TrainERGY project

Case Study

Submission Date:	9 March 2018
Place:	The University of Sheffield International Faculty, CITY College, 3 Leontos Sofou Street, Thessaloniki, Greece

Sector Analysed:	Textiles
Product Analysed:	Stitched shoulder pads

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1 Introduction

The main objective of the analysis is to assess the total lifecycle of carbon emissions, recognize carbon hot-spots and suggest two possible scenarios to reduce CO_2 emission in the supply chain of the stitched shoulder pads.

2 Overview

2.1 Firm description

AN-MAR Anna Czarnecka is a family-run company which operates since 01/02/1994 in a textile sector. It employs 9 people. The production plant and warehouse are located in Pabianice (central Poland) and occupy an area of 355 m^2, where on modern processing lines 550 packages of stiched shoulder pads are produced ever year. The company offers a wide portfolio of garment accessories. Primary products are: insets, shoulder pads, bra and wedding dress pads, shoulder shapers for hangers. The company produces elements from nonwoven fabrics and foams with various shapes and applications using stitching, basting, quilting, sawing and gluing. It collaborates with numerous companies and wholesalers from Poland, Czech Republic, Slovakia, Ukraine and Lithuania supporting needs mainly of clothing, cosmetic, SPA and gardening industry. In the product supply chain AN-MAR is the manufacturer. The production is made to order. The company is open to new challenges. It offers the possibility of cooperation with both customers and academic staff in creation of new and innovative products. One of the example of cooperation between business and science was the production of foam fillings for football goalkeepers etc. AN-MAR used green technologies including recycling of raw materials, producing green energy and reducing quantity of wastes.

2.2 Product description

Primary products of AN-MAR are: insets, shoulder pads, bra and wedding dress pads, shoulder shapers for hangers, plant pot discs against weeds, disposable towels.

The subject of an analysis is 1 package of 100 pairs of stitched shoulder pads (Fig. 1). Each shoulder pad consists of two layers: polyester nonwoven fabrics (made from virgin fibres and processed fibres such as PET bottles) and polyester foam connected during the production processes.

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Fig. 1. The example of the stitched shoulder pad
http://www.fiberi.pl

