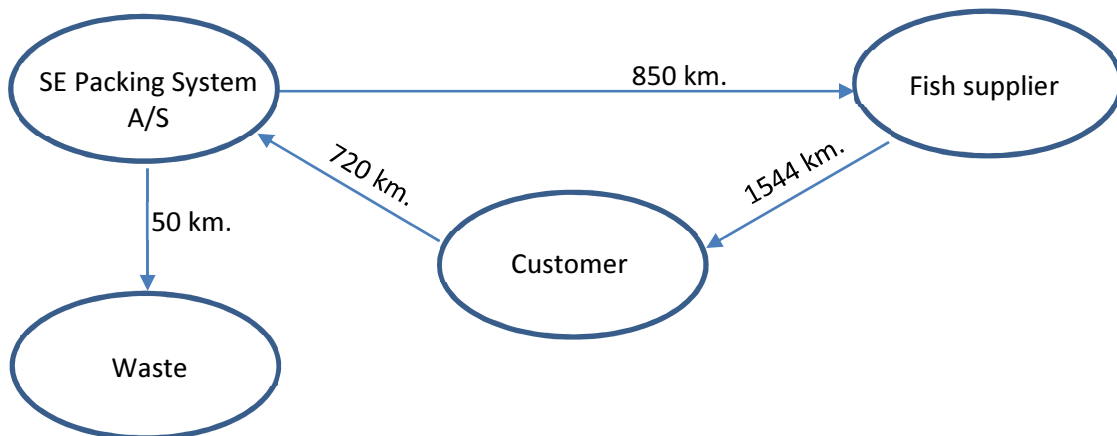


Figure 3: Example 1: Box flow with distances, reusable boxes from SE Packing System A/S

By use of the calculation tool for calculation of the CO<sub>2</sub>-emission from fish distribution, the values for example 1 are as follows:

CO <sub>2</sub> -emission by production and transportation of 1000 fish boxes (example 1)	EPS non-returnable boxes	HDPE reusable boxes
Production of boxes (incl. Lids) [kg. CO <sub>2</sub> ]	3312.00	48.91
Transportation of boxes between box supplier and fish supplier [kg. CO <sub>2</sub> ]	48.99	187.39
Transportation of filled boxes from fish supplier to customer [kg. CO <sub>2</sub> ]	1651.44	1651.44
Transportation of empty boxes to receiving station for waste [kg. CO <sub>2</sub> ]	4.41	0.18
Transportation of empty reusable boxes and lids to wash [kg. CO <sub>2</sub> ]	-	159.38
Wash of empty reusable boxes and lids [kg. CO <sub>2</sub> ]	-	116.08
<b>Total [kg. CO<sub>2</sub>]</b>	<b>5016.84</b>	<b>2162.00</b>

Figure 4: CO<sub>2</sub> contribution/1000 boxes – example 1

It can be seen from figure 4 that there in example 1 will be a reduction in the CO<sub>2</sub> contribution from distribution of fish of approximately 56.9 % by changing from the traditional non-returnable EPS boxes to reusable boxes of HDPE from SE Packing System A/S.

## Example 2:

An example of box flow between box supplier, fish supplier and customer:

### Conditions:

Box supplier, EPS-boxes:

Ålesund, Norway

Fish supplier:

Ålesund, Norway

Customer:

