TrainERGY project

Case Study - Template

Submission Date:	19/05/2017
Place:	Università degli studi di Napoli Federico II

Sector Analysed:	Wood-Fired
Product Analysed:	Boiler

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 the following analysis is to calculate and evaluate GHGs emission related to the Boiler supply chain using Scenat (Supply Chain Environmental Analysis Tool). According to the results provided by Scenat tool, EgoLittle srl can implement green strategies in order to improve its environmental performances through the development of two different intervention scenarios.

2 Overview

2.1 Firm description

EgoLittle Srl is an Italian SME located in Santa Maria Capua Vetere(CE), operating mainly in the sector of wood-fired, pellet or mixed-fuel fireplace boilers.
The core business is the boilers construction. Thanks to the R&D sector of the company, *EgoLittle Srl* produces boilers equipped with automatic switching system with same characteristics such as 87% heat efficiency, environmental friendly, self cleaning, consume up to 70% less. The company has twenty workers (three managers, six employees and eleven workers) with a production of around 1000 boilers per year

2.2 Product description

The unit analysis is represented by a *Single Boiler* (size: 95x120x70 cm; weight: 30 kg) made of a core engine to burn pellets, and elegant, sophisticated claddings to tie an esthetic appearance so to be inserted into a styled home environment.
The finished product is transported to customers that are located in Calabria (8 % of the total production), Sicilia (9%), Campania (16%), Piemonte (18%) and Sardegna (26%).

2.3 Supply chain of the product

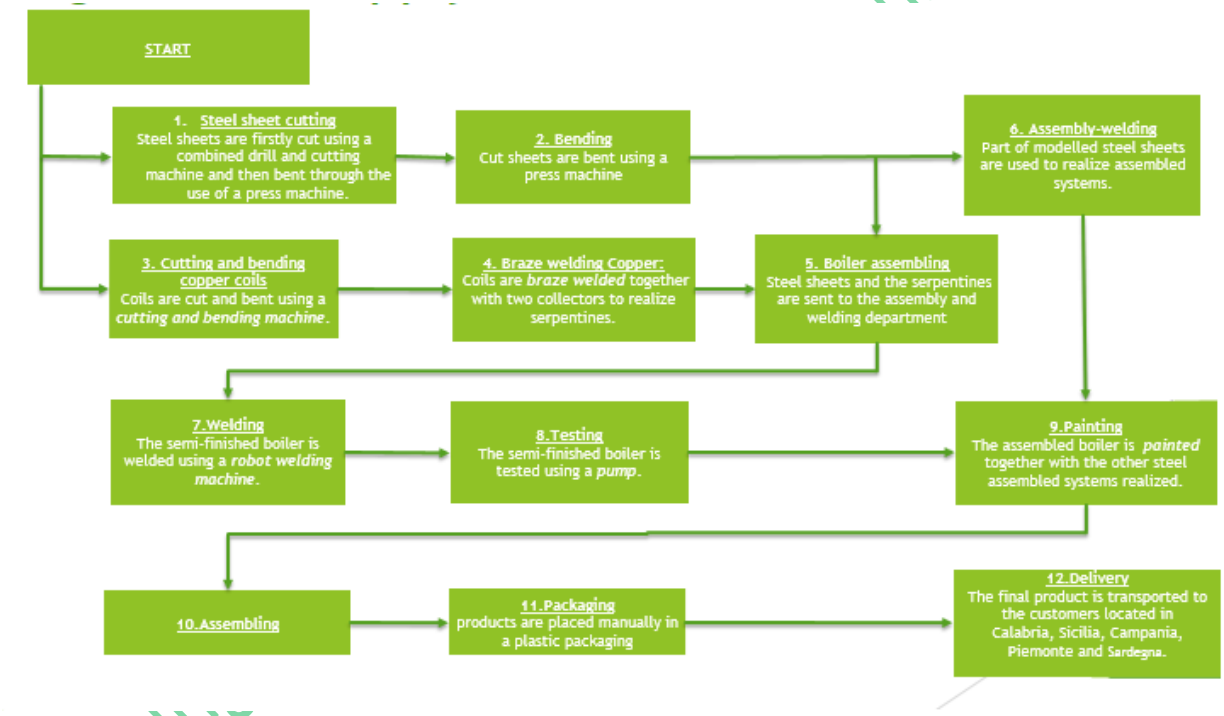
The product's complete lifecycle is the following: the company purchases steel sheets and copper coils from two different suppliers (located respectively in Parma and in Brescia). The materials are purchased in quantities equal to 254 kg and 4.1 kg and, after, are transported in Santa Maria Capua Vetere with lorries.
Copper coils are cut and bent using a *cutting and bending machine* and then *braze welded* together with two collectors (purchased from a supplier in Udine) to realize serpentines.
In parallel, steel sheets are firstly cut using a *combined drill and cutting machine* and then bent through the use of a *press machine*.
At this stage, the process splits in two new parallel lines:
Part of the modelled steel sheets (around 20% of the work in progress product) are used to realize assembled systems, using various steel components, steel springs and glass in a combined