2.3 Supply chain of the product

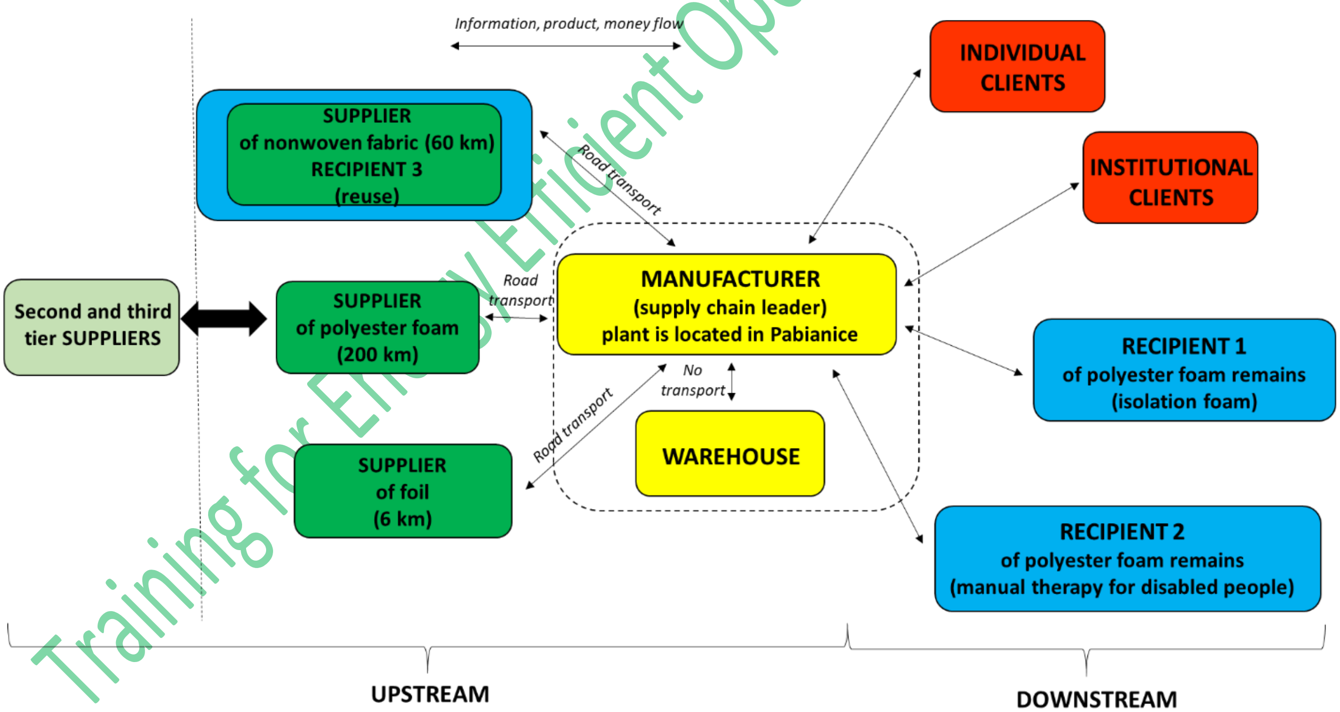

Fig. 2. The supply chain of analysed product

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The supply chain of stitched shoulder pads consists of different links located in upstream and downstream. It is an international supply chain with the first, second and third tier suppliers. Supply chain leader is a described manufacturer of stitched shoulder pads – AN-MAR. The plant is located in Pabianice. The company cooperates with three main suppliers. It purchases:

1) the nonwoven fabric from the supplier, located 60 km from Pabianice,
2) the polyester foam from a manufacturer, located 200 km from the plant, and
3) the foil from the company located 6 km from Pabianice.

All raw materials are delivered to the plant by road transport. The supply chain consists of second and third suppliers too (Fig. 2). From mentioned above raw materials, stitched shoulder pads, are produced in the plant. The production is made to order so the product does not spend a lot of time in the warehouse. Then the products are sold both to individual customers and institutional clients. The part of unused polyester foam is delivered to the recipient No 1 when it is converted into isolation foam. The rest is given to some centers of manual therapy for disabled people. The remains of unused nonwoven fabric is recycled in the plant of the recipient No 3 (who is also a supplier).

3 Main Analysis

3.1 Process approach

The production of stitched shoulder pads is rather simple and consists of:

1) preparation and cutting of foam and nonwoven fabric;
2) connecting the layer of the nonwoven fabric with foam by using stitching (migration of fibres between layers);
3) packaging with the foil.

Two first phases of manufacturing process requires electricity, while packaging is manual only.

3.1.1 Resources and materials

Process	Input/Element/Material	Quantity (per single unit like kg, km etc.)	Physical Unit
Preparation and cutting	polyester foam	0,95	kg
Preparation and stitching (migration of fibres between layers)	nonwoven fabric	0,7122	kg
Packaging	foil packages	0,04	kg

Table 1. Resources and materials

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3.1.2 Energy usage (per single unit of analysed product)

Process	Energy	Quantity (per single unit like kg, km etc.)	Physical Unit
Preparation and cutting	electricity	1,625	kWh
Preparation and stitching (migration of fibres between layers)	electricity	0,125	kWh
Packaging	NA		

Table 2. Energy usage

3.1.3 Packages (per single unit of analysed product)

Process	Sort of package	Quantity (single unit like kg, km etc.)	Physical Unit
Preparation and cutting	NA		
Preparation and stitching (migration of fibres between layers)	NA		
Packaging	foil packages	0,04	kg

Table 3. Packages

3.1.4 Water Usage (per single unit of analysed product)

Process	Water	Quantity (per single unit of analysed product)	Physical Unit
Preparation and cutting	NA		
Preparation and stitching (migration of fibres between layers)	NA		
Packaging	NA		

Table 4. Water Usage

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)
Preparation and cutting	Polyester foam	200 km /road	200 km x 0,32 tony = 64 tkm
Preparation and stitching (migration of fibres between layers)	Nonwoven fabric	60 km /road	60km x 0,5ton = 30 tkm
Packaging	Foil package	6 km /road	6 km x 0,05 tony = 0,3 tkm

Table 5. Means of transport

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3.1.6 Waste (per single unit of analysed product)

