TrainERGY project

Case Study - Template

Submission Date:	25th November 2016
Place:	Sheffield University

Sector Analysed:	Glass
Product Analysed:	Koby Design Windows

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1 Introduction

The main aim of this work is to determine the environmental impact of the product described below and compare that to possible saving suggestions that may be implemented in the supply chain. The SCEnATi tool will be used to calculate a hybrid life cycle assessment of the product and the suggested changes.

2 Overview

2.1 Firm description

2G Inc. is a glass manufacturing company based in Hull, East Yorkshire. The company manufactures double glazing windows for the construction industry; their main product (contributing to 80% of production) is the *Koby Design Double Glazing Glass Window*. The company wants to increase their Environmental Credentials by entering this product into the Association of Construction Industries 'Green Materials Award'.

2.2 Product description

The main product produced by 2G Inc. is the Koby Design Double Glazing Glass Window. The first tier of the supply chain for this material is as follows:

- Uncoated flat glass
- Plastic film
- Polyvinylchloride (PVC)
- Aluminium window frame/wooden window frame

1.45GWh of electricity is required to product 120,000m^2 of this product.

Although information is not provided regarding the main markets and users of this product, it is assumed that 2G Inc. sell this product to both retailers (e.g. B&Q who have their own warehousing facilities) and distributors who other retailers would purchase from. As there is no information available, it is assumed that the packaging of the product is out of scope.

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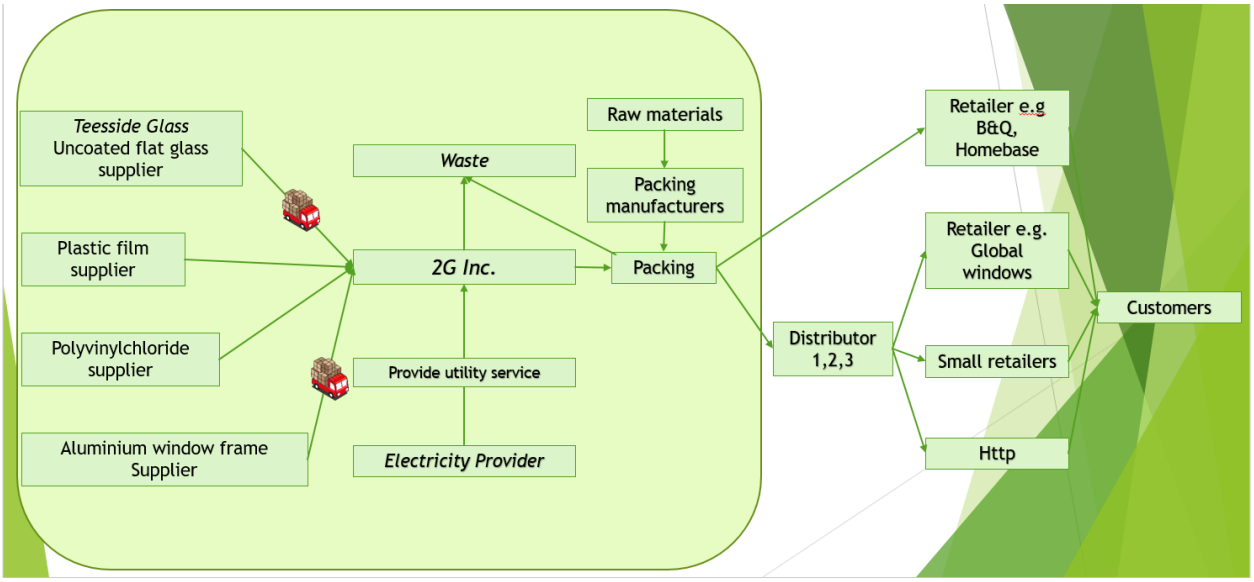

2.3 Supply chain of the product

Figure 1: Supply chain of the Koby Double Glazing Window Frame.

Environmental Aspects:

- Use of raw materials to produce first tier supplier products (out of scope)
- Transportation of the first tier supplier products to 2F Inc. (plastic film and PVC transportation are out of scope)
- Electricity and gas use in first tier supplier products manufacture
- Electricity in Koby Design Double Glazing Glass manufacture
- Use of raw materials to produce packaging materials
- Electricity and gas use in the manufacture of packaging materials
- Manufacturing and packaging waste created by 2G Inc.