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.

assembly-welding phase. In details, the company orders 4 steel components, 12 springs and 1 m^2 glass plate. Suppliers are respectively located in Bologna, Padua and Caserta. All this phase is performed manually by the workers using a *gas metal arc welding machine*. The assembled systems are then ready to be painted.

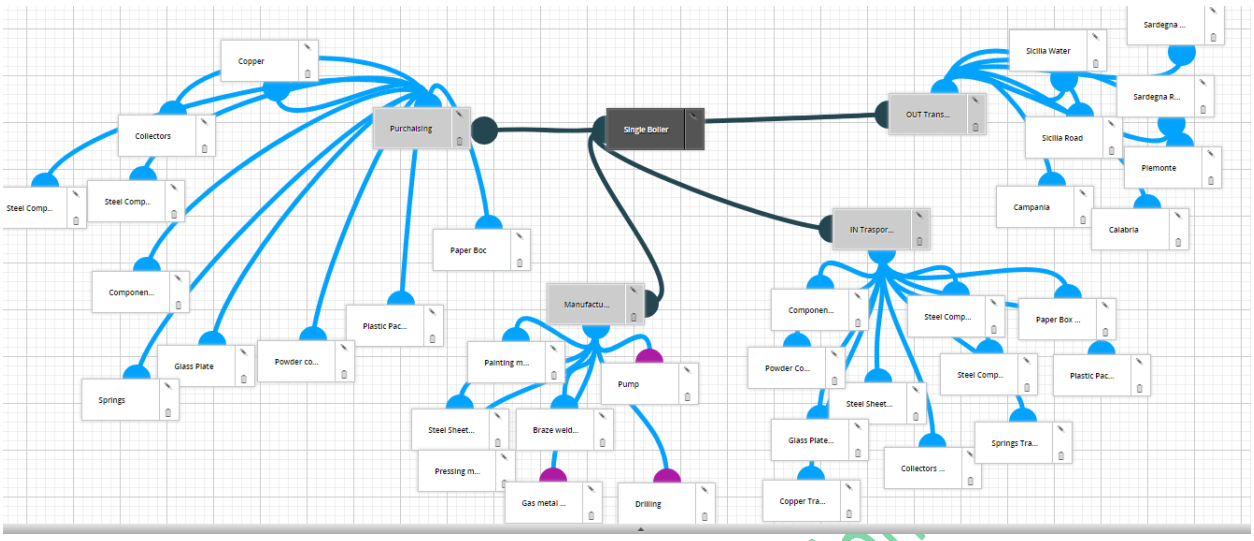
At the same time, the remaining steel sheets (80%) and the serpentines are sent to the assembly and welding department. In this phase, also external steel components are used (2 ordered from a supplier in Ancona and 1 from a supplier in Treviso). This phase is performed manually through the use of a *gas metal arc welding machine*. The output of this phase is a semi-finished boiler that is successively welded (using a *robot welding machine*), tested (using a *pump*), and *painted* together with the other steel assembled systems realized.

The painted phase is performed buying *powder coating* (1,5 kg) from another external supplier located in Milan.



1 Boiler Supply Chain

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.