Process	Waste	Amount	Amount per single unit of analysed product
Preparation and cutting	polyester foam	16 kg	0.0475 kg
Preparation and stitching (migration of fibres between layers)	nonwoven fabric	75 kg	0.1068 kg
Packaging	foil packages	2.5 kg	0.002 kg

Table 6. Waste

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]
Preparation and cutting	Polyester foam	0.95	kg	1.0259
	Electricity	0.125	kWh	1.1625
Preparation and stitching	Nonwoven fabric	0.7122	kg	3.8186
	Electricity	1.625	kWh	1.1625
Packaging	Foil	0.04	kg	2.9536
Road transport	Nonwoven fabric transport	30	tkm	0.16743
	Foam transport	64	tkm	0.16743
	Foil transport	0.3	tkm	0.16743

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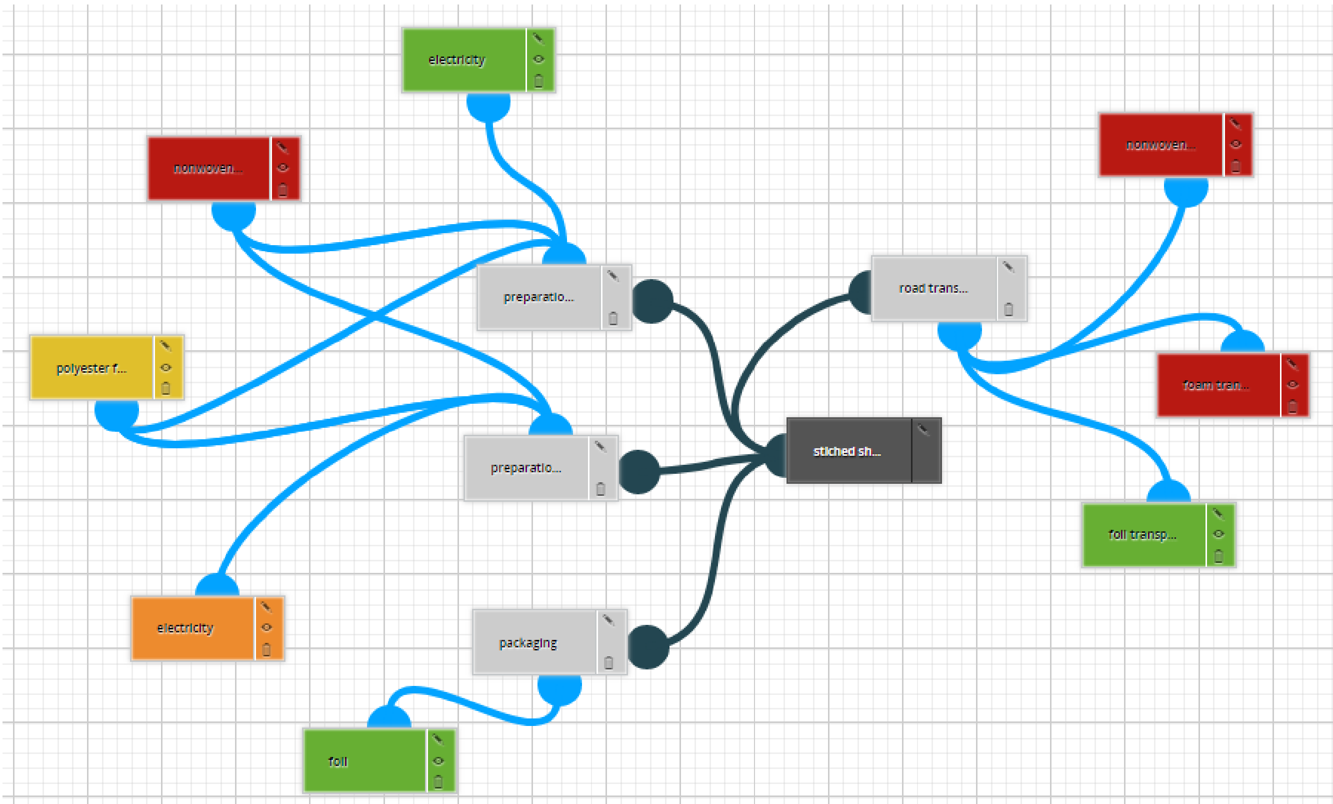
B. Picture from Scenat



