TrainERGY project

Case Study - Template

Submission Date:	25.11.2016
Place:	University of Sheffield

Sector Analysed:	Chemical sector
Product Analysed:	1 m^3 of polystyrene block (brick)

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1 Introduction

The main goal of our project is to evaluate the total lifecycle carbon emissions, identify carbon hot-spots and suggest possible low carbon intervention measures to address the hot-spots in the supply chain of polystyrene brick produced by polish company IZODOM. The most important advantage of our analysis is to improve the production of polystyrene bricks to reduce CO_2 emission using Scenat.

2 Overview

2.1 Firm description

The IZODOM was founded in 1991. It is a micro company, employing about 50 people. It is located in Zduńska Wola in Lodz region, Poland. The company's objective is to offer a complete system for building low-energy and passive houses - from foundations, through walls, all the way to the roof. It produces construction elements from polystyrene using only steam and power. They do not add any chemicals in the production process (poisonous adhesives, solvents, preservatives, paints). The company operates in the Chemical Sector. The advantages of their technology are durable concrete structure, unheard-of thermal insulation parameters, absence of thermal bridges, quick completion times and most of all energy efficiency throughout the building use time. During twenty-five years of activity IZODOM built over 20.000 buildings all over the world including Germany, France, Russia, Ukraine, United Arab Emirates and Morocco. The role of the company in the product supply chain is manufacturer.

2.2 Product description

IZODOM offers products listed below:

1. Ground slabs
2. Wall blocks
3. Floor slabs
4. Roof slabs
5. Perimetric slabs
6. Insulation slabs
7. Polystyrene auxiliary elements
8. House building service (using the IZODOM system)

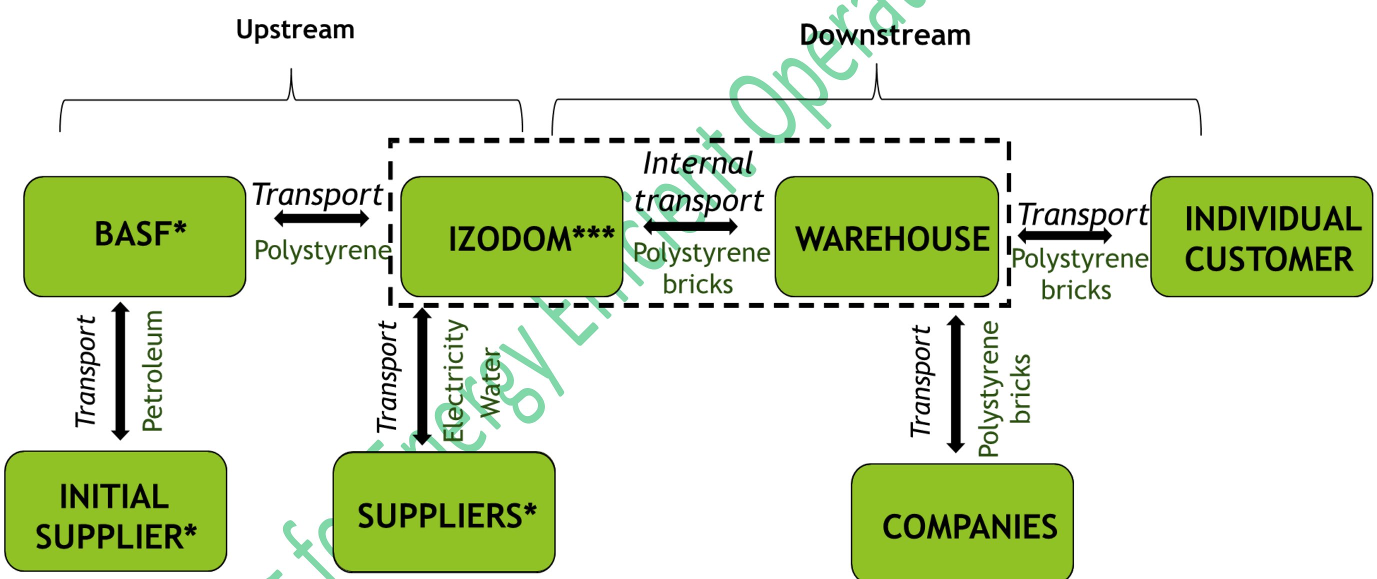
This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

The company operates on the international market supplying its products both to European countries and United Arab Emirates and Russia, while the biggest market are: Germany (from 1996), France and Scandinavia (from 2006).