2 Supply Chain map

3 Main Analysis

3.1 Process approach

In order to produce “Boiler” steel sheets are firstly cut using a combined drill and cutting machine and then bent through the use of a press machine. At the same time coils are cut and bent using a *cutting and bending machine.* Coils are *braze welded* together with two collectors to realize serpentines. A part of steel sheet and the serpentines are sent to the assembly and welding department, the other quantity of steel sheet are used to realize assembled systems. Now the semi-finished boiler is welded using a robot welding machine and after is tested using a pump. The assembled boiler is painted together with the other steel assembled systems realized. The final step is the assembling and packaging.

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
Steel sheet cutting and bending	Steel sheet	254	kg	0.70 €/kg	178€
Cutting and bending copper coils	Copper coil	4.1	kg	5,85 €/kg	24 €
Braze welding	Collectors	2	pcs	2.70 €/pcs	5.4 €
Boiler assembling	Steel component (A)	2	pcs	9 €/pcs	18 €
	Steel component (B)	1	pcs	5.5 €/pcs	5.5 €
Assembling	Components	4	pcs	1.13 €/pcs	4.5 €
	springs	12	pcs	0.92 €/pcs	11 €
	Glass plate	1	pcs	30 €/pcs	30 €
Painting	Powder coating	1.5	kg	25 €/kg	37.5€

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
Utilities	Electricity	0.13	KWh	0.18 €/KWh	0.02 €

Table 2. Energy usage

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.

3.1.3 Packages (per single unit of analysed product)

Process	Sort of package	Quantity (single unit like kg, km etc.)	Physical Unit	Approximate/Average Cost Unit	Total cost
Packaging	plastic	4	kg	3 €/kg	12€

Table 3. Packages

3.1.4 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
Steel sheet Transportation	Lorry	623 km	2.87 tkm	0.1 €/unit	0.287€
Copper Transportation	Lorry	719 km	3.2103 tkm	10.24 €/unit	32.87€
Collectors Transportation	Lorry	804 km	0.766 tkm	1.00 €/unit	0.766 €
Steel Component (A) Transportation	Lorry	385 km	0.365 tkm	4.79 €/unit	1.75€
Steel Component (T) Transportation	Lorry	708 km	0.667 tkm	8.73 €/unit	5.83€
Component (B) Transportation	Lorry	541 km	1.094 tkm	7.16 €/unit	7.83€
Cardboard boxes	Lorry	38.6 km	0.1599 tkm	0.389 €/unit	0.06 €
Spring Transportation	Lorry	655 km	0.79 tkm	8.76 €/unit	6.92 €

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.

Glass Plate Transportation	Lorry	45.4 km	0.871 tkm	0.87 €/unit	0.76 €
Powder Coating Transportation	Lorry	739 km	1.119 tkm	9.86 €/unit	11.03 €
Out transportation					
Campania	Lorry	38.6 km	1.776 tkm	0.399 €/unit	0.70 €
Calabria	Lorry	438 km	10.22 tkm	0.399 €/unit	4.1 €
Sicilia road	Lorry	503 km	0.999 tkm	0.399 €/unit	0.4 €
Sicilia water	Lorry	10.5 km	12.414 tkm	0.192 €/unit	2.4 €
Sardegna road	Lorry	261 km	2.26 tkm	3.47 €/unit	7.9 €
Sardegna water	Lorry	238 km	19.404 tkm	0.0756 €/unit	1.5 €
Piemonte	Lorry	846 km	45.36 tkm	10.96 €/unit	497.2€

Table 5. Means of transport

3.2 Scenat analysis

3.2.1 SC Carbon Map

A. Table of SC Carbon Map

Process	Input/Element/Material	Quantity	Unit	GHG Intensity [kg CO2eq/unit]	Total cost
Purchasing	Steel sheet	254	kg	1.8039	0.70 €/kg
	Copper coil	4.1	kg	3.1698	5,85 €/kg
	Collectors	2	pcs	1.00	2.70 €/pcs

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.