3.3 Results

In our analysis, we didn't take into account the costs because those information were not prepared for us by the company. Moreover, we didn't add any missing inputs, because they completely interferred the results of analysis. Total emission of CO_2 was 50.66 kg. Three hotspots were indicated (red colour): transport of nonwoven fabric; transport of foam; and raw material – nonwoven fabric used in the production of stitched shoulders pads (phase: preparation and stitching). So, transport of foam (200 km) caused the greatest impact on the environment. In this process the highest amount of kg CO_2 was emitted, which comprised 49% of its total amount. The transport of nonwoven fabric (60 km) and using this raw material in the production processes, influenced the environment much less (23% and 13% respectively). Others inputs achieved very low values and this was the reason of adding them into one category (15% in total). Electricity in the preparation of nonwoven fabric is the element of the production which also was quite dangerous for the environment (orange colour). Rest of the inputs are negligible (green colour) in the first stage of our analysis.

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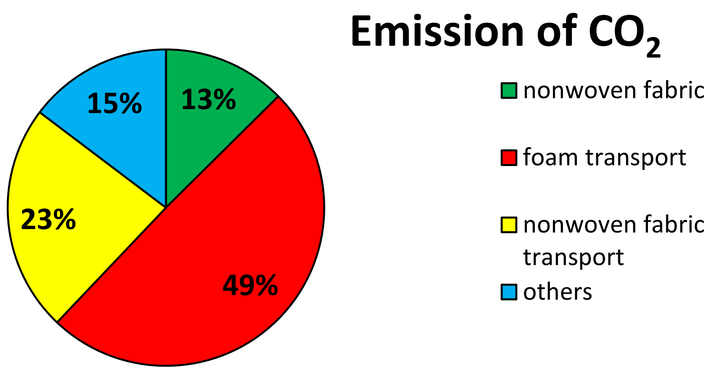

4 Possible improvements

4.1 Scenario 1

In our scenarios, we didn't take into account the cost of improvements. However, the European Union co-finances projects related to the implementation of innovative solutions in the production process.

4.2 Scenario 1

4.2.1 SC Carbon Map

Step 1

In the first scenario the transport optimisation possibilities were analysed. In this case transport causes greatest harm to the environment. Our team decided to change suppliers of raw materials and start to cooperate with local ones. For nonwoven we selected the new supplier situated 6 km from the company (instead of 60 km) and for the foam we selected the new supplier situated 10 km from the company (instead of 200 km). Fortunately our analysed company is in the region where many potential textile suppliers are situated.

A. Table of SC Carbon Map

	Input	**Quantity**	**Unit**	**GHG Intensity [kg CO_2eq/unit]**
Preparation and cutting	Polyester foam	0.95	kg	1.0259
	Electricity	0.125	kWh	1.1625