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- Transport of the Koby Design Double Glazing Glass to retailers and distributors

There are five first tier suppliers; it is assumed that each supplier is a manufacturer of the product and therefore each are likely to be large enterprises. It is assumed that 2G Inc. have the following customer types:

- The construction industry
- Large scale retailers who have warehousing capabilities e.g. B&Q
- Distributors who then sell on to retailers who do not have warehousing capabilities e.g. Global Windows (large retailers), independent retailers (small retailers) and online (small companies e.g. builders)

Uncertainties:

- Uncertainty in demand and supply
- conflicting objectives among the actors
- Changing customer requirements
- Inaccurate information

Risk:

- Inaccuracy of the forecast result extensive inventory

3 Main Analysis

3.1 Process approach

The production process employed by 2G Inc. is assembly of the four products supplied to them, namely the uncoated flat glass, plastic film, PVC and aluminium frame.

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3.1.1 Resources and materials

The functional unit of this study is 1m^2 of Koby Design Double Glazing Glass Window.

Process	Input/Element/Material	Quantity (per single unit like kg, km etc.)	Physical Unit	Approximate/Average Cost Unit	Total cost
1	Uncoated flat glass	4.48	kg	£17.1746	£76.9422
2	Plastic film	1.05	kg	£0.01 per kg	£0.0105
3	PVC	1.05	kg	£0.292 per kg	£0.3066
4a	Aluminium window frame	1.00	m^2	£12.5 per m^2	£12.50
4b	Wooden window frame	1.00	m^2	£5.50	£5.50

Table 1. Resources and materials

It has been assumed that the aluminium window frame has a thickness of 6.35mm [1].

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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	Electricity	12.08333	kWh	£0.082	£0.991

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	Approximate/Average Cost Unit	Total cost

Table 3. Packages

As no information was supplied regarding packaging, this aspect was covered by the I-O approach using SCEnATi.

3.1.4 Water Usage (per single unit of analysed product)

Process	Water	Quantity (per single unit of	Physical Unit	Approximate/Average Cost Unit	Total cost

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		analysed product)			

Table 4. Water Usage

No information was supplied regarding water usage. The SCEnATi tool was used to input I-O information regarding water.

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

Process	Transport	Distance (miles)	Tonne.kilometers (km x the volume transported per month (in tonnes))	Approximate/Average Cost Unit	Total cost
1	Road	93.7	2.78	£0.50	£0.067
2	Sea	1670	100	£0.35	£35

Table 5. Means of transport

No information was provided regarding the sourcing of the aluminium frame. It was assumed that a manufacturing company in Loughborough, UK is the supplier [2].

3.1.6 Waste (per single unit of analysed product)

Process	Waste	Amount	Amount per single unit of	Approximate/Average Cost Unit	Total cost

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			analysed product		

Table 6. Waste

Information was not provided regarding any manufacturing waste. The SCEnATi tool was used to input I-O information regarding waste collection.

3.2 Scenat analysis

3.2.1 SC Carbon Map

The functional unit of this study is 1m^2 of Koby Design Double Glazing Glass Window.

A. Table of SC Carbon Map

	Input	**Quantity**	**Unit**	**GHG Intensity [kg CO_2eq/unit]**	**Unit Price [€/Unit]**
Window Assembly	Uncoated flat glass	4.48	kg	0.234737	0.318761
	Plastic film	1.05	kg	0.52402	0.01
	PVC	1.05	kg	2.0083	0.2920
	Al Window Frame	1	m2	481.41	12.5
	Electricity	12.083	kWh	0.53143	0.082
	Road Transport	2.78	t.km	0.13364	0.5

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Table 7: List of inputs used in the SCEnATi tool.