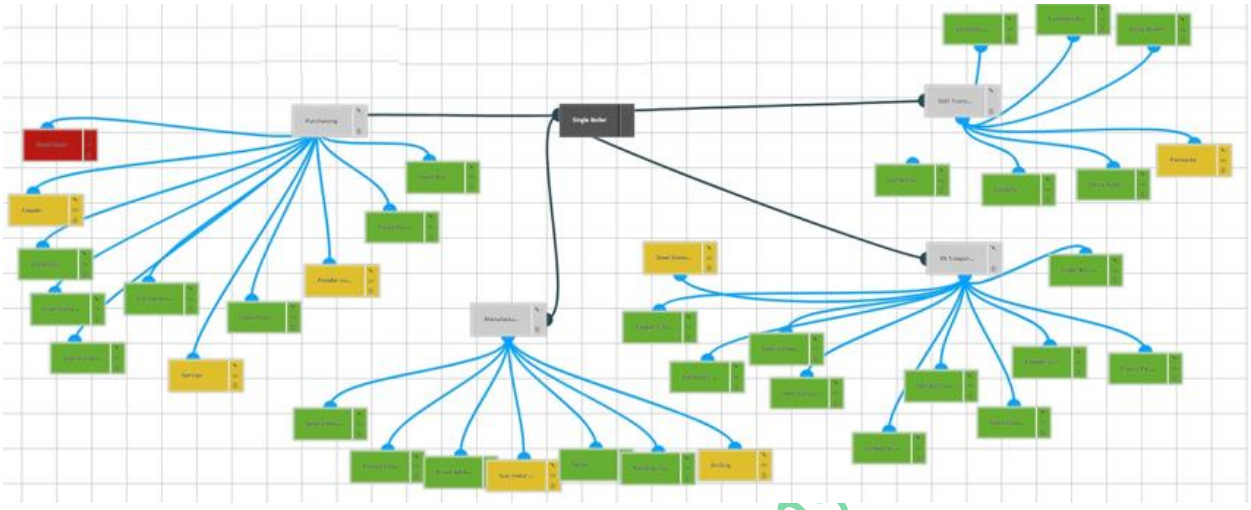
	Steel component (A)	2	pcs	0.64365	9 €/pcs
	Steel component (B)	1	pcs	1.00	5.5 €/pcs
	Components	4	pcs	0.64	1.13 €/pcs
	Springs	12	pcs	1.00	0.92 €/pcs
	Glass plate	1	pcs	1.00	30 €/pcs
	Powder coating	1.5	kg	4.5613	25 €/kg
Manufacturing					
	Steel sheet cutting	4.8	kWh	0.6416	0.71 €/ kWh
	Pressing machine	17	kWh	0.64168	0.072€/ kWh
	Braze welding machine	6.89	kWh	0.64168	0.072€/ kWh
	Gas metal arc welding machine	9.275	kWh	0.64168	0.072€/ kWh
	Pump	0.065	kWh	0.64168	0.072€/ kWh
	Painting machine	0.05	kWh	0.64168	0.072€/ kWh
	Drilling	27	kWh	0.64168	0.072€/ kWh
In transportation					
	Steel sheet Transportation	137.98 tkm	tkm	0.16791	0.1 €/unit
	Copper Transportation	3.2103 tkm	tkm	0.16791	10.24 €/unit
	Collectors Transportation	0.766 tkm	tkm	0.16791	1.00 €/unit
	Steel Component (A) Transportation	0.365 tkm	tkm	0.16791	4.79 €/unit
	Steel Component (T) Transportation	0.667 tkm	tkm	0.16791	8.73 €/unit
	Component (B) Transportation	1.094 tkm	tkm	0.16791	7.16 €/unit

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.

	Cardboard boxes	0.1599 tkm	tkm	0.16791	0.389 €/unit
	Spring Transportation	0.79 tkm	tkm	0.16791	8.76 €/unit
	Glass Plate Transportation	0.871 tkm	tkm	0.16791	0.87 €/unit
	Powder Coating Transportation	1.119 tkm	tkm	0.16791	9.86 €/unit
	Plastic Packaging Transportation	0.472 tkm	tkm	0.16791	1.56 €/unit
Out transportation					
	Campania	1.776	tkm	0.16791	0.399 €/unit
	Calabria	10.22	tkm	0.16791	0.399 €/unit
	Sicilia road	0.99	tkm	0.16791	0.399 €/unit
	Sicilia water	12.414	tkm	0.0107	0.192 €/unit
	Sardegna road	2.26	tkm	0.16791	3.47 €/unit
	Sardegna water	19.404	tkm	0.0107	0.0756 €/unit
	Piemonte	45.36	tkm	0.16791	10.96 €/unit

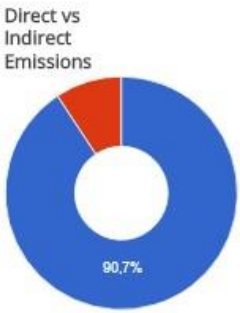
B. Picture from Scenat (please make a snapshot of a map from the Scenat tool.)