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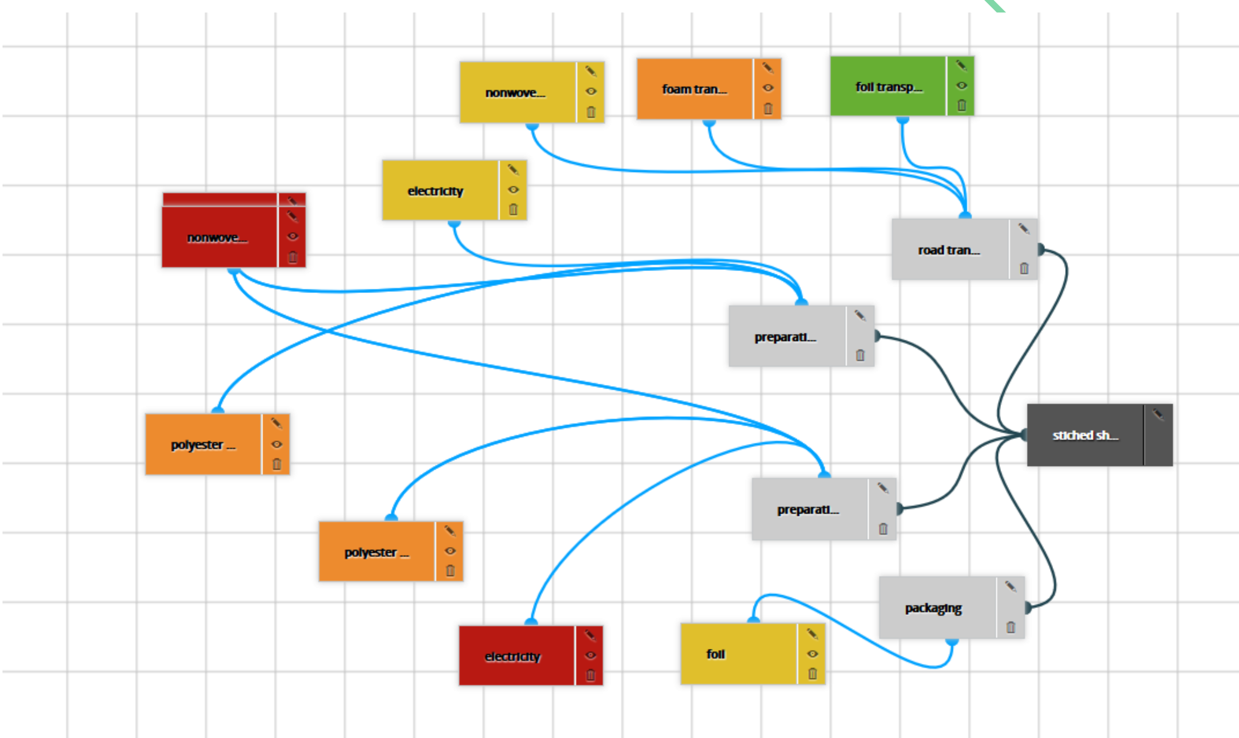
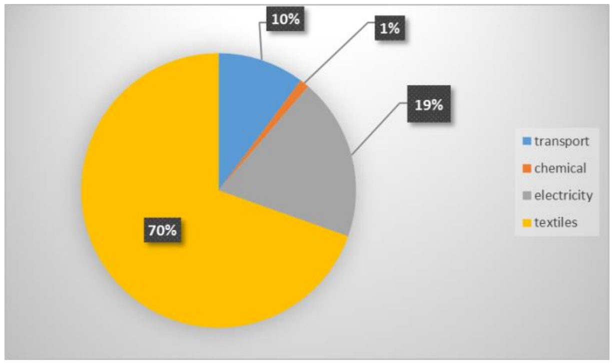
Preparation and stitching	Nonwoven fabric	0.7122	kg	3.8186
	Electricity	1.625	kWh	1.1625
Packaging	Foil	0.04	kg	2.9536
Road transport	Nonwoven fabric transport	3	tkm	0.16743
	Foam transport	3,2	tkm	0.16743
	Foil transport	0.3	tkm	0.16743

B. Picture from Scenat



Results

After the first improvement, we observed that CO_2 emission dropped significantly from 50,66 kg to 21,26 kg and another factors became noticeable, but the transport is still marked as a hotspot. We propose second improvement in transport optimisation.



4.3 Scenario 2

4.3.1 SC Carbon Map

Step 1

In the second scenario our team decided to change the raw material in the production process (preparation and cutting). Consequently in the first step the polyester was replaced by polysterene foam.

A. Table of SC Carbon Map

	Input	**Quantity**	**Unit**	**GHG Intensity [kg CO_2eq/unit]**
Preparation and cutting	Polystyrene foam	0.95	kg	0,69549
	Electricity	0.125	kWh	1.1625
Preparation and stitching	Nonwoven fabric	0.7122	kg	3.8186
	Electricity	1.625	kWh	1.1625
Packaging	Foil	0.04	kg	2.9536
Road transport	Nonwoven fabric transport	3	tkm	0,08663
	Foam transport	3,2	tkm	0,08663
	Foil transport	0,3	tkm	0,08663