Boulogne sur Mer, France

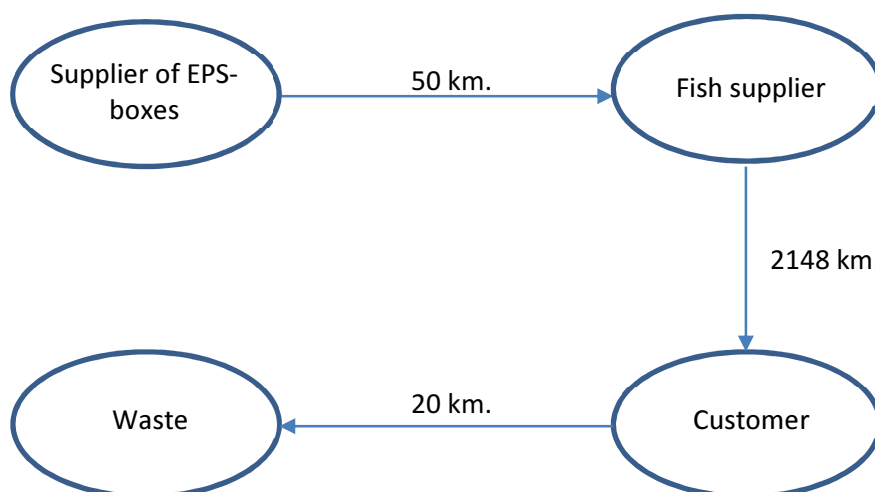


Figure 5: Example 2: Box flow with distances, EPS non-returnable boxes

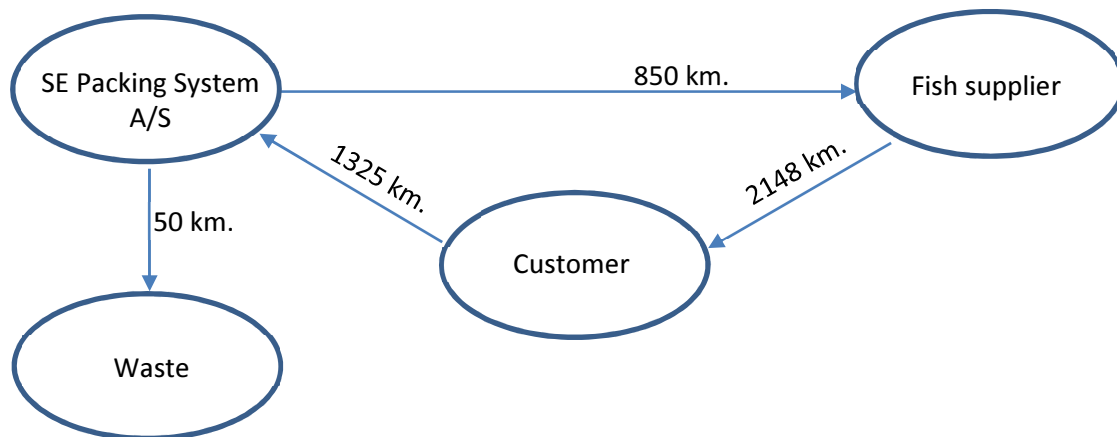


Figure 6: Example 2: Box flow with distances, reusable boxes from SE Packing System A/S

By use of the calculation tool for calculation of the CO<sub>2</sub>-emission from fish distribution, the values for example 2 are as follows:

CO <sub>2</sub> -emission by production and transportation of 1000 fish boxes (example 2)	EPS non-returnable boxes	HDPE reusable boxes
Production of boxes (incl. Lids) [kg. CO <sub>2</sub> ]	3312.00	48.91
Transportation of boxes between box supplier and fish supplier [kg. CO <sub>2</sub> ]	48.97	187.39
Transportation of filled boxes from fish supplier to customer [kg. CO <sub>2</sub> ]	2297.47	2297.47
Transportation of empty boxes to receiving station for waste [kg. CO <sub>2</sub> ]	4,41	0.18
Transportation of empty reusable boxes and lids to wash [kg. CO <sub>2</sub> ]	-	293.30
Wash of empty reusable boxes and lids [kg. CO <sub>2</sub> ]	-	116.08
<b>Total [kg. CO<sub>2</sub>]</b>	<b>5662.87</b>	<b>2941.96</b>

Figure 7: CO<sub>2</sub>-contribution/1000 boxes – example 2

It can be seen from figure 7 that there in example 2 will be a reduction in the CO<sub>2</sub> contribution from distribution of fish of approximately 48 % by changing from the traditional non-returnable EPS boxes to reusable boxes of HDPE from SE Packing System A/S.

## Conclusion

Based on the conditions which apply for this report, it can be concluded that a significantly reduction in the CO<sub>2</sub>-emission from distribution of fish can be achieved, if the reusable boxes from SE Packing System A/S are used instead of the traditional non-returnable EPS boxes. This reduction of the CO<sub>2</sub>-emission is larger if customer and fish distributor are geographically closely placed to SE Packing System A/S, and will fall the further away the fish distributor and customer are placed from SE Packing System A/S.



## Assumptions:

All calculations and conclusions in this report are based on the in the report mentioned calculation tool, with the additional assumptions:

CO <sub>2</sub> emission by production of EPS packaging:	2.07 kg. CO <sub>2</sub> / kg. EPS box
Weight of standard 20 kgs. EPS fish box incl. lid:	1.6 kg.
CO <sub>2</sub> emission by production of HDPE packaging:	1.3 kg. CO <sub>2</sub> / kg. HDPE box
Weight of HDPE reusable fish box (SE Rebox):	2.0 kg.
Weight of HDPE lid for reusable fish box (SE Rebox):	0.9 kg.
There are 120 empty SE Rebox boxes on one EUR Pallet	
There are 360 SE Rebox lids on one EUR Pallet	
There are 27 filled SE Rebox boxes (and 3 lids) on one EUR Pallet	
There are 27 EPS boxes with 27 lids on one EUR Pallet	
SE Rebox boxes are reused 60 times, before they are scrapped (driven to waste plant)	

### CO<sub>2</sub>-emission by lorry transportation:

International Transport Denmark, environmental data calculator:

<http://www.itd.dk/Miljo/Em.aspx?ID=168>

Assumptions: Whole lorry loads of 33 EUR-pallets are transported, Engines according to EURO 5 norm, weight of lorry with trailer: more than 20 ton.

### Wash of used fish boxes:

Energy consumption for wash of boxes (electricity and natural gas) has been informed by SE Packing System A/S

CO<sub>2</sub>-emission for the energy consumption is based on figures from Energinet.dk

### Production of fish boxes:

The values of CO<sub>2</sub>-emission for production of fish boxes of respectively EPS and HDPE comes from:

Wallmart Stores Package Modeling 3.0: [www.packagemodeling.com](http://www.packagemodeling.com)

### Disposal of waste:

The CO<sub>2</sub>-emission in connection with the disposal of scrapped fish boxes is not included, as disposal of waste is not made in a uniform way. The disposal of used fish boxes – whether it is EPS or HDPE, can be made by incineration, reuse as raw materials for certain plastics items as well as landfill.