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

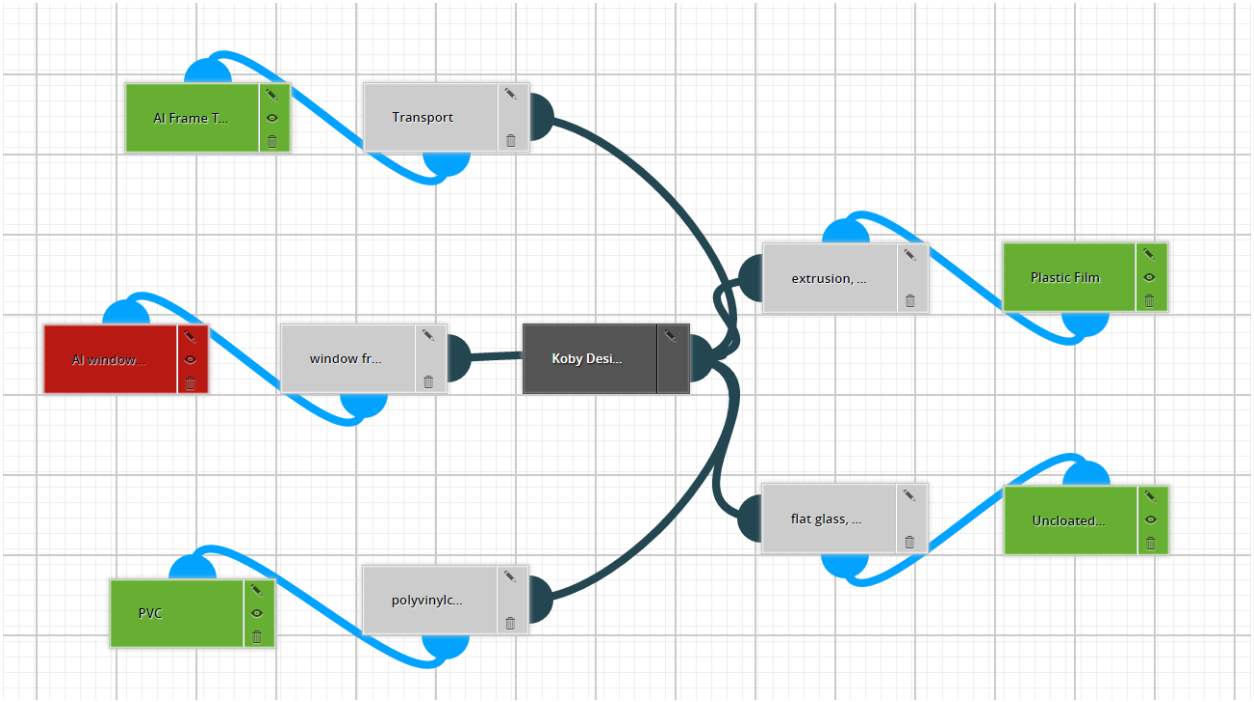

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Figure 2: Supply Chain of Koby Glass Window from SCEnATi

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

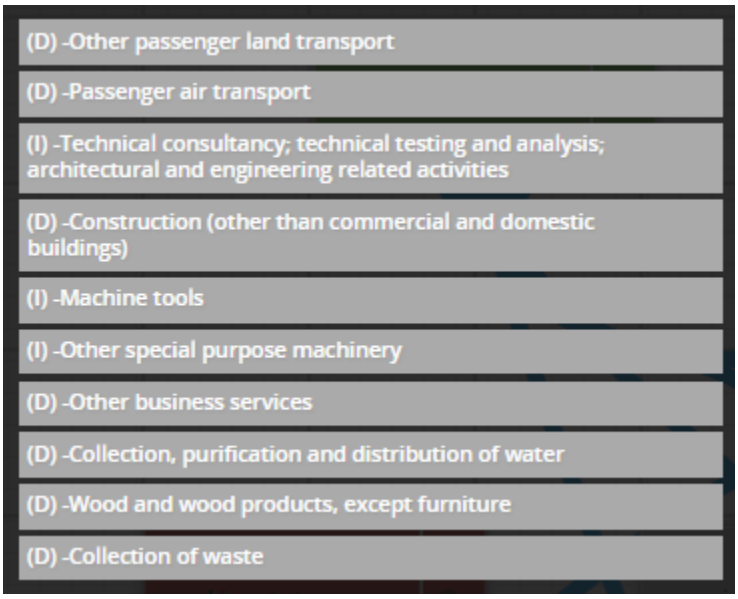

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Figure 3: Missing Inputs added to the supply chain using SCEnATi