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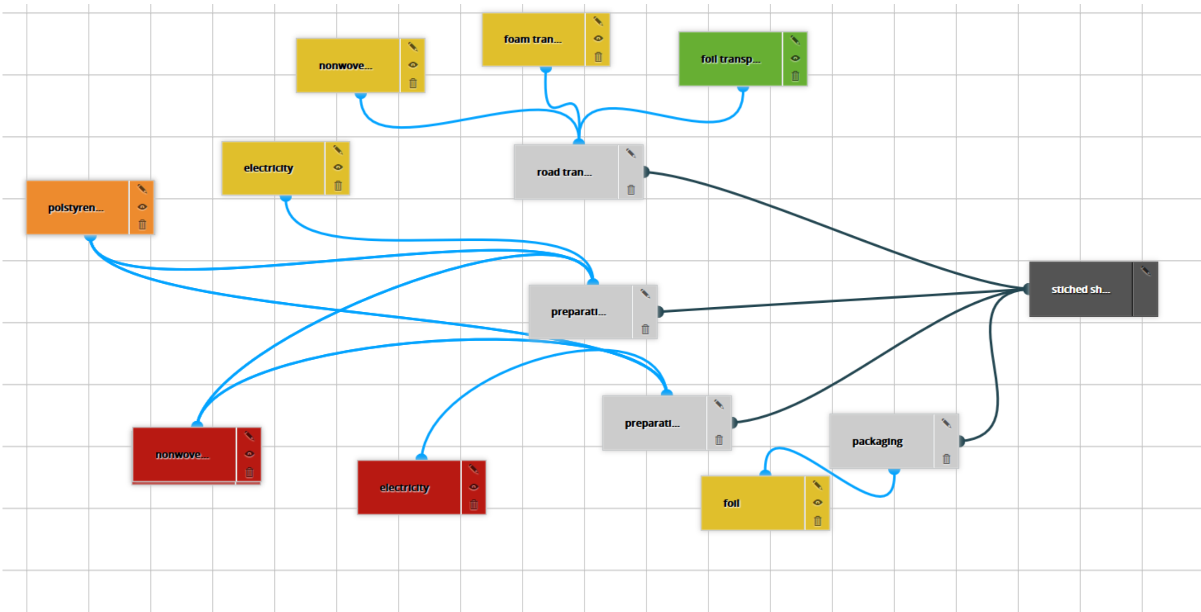
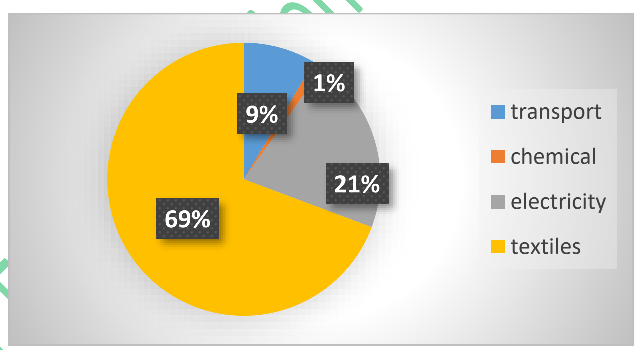
B. Picture from Scenat



Results

Realisation of this step reduced CO_2 emission to 19,50 kg.



4.3.2 SC Carbon Map

Step 2

After researching different databases, we decided also to change second raw material in the production system. Instead of nonwoven fabric we decided to use polypropylene product in the production process (preparation and stitching).

A. Table of SC Carbon Map

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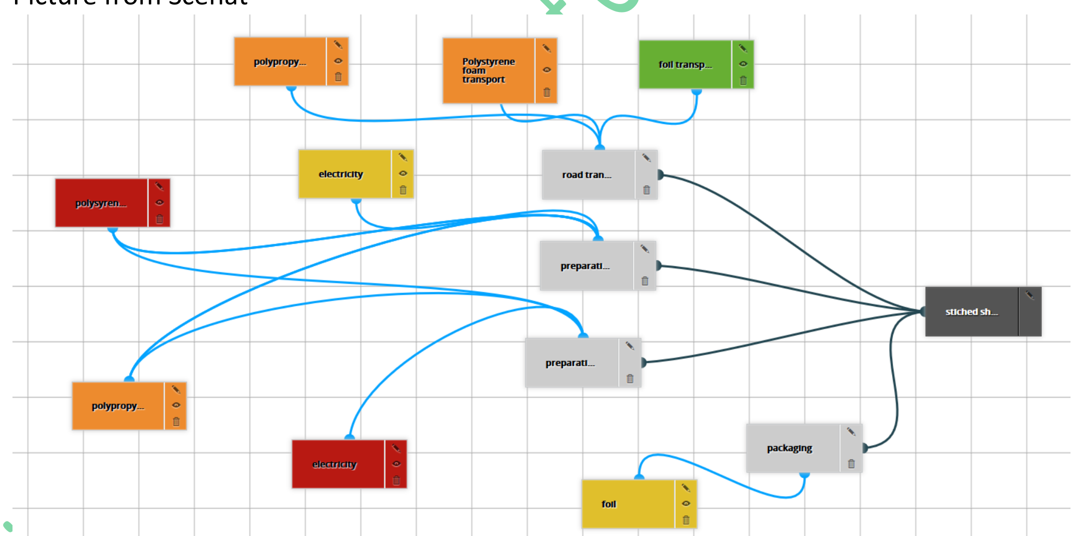
	Input	Quantity	Unit	GHG Intensity [kg CO_2eq/unit]
Preparation and cutting	Polystyrene foam	0.95	kg	0,69549
	Electricity	0.125	kWh	1.1625
Preparation and stitching	Polypropylene product	0.7122	kg	0,28462
	Electricity	1.625	kWh	1.1625
Packaging	Foil	0.04	kg	2.9536
Road transport	Nonwoven fabric transport	3	tkm	0,08663
	Foam transport	3,2	tkm	0,08663
	Foil transport	0,3	tkm	0,08663