The competition in the production of building elements according to ICF technology (Insulated Concrete Forms) is not very strong. Nowadays, IZODOM has a one competitor in the polish market (Thermodom) and several in the international level, but the complexity of its offer is unique at the world scale. The company has developed very quickly supporting innovative solutions with high quality for a relatively low price (in comparison to competitors).

The product on which this analysis concerns is a polystyrene brick MC2/35 (200x25x35 cm^3) which can be used for building low-energy and passive houses. This product can be interesting for individual customers who would like to reduce costs of living in house and who are eco-friendly. This technology seems to be also useful for innovative construction companies.

2.3 Supply chain of the product



*large company, **medium company, ***small company

Supply chain of the product includes 6 elements: Initial Supplier of petroleum to BASF (second-tier supplier), BASF and Suppliers of the electricity and water (first-tier suppliers), IZODOM (manufacturer) and final customers: individual and companies (first-tier customers). Three elements are involved in upstream of the product supply chain: Initial Supplier of petroleum, BASF and Suppliers of the electricity and water while IZODOM and different types of customers - in downstream.

Risk factors can be:

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- seasonal crises on the construction market (the company diversifies the risk by selling their products on foreign national markets and by offering additional services such as house designing)
- transport accidents
- utilities suppliers malfunction

On the level of initial supplier (Life Cycle [LC] stage 1), the identified environmental impact emerges during the production of polystyrene from petroleum. This process, without a shadow of doubt, emits harmful CO_2 quantities. There are different means of transportation between every stage of the product's life cycle. Car transport is used to relocate polystyrene grains from BASF factory to the analysed company (LC stage 2). When the final product is finished in IZODOM at Zdunska Wola it is transported using forklifts to the company-owned warehouse (LC stage 3) located next to the proper factory. Forklifts are also used inside the warehouse to fulfil its tasks and operations. Finally, when the order is placed, car transport is used to deliver the polystyrene bricks to the customer, who can be an individual customer as well as a different company (LC stage 4). Taking into consideration long-term effectiveness, the most environmentally friendly mean of transport is train thanks to European Union standardisation and ecological legal framework enforced in all of member states. Despite the that forklifts use diesel to function and carry high-weight products, they operate on a small distance which classifies them on the second position of means of transport used to link each stage of the polystyrene brick life circle. The least eco-friendly in our analysis is car transport (delivery trucks), which travels long distances and emits green-house gases harmful for the natural environment. All the environmental issues regarding the production conducted at IZODOM factory are described in detail below.

3 Main Analysis

3.1 Process approach

Polystyrene is transported from BASF (Germany) to IZODOM (Poland). During the pre-processing this material is steamed to increase its volume from the size of a salt grain to the size of a pepper grain. After the first inspection, it is seasoned in silos and then steamed again in the moulding machine. At a high temperature in the mould, the granules become glued together, giving the product the required shape and cohesiveness. On leaving the machine, the product undergoes the preliminary quality control and it is sent to the warehouse. Next quality checks are performed after a suitable time and if all parameters are satisfactory, the product is shipped to the customer.

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

3.1.1 Resources and materials

Process	Input/Element/Material	Quantity (per single unit like kg, km etc.)	Physical Unit	Approximate /Average Cost Unit	Total cost
1 foaming	Polystyrene	18.74	kg	-	-
	Steam	30	MJ	-	-
2 forming	Steam	237.6	MJ	-	-

Table 1. Resources and materials

3.1.2 Energy usage (per single unit of analysed product)

Process	Energy	Quantity (single unit like kg, km etc.)	Physical Unit	Approximate/Average Cost Unit	Total cost
1 foaming	Electricity	6	kWh	-	-
2 forming	Electricity	12.57	kWh	-	-
3 storage	Electricity	0.125	kWh	-	-

Table 2. Energy usage

3.1.3 Packages (per single unit of analysed product)

Packaging is not used in the production of polystyrene bricks.