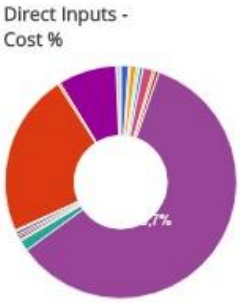
This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

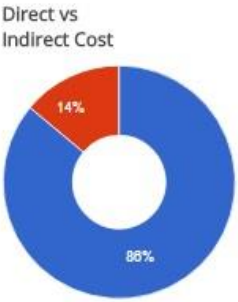


C. ***Missing Inputs selection, based on analysed product process description***
   - Electricity production, collection and distribution due to almonds toasting process made in outsourcing;
   - Paper and related products: includes advertisements and printing.

D. **Direct and indirect emissions charts (please make a chart presenting % share of direct and** indirect emissions for the analyzed supply chain)







3.3 Results

From the analysis of the carbon map, the various elements in the boxes get different colours according to the percentage of emissions on the total amount. In particular, elements are represented in green, yellow and orange if their emissions are respectively negligible, moderate or tolerable. Red boxes are elements with a percentage over 10% and represent a carbon hotspot that needs to be monitored and, if possible, an intervention and improvement plan has to be developed.

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.

According to Scenat tool calculations, the total emissions of EgoLittle srl supply chain per single unit of product are 656,85 kg CO_2eq/kg. In particular, steel sheet results being the element that has the biggest impact on final emission.

4 Possible improvements

As we can see from the carbon map the hotspot of our supply chain is steel sheet purchasing. Anyway nowadays is not possible to find a material that is greener than steel and at the same time has the same mechanical properties and heat resistance of the steel. Hence, we thought about two possible interventions:

- Process innovation
- Suppliers selection

4.1 Scenario Process innovation

After the analysis of welding process we redesigned the operations' sequencing in order to get a reduction of the time process of the 75%.

*A. Table of SC Carbon Map - **unit of analysis: Boiler***

Process	Input/Element/Material	Quantity	Unit	GHG Intensity [kg CO2eq/unit]	Total cost
Purchasing	Steel sheet	254	kg	1.8039	0.70 €/kg
	Copper coil	4.1	kg	3.1698	5,85 €/kg
	Collectors	2	pcs	1.00	2.70 €/pcs
	Steel component (A)	2	pcs	0.64365	9 €/pcs

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.