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

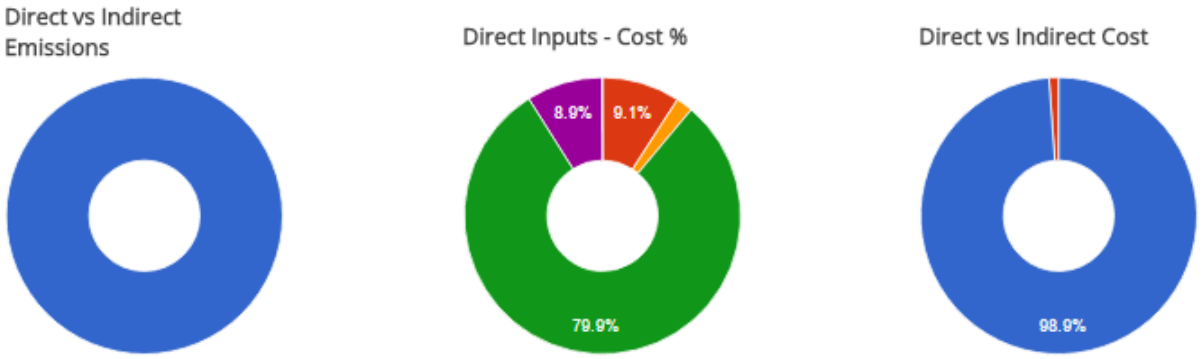

Figure 4: Direct and Indirect emissions charts from SCEnATi

3.3 Results

SCEnATi represents the carbon hotspots in a supply chain using a coloured scale. Lower than 1% is shown in green, yellow represents 1-5%, orange represents 5-10% and 10% or higher is shown in red.

Figure 2 shows that the carbon hotspot in the Koby Glass Window is the Aluminium Window Frame.

Figure 4 shows that 100% of the emissions are from direct sources; the highest direct cost can be attributed to the aluminium window frame (79.9%). SCEnATi reports that the total emissions are 485.67kg and the total cost is £15.81 for 1m^2 of the Koby Glass Window.

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4 Possible improvements

SCENARIO 1- The first possible improvement that 2G Inc. want to investigate is the use of wooden window frames instead of aluminium window frames. The embodied emissions of the wooden frames is lower than that of aluminium frames (131.1 kg CO2-eq/m2 and 481.41 kg CO2-eq/m2 respectively) but the wooden window frames are sourced from the Czech Republic and are transported by sea, whereas the aluminium window frames are assumed to be sourced from Loughborough, UK and are delivered by road. Figure 5 below shows the change to the supply chain when this is implemented.

SCENARIO 2- Although the uncoated flat glass from Teesside Glass is not a carbon hotspot in the supply chain, 2G Inc. already have a good working relationship with the company and therefore it would be possible to engage with them regarding possible improvements that could be made to their supply chain. By working with the supply chain to implement green initiatives, improvements can be made to its environmental impact. This collaboration can also lead to cost savings. It is assumed that an improvement of 5% can be made on both electrical and gas usage at the Teesside Glass plant, the results of this change are shown in Figure 8.

4.1 Scenario 1

A Table of SC Carbon Map

	Input	Quantity	Unit	GHG Intensity	Unit Price [€/Unit]

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				[kg CO_2eq/unit]	
Window Assembly	Uncoated flat glass	4.48	kg	0.234737	0.318761
	Plastic film	1.05	kg	0.52402	0.01
	PVC	1.05	kg	2.0083	0.2920
	Wood Window Frame	1	m2	131.1	5.5
	Electricity	12.083	kWh	0.53143	0.082
	Sea Transport	100	t.km	0.04641	0.35

Table 8: List of inputs used in the SCEnATi tool.