3.1.4 Water Usage (per single unit of analysed product)

Water in this production is used in the form of water steam, which is quoted later in the analysis.

3.1.5 Means of transport (per single unit of analysed product)

Process	Transport	Distance	Tonokilometers (km x the volume transported per month (in tonnes)	Approximate/Average Cost Unit	Total cost

In-bound transport	Road transport	960 km	17.99 tkm	-	-
Internal transport	Forklift	0.6 km	0.0056 tkm	-	-

Table 5. Means of transport

3.1.6 Waste (per single unit of analysed product)

The production does not generate any waste. It consumes 100% of the raw material.

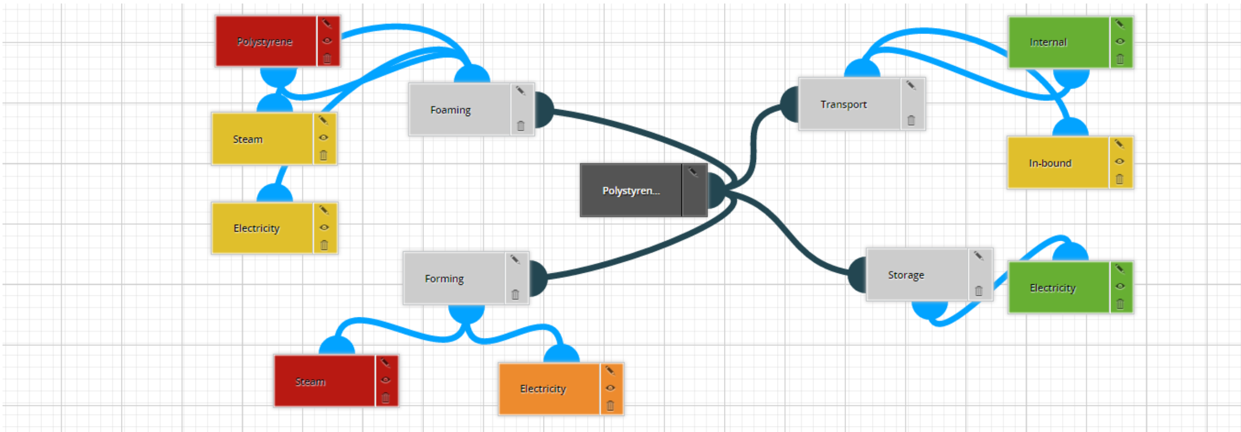
3.2 Scenat analysis

3.2.1 SC Carbon Map

A. Table of SC Carbon Map

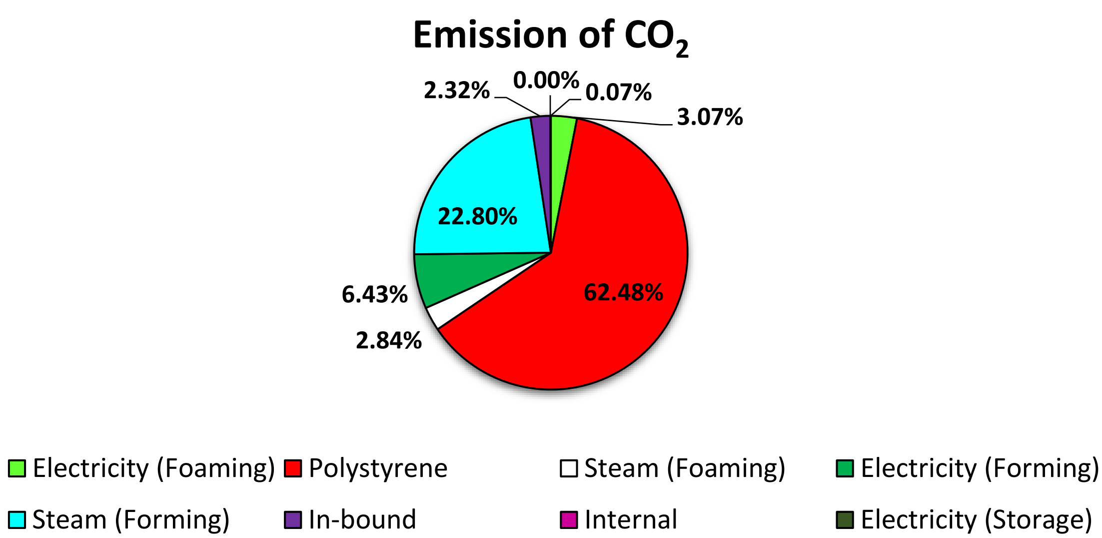
	Input	Quantity	Unit	GHG Intensity [kg CO_2eq/unit]	Unit Price [PLN/Unit]
Transport	In-bound	18	tkm	0.13364	-
Foaming	Polystyrene	18.74	kg	3.4653	-
	Steam	30	MJ	0.099747	-
	Electricity	6	kWh	0.53131	-
Forming	Steam	237.6	MJ	0.099747	-
	Electricity	12.57	kWh	0.53131	-
Transport	Internal	0.0056	tkm	0.13364	-
Storage	Electricity	0.125	kWh	0.53131	-