B. Picture from Scenat



Results

Total CO_2 emission decreased from to 7,16 kg thanks to an innovative implementation of the newest technology.

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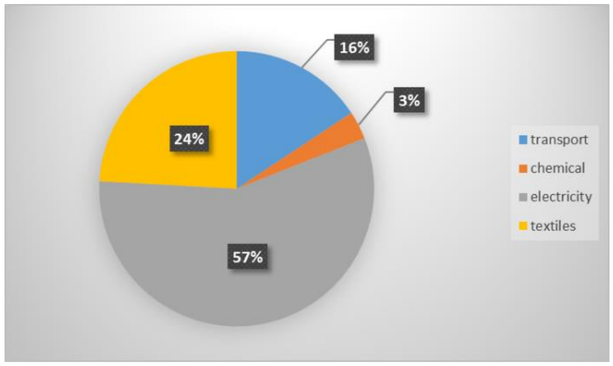
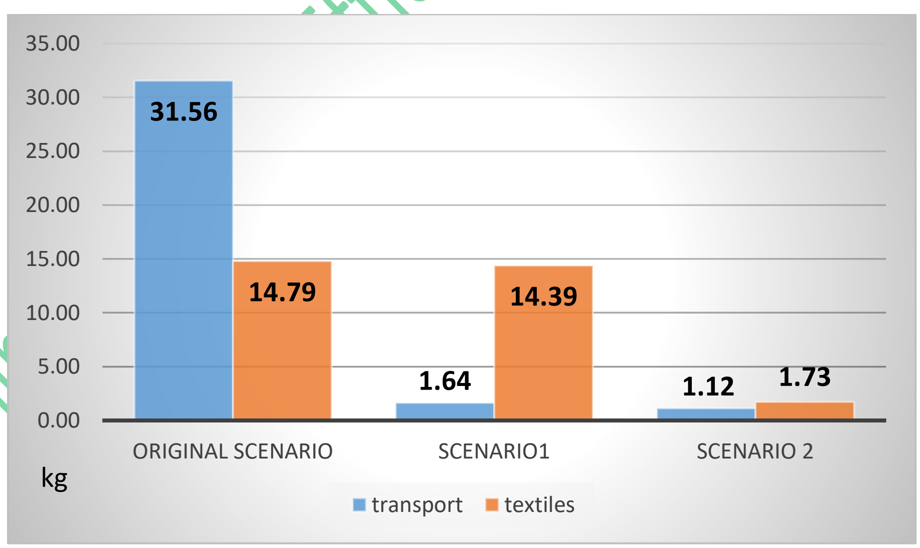


5 Final conclusions

Analysis of the original scenario highlighted nonwoven fabric transport, foam transport and nonwoven fabric as major sources of carbon emissions. Based on this statement, we proposed two scenarios (each two step) with some changes. In scenario 1, we changed suppliers of raw materials and start to cooperate with local ones and bought more ecology engines. Analysis show that thanks to this two steps we reduced the CO2 emission from 50, 66 kg to 20,21 kg. In scenario 2 we replaced two type of textiles. From polyester foam to polystyrene foam and nonwoven fabric to polypropylene product. This suggestion will reduce CO2 emission to 7,16 kg.

The graph below shows the CO2 emissions (kg) in the main hot spot.



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