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

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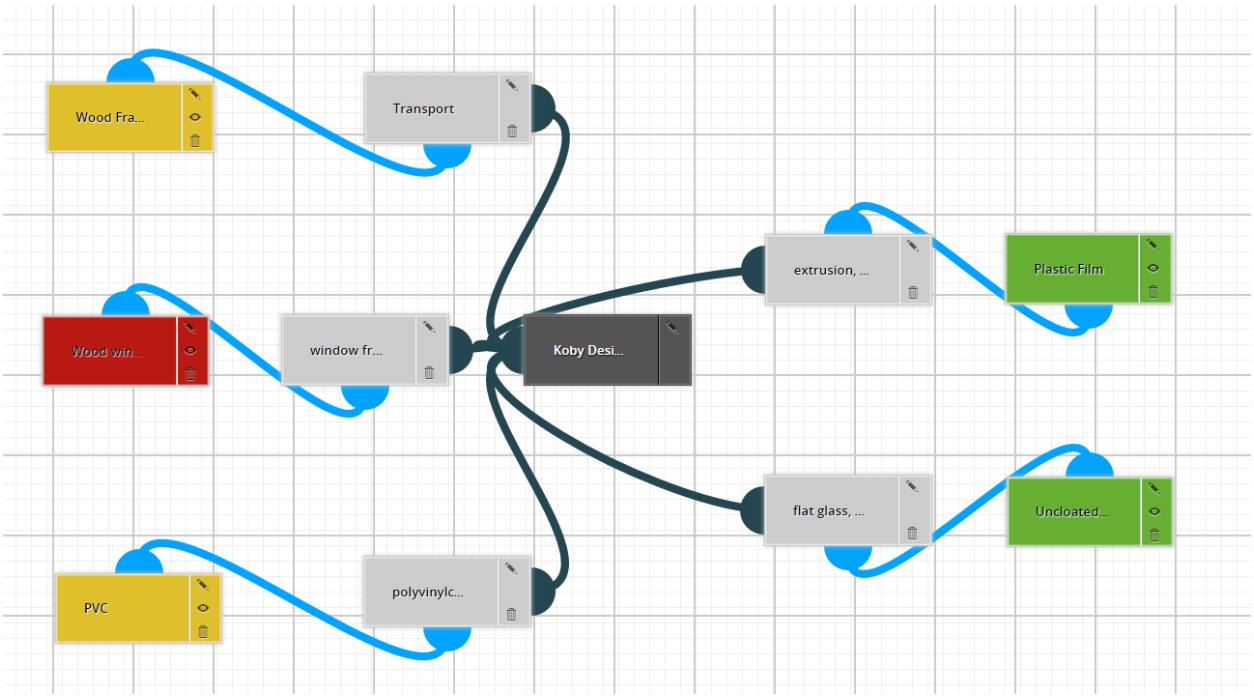

Figure 5: Supply Chain of Koby Glass Window from SCEnATi using Wooden Window Frames

C Missing Inputs selection, based on analysed product process description

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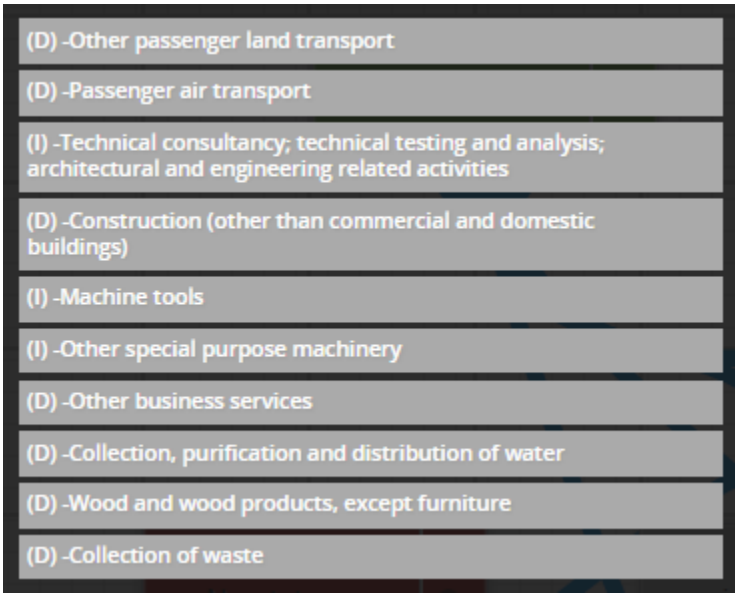
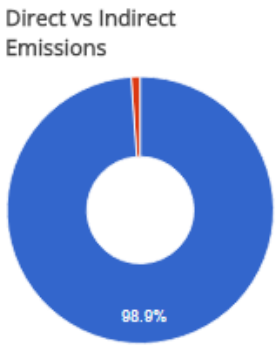
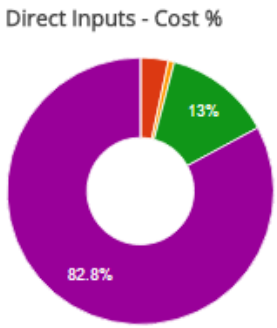


Figure 6: Missing Inputs added to the supply chain using SCEnATi for the Wooden Window Frame

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





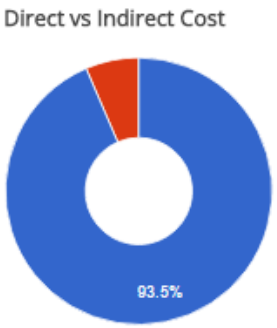


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Figure 7: Direct and Indirect emissions charts from SCEnATi for the Wooden Window Frame

Figure 5 shows that the carbon hotspots in the Koby Glass Window using a Wooden Window Frame are the Wooden Window Frame; the relative impacts of the transportation of the window frame and the use of PVC have also increased.