B. Picture from Scenat (please make a snapshot of a map from the Scenat tool.)



3.3 Results

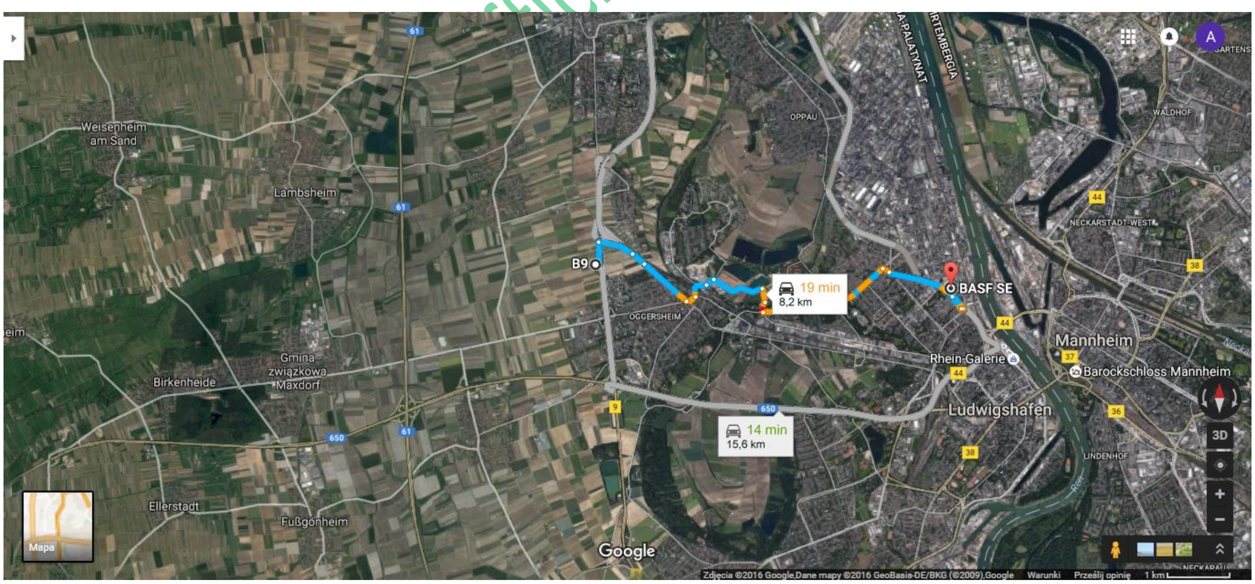
Total emission of assessed product is 103.97 kg. Two processes are considered as hotspots (red colour): steam in the forming process and polystyrene foaming. The greatest impact on environment is caused by polystyrene in the foaming process, which comprised 62.5% of total emission. 64.94 kg of CO_2 is emitted in this process. The second most influential input was water steam used in the forming. Its value averaged at 22.8% of the total emission (23.70 kg CO_2). Third most harmful input was electricity needed for forming. It made for 6.4% of total emission (6.68 kg CO_2). This input was marked as orange. Other inputs, less harmful for the environment (yellow colour) are: steam (2.9%, 2,99 kg CO_2) and electricity (3.1%, 3,19 kg CO_2) in foaming and in-bound transport from Ludvigshafen to Zdunska Wola (2.3%, 2.41 kg CO_2). Rest of the inputs are negligible (green colour).