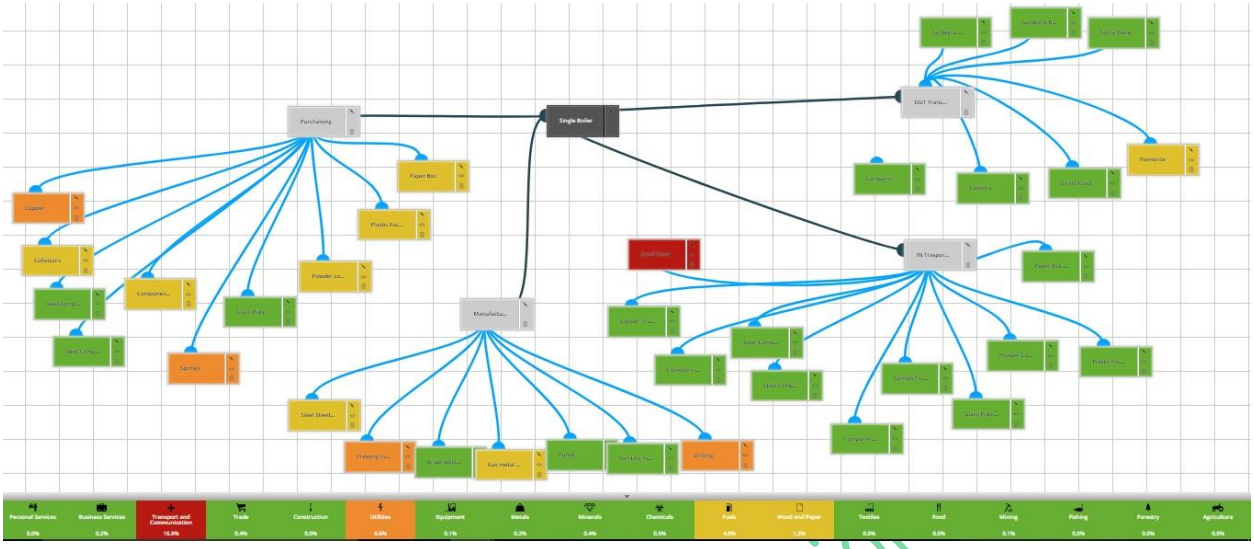
	Steel component (B)	1	pcs	1.00	5.5 €/pcs
	Components	4	pcs	0.64	1.13 €/pcs
	Springs	12	pcs	1.00	0.92 €/pcs
	Glass plate	1	pcs	1.00	30 €/pcs
	Powder coating	1.5	kg	4.5613	25 €/kg
Manufacturing					
	Steel sheet cutting	4.8	kWh	0.6416	0.71 €/ kWh
	Pressing machine	17	kWh	0.64168	0.072€/ kWh
	Braze welding machine	1.7225	kWh	0.64168	0.072€/ kWh
	Gas metal arc welding machine	9.275	kWh	0.64168	0.072€/ kWh
	Pump	0.065	kWh	0.64168	0.072€/ kWh
	Painting machine	0.05	kWh	0.64168	0.072€/ kWh
	Drilling	27	kWh	0.64168	0.072€/ kWh
In transportation					
	Steel sheet Transportation	137.98 tkm	tkm	0.16791	0.1 €/unit
	Copper Transportation	3.2103 tkm	tkm	0.16791	10.24 €/unit
	Collectors Transportation	0.766 tkm	tkm	0.16791	1.00 €/unit
	Steel Component (A) Transportation	0.365 tkm	tkm	0.16791	4.79 €/unit
	Steel Component (T) Transportation	0.667 tkm	tkm	0.16791	8.73 €/unit
	Component (B) Transportation	1.094 tkm	tkm	0.16791	7.16 €/unit

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.

	Cardboard boxes	0.1599 tkm	tkm	0.16791	0.389 €/unit
	Spring Transportation	0.79 tkm	tkm	0.16791	8.76 €/unit
	Glass Plate Transportation	0.871 tkm	tkm	0.16791	0.87 €/unit
	Powder Coating Transportation	1.119 tkm	tkm	0.16791	9.86 €/unit
	Plastic Packaging Transportation	0.472 tkm	tkm	0.16791	1.56 €/unit
Out transportation					
	Campania	1.776	tkm	0.16791	0.399 €/unit
	Calabria	10.22	tkm	0.16791	0.399 €/unit
	Sicilia road	0.99	tkm	0.16791	0.399 €/unit
	Sicilia water	12.414	tkm	0.0107	0.192 €/unit
	Sardegna road	2.26	tkm	0.16791	3.47 €/unit
	Sardegna water	19.404	tkm	0.0107	0.0756 €/unit
	Piemonte	45.36	tkm	0.16791	10.96 €/unit

B. Picture from Scenat

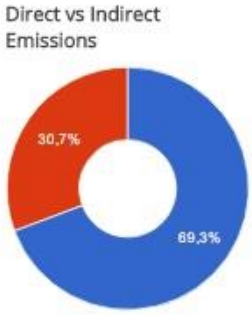
This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

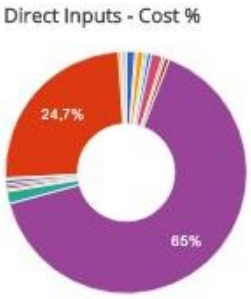


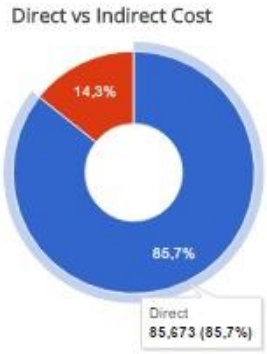
C. Missing Inputs selection, based on analysed product process description

- Electricity production, collection and distribution due to almonds toasting process made in outsourcing;
- Paper and related products: includes advertisements and printing.