4 Possible improvements

4.1 Scenario 1

The first scenario proposed by us concerns relocating the entire production with the warehousing to Ludvigshafen and installing solar panels on the roof of the warehouse. Both hot spots are crucial for receiving high quality product. Satisfying substitutes of steam and polystyrene do not exist. In the light of that, the only processes we can change are these that emit less pollution than the hot spots which are electricity (orange and yellow colours) and in-bound transport (yellow colour). Trucks used to relocate the raw material from Ludvigshafen to Zdunska Wola are not the most environmentally friendly mean of transport, moreover the long distance between those two cities determines the emerged ecological issue - air pollution. The distance between both factories is 960 km (18 tkm). In Ludvigshafen there is enough space within 8 km to place the factory and warehouse. Building solar panels on the roof of the warehouse will further reduce the negative impact of IZODOM on the environment. If we relocate the company, the car transport used on the distance of 8 km will carry 0,5 tkm. We take to consideration the surface of the roof of warehouse (5,500 m^2). Then we found a solar panel which can support the most effective cover of the roof (2.052x1.173 m^2). We calculate that 2,282 solar panels can cover the roof completely. This type of solar panels produces 320 kWh per one hour. They will produce 730,240 kWh per year. Then we assume that the process of the production of 1 m^3 of polystyrene block lasts 10 minutes. So, during one hour the firm produces 6 m^3, so for 24 hours – 144 m^3. For one-year production the firm needs 984,960 kWh. The amount of solar panels electricity for one-year production is about 70%of total electricity needed. This is the most environmentally friendly scenario for the company regardless the costs.

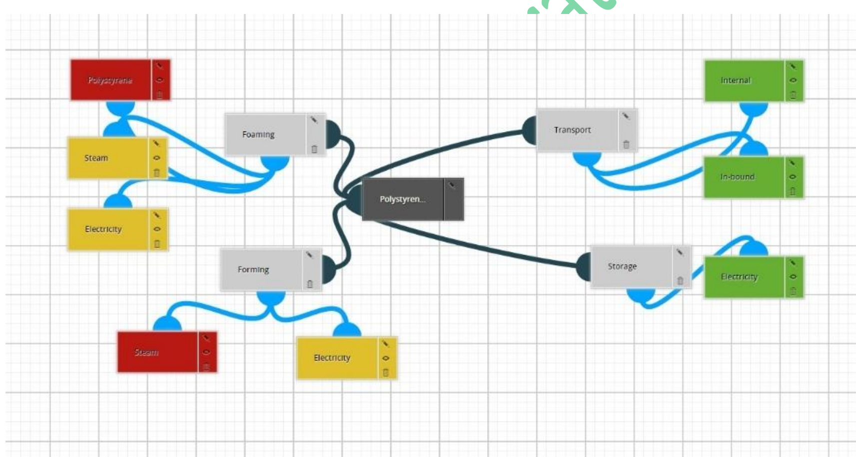


4.1.1 SC Carbon Map

A. Table of SC Carbon Map

	Input	Quantity	Unit	GHG Intensity [kg CO_2eq/unit]	Unit Price [PLN/Unit]
Transport	In-bound	0.5	tkm	0.13364	-
Foaming	Polystyrene	18.74	kg	3.4653	-
	Steam	30	MJ	0.099747	-
	Electricity	3	kWh	0.53131	-
Forming	Steam	237.6	MJ	0.099747	-
	Electricity	3	kWh	0.53131	-
Transport	Internal	0.0056	tkm	0.13364	-
Storage	Electricity	0.125	kWh	0.53131	-

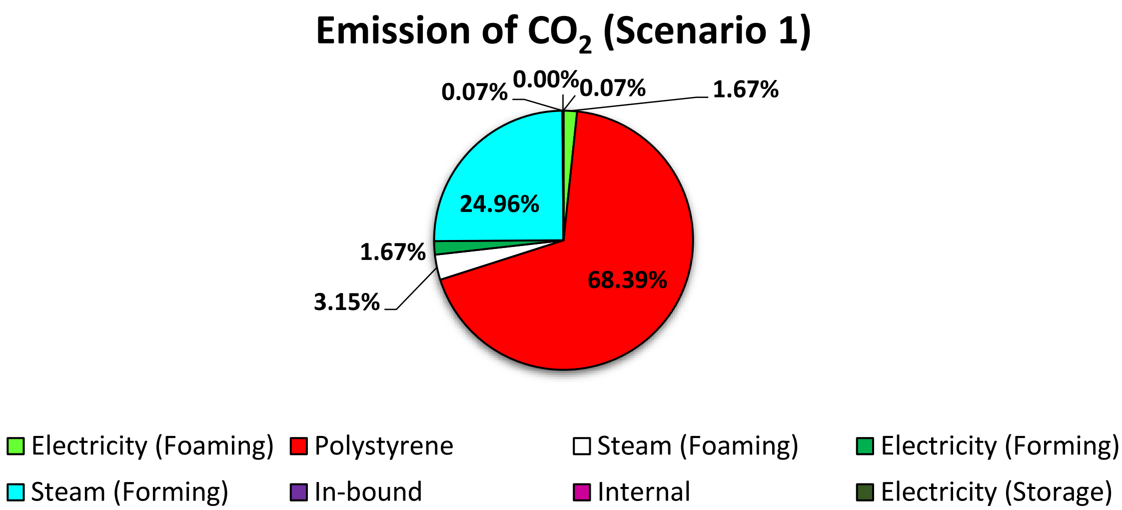
B. Picture from Scenat



Results

Total emission of assessed product decreased to 94.95 kg. Hotspots are the same (red colour): polystyrene in the foaming and steam in the forming. Polystyrene achieved the value of 68.4% of total emission of CO_2 (64.94 kg CO_2). Water steam in the forming process comprised 25% (23.7 kg CO_2). The influence of electricity both in foaming and forming processes decreased to 1.7% (1.59 kg CO_2). Values of in-bound transport were also lower (0.1%, 0.07 kg CO_2) and modified from yellow to green. The electricity in foaming changed the colour from orange to yellow while in the forming remained yellow but the emission of CO_2 was lower in comparison to the basic version.

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



4.2 Scenario 2

In the second scenario, we decided to introduce input changes from the first scenario as well as reusing water steam in the forming process. The steam is marked to be a hotspot, thus it is crucial to lower its impact on the environment. Reducing CO_2 emission of water steam in forming of polystyrene can be done using proper electrical installation which enables the steam to be reused. Introducing this method, we can create closed cycle of water stream which can be reused repeatedly in forming. However, steam inside the pipes has to be released once a month. This leads to a 90% reduction of this resource usage. Final amount of water steam needed for the process is 23.8 MJ. The input is not considered as a hotspot after the change. Electrical installation increases whole energy input cost by 10%. Requirement for electricity in the forming process rises to 14.2 kWh.

4.2.1 SC Carbon Map

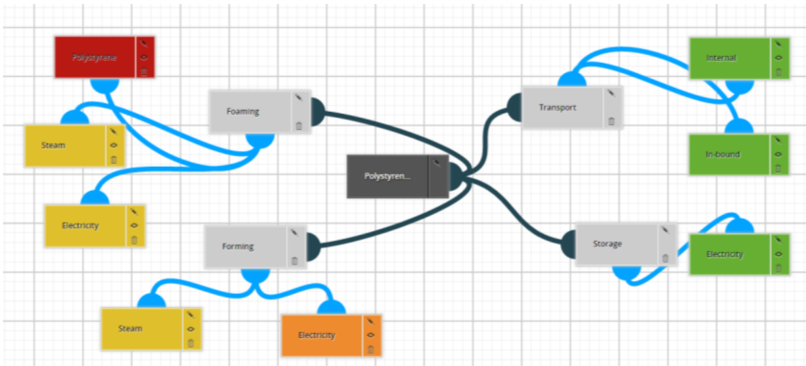
A. Table of SC Carbon Map

	Input	Quantity	Unit	GHG Intensity [kg CO_2eq/unit]	Unit Price [PLN/Unit]
Transport	In-bound	0.5	tkm	0.13364	-
Foaming	Polystyrene	18.74	kg	3.4653	-
	Steam	30	MJ	0.099747	-
	Electricity	3	kWh	0.53131	-
Forming	Steam	23.8	MJ	0.099747	-