D. Direct and indirect emissions charts







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

Suppliers selection

Identification of a set of new suppliers in order to reduce distances covered for raw materials provisions. We selected a new steel sheet suppliers from Caserta distant only 13 km that is closer than the first one located in Parma distant 625 km

A. *Table of SC Carbon Map - **unit of analysis: Boiler***

Process	Input/Element/Material	Quantity	Unit	GHG Intensity [kg CO2eq/unit]	Total cost
Purchasing	Steel sheet	254	kg	1.8039	0.70 €/kg
	Copper coil	4.1	kg	3.1698	5,85 €/kg
	Collectors	2	pcs	1.00	2.70 €/pcs
	Steel component (A)	2	pcs	0.64365	9 €/pcs
	Steel component (B)	1	pcs	1.00	5.5 €/pcs
	Components	4	pcs	0.64	1.13 €/pcs
	Springs	12	pcs	1.00	0.92 €/pcs
	Glass plate	1	pcs	1.00	30 €/pcs
	Powder coating	1.5	kg	4.5613	25 €/kg
Manufacturing					
	Steel sheet cutting	4.8	kWh	0.6416	0.71 €/ kWh
	Pressing machine	17	kWh	0.64168	0.072€/ kWh
	Braze welding machine	1.7225	kWh	0.64168	0.072€/ kWh
	Gas metal arc welding machine	9.275	kWh	0.64168	0.072€/ kWh
	Pump	0.065	kWh	0.64168	0.072€/ kWh

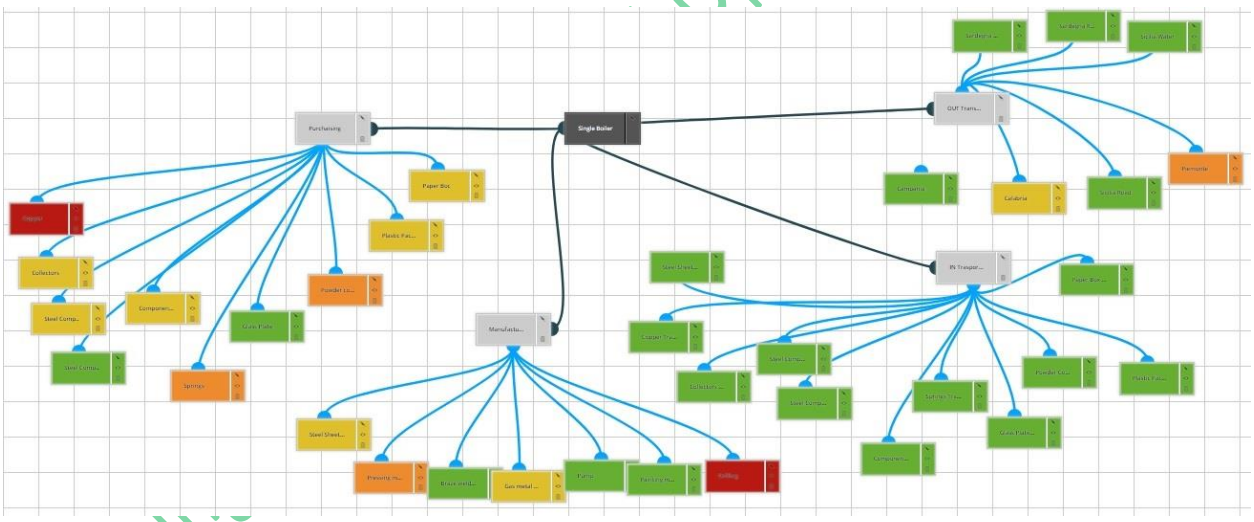
This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	Painting machine	0.05	kWh	0.64168	0.072€/ kWh
	Drilling	27	kWh	0.64168	0.072€/ kWh
In transportation					
	Steel sheet Transportation	2.87 tkm	tkm	0.16791	0.1 €/unit
	Copper Transportation	3.2103 tkm	tkm	0.16791	10.24 €/unit
	Collectors Transportation	0.766 tkm	tkm	0.16791	1.00 €/unit
	Steel Component (A) Transportation	0.365 tkm	tkm	0.16791	4.79 €/unit
	Steel Component (T) Transportation	0.667 tkm	tkm	0.16791	8.73 €/unit
	Component (B) Transportation	1.094 tkm	tkm	0.16791	7.16 €/unit
	Cardboard boxes	0.1599 tkm	tkm	0.16791	0.389 €/unit
	Spring Transportation	0.79 tkm	tkm	0.16791	8.76 €/unit
	Glass Plate Transportation	0.871 tkm	tkm	0.16791	0.87 €/unit
	Powder Coating Transportation	1.119 tkm	tkm	0.16791	9.86 €/unit
	Plastic Packaging Transportation	0.472 tkm	tkm	0.16791	1.56 €/unit
Out transportation					
	Campania	1.776	tkm	0.16791	0.399 €/unit
	Calabria	10.22	tkm	0.16791	0.399 €/unit