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	Electricity	14.2	kWh	0.53131	-
Transport	Internal	0.0056	tkm	0.13364	-
Storage	Electricity	0.125	kWh	0.53131	-

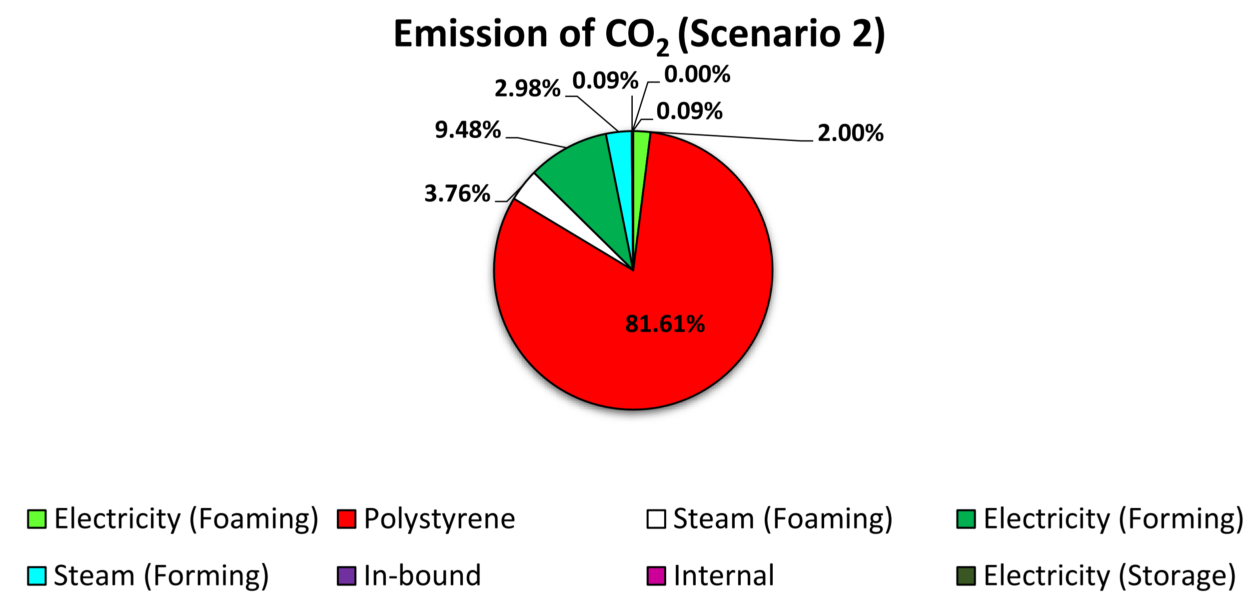
B. Picture from Scenat



Results

Total emission of assessed product decreased to 79.58 kg. After the changes, only one hot spot remained. It was polystyrene in the foaming. It achieved the value of 81.6% of total emission of CO_2 (64.94 kg CO_2). Water steam comprised only 3% (2.37 kg CO_2) in the forming process and 3.8% (2.99 kg CO_2) in the foaming (yellow colour). The influence of electricity in foaming was assessed on 2% (1.59 kg CO_2), in forming - 9.5% (7.54 kg CO_2). Values of in-bound transport were also lower (0.09%, 0.07 kg CO_2) and modified from yellow to green.

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



5 Final conclusions

The case study itself was rather demanding, because the IZODOM is already highly environmentally friendly and had pursued ecological goals since the very beginning. Identifying and introducing further eco-development was both time consuming and difficult. The proposed solutions must have been highly innovative or simple. Finding interesting examples of good practices was easier. There are many companies, even on a global scale, that are focus on making their activity not only safe for the environment, but also supportable for Mother Earth's existence. However, we decided choose an enterprise that operates locally. We hope that more companies with the sense of environmental responsibility will emerge.