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.

	Sicilia road	0.99	tkm	0.16791	0.399 €/unit
	Sicilia water	12.414	tkm	0.0107	0.192 €/unit
	Sardegna road	2.26	tkm	0.16791	3.47 €/unit
	Sardegna water	19.404	tkm	0.0107	0.0756 €/unit
	Piemonte	45.36	tkm	0.16791	10.96 €/unit

B. Picture from Scenat

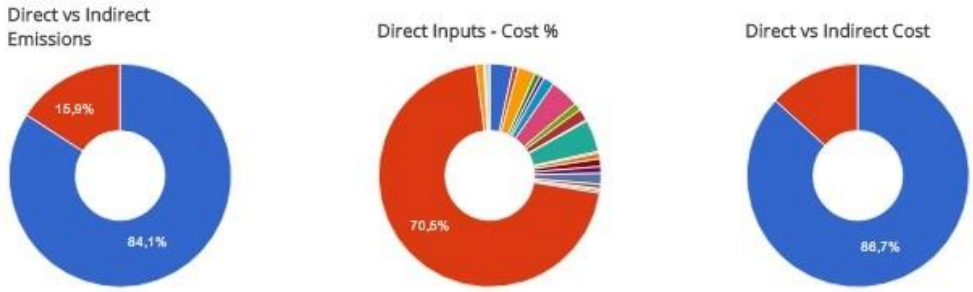


C. Missing Inputs selection, based on analysed product process description

- Electricity production, collection and distribution due to almonds toasting process made in outsourcing;
- Paper and related products: includes advertisements and printing.

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.

D. Direct and indirect emissions charts



4.3 Results

According to Scenat tool calculations for this scenario, the total emissions of EgoLittle's supply chain per single unit of product (single Boiler) are 582.39 kg CO2eq/kg (-12% than current situation).

5 Final conclusions

Starting from the current situation of EgoLittle srl, an analysis in terms of GHGs emissions has been made with Scenat tool. The resulting carbon map highlighted some hotspots in the different processes and areas of the whole supply chain. From this analysis, it emerges that the biggest contribute to the total amount of emission is due to the steel sheet purchasing. Being impossible to substitute the steel, we have focused our attention on some process innovation and suppliers' selection. For this reason, two different scenarios have been proposed in order to reduce the impact of these hotspots. In particular, in the first proposed scenario, we redesigned the operations' sequencing in order to get a reduction of the time process of the 75%. In the second one, we identification of a set of new suppliers in order to reduce distances covered for raw materials provisions; in particular, we selected a new steel sheet suppliers from Caserta distant

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.

only 13 km that is closer than the first one located in Parma distant 625 km. The results of these scenarios, in terms of global emissions, are reported in the following table:

Scenario	GHG Intensity [kg CO_2eq/kg]	Total cost
Current situation	656.85	2548.24 €/unit
Process innovation + Suppliers selection	582.39	1011.11 €/unit

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.