Figure 7 shows that there has been an increase of indirect emissions associated with the product (1.1%); the highest direct cost is now attributed to the transportation of the wooden frame (82.8%). SCEnATi reports that the total emissions are 141.04kg and the total cost is £45.16 for $1m^2$ of the Koby Glass Window with a Wooden Window Frame. This means that although the wood frame is still a carbon hotspot and the transportation has increased in intensity, overall the environmental impact of the product has decreased because sea transport is more efficient that road transport.

4.2 Scenario 2

A Table of SC Carbon Map

	Input	Quantity	Unit	GHG Intensity [kg CO_2eq/unit]	Unit Price [€/Unit]
Window Assembly	Uncoated flat glass	4.48	kg	0.231334	0.31671
	Plastic film	1.05	kg	0.52402	0.01
	PVC	1.05	kg	2.0083	0.2920
	Wood Window Frame	1	m2	131.1	5.5
	Electricity	12.083	kWh	0.53143	0.082

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	Sea Transport	100	t.km	0.04641	0.35

Table 98: List of inputs used in the SCEnATi tool.

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

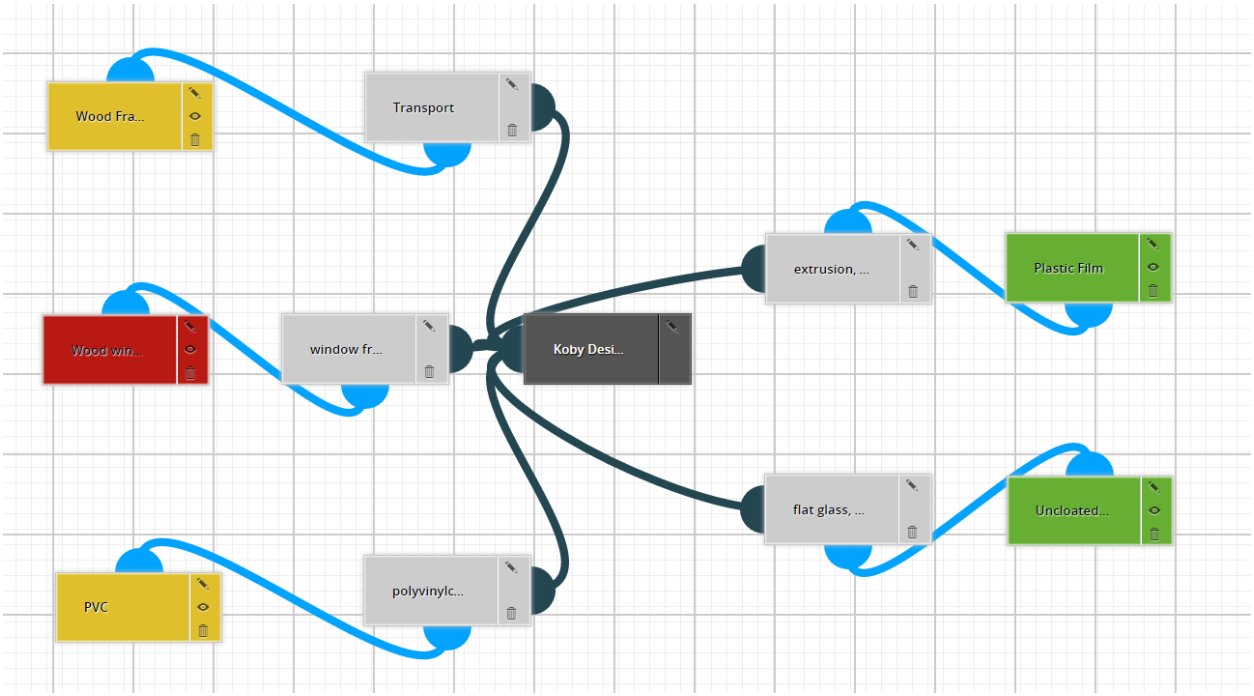

Figure 8: Supply Chain of Koby Glass Window from SCEnATi using Wooden Window Frames

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C Missing Inputs selection, based on analysed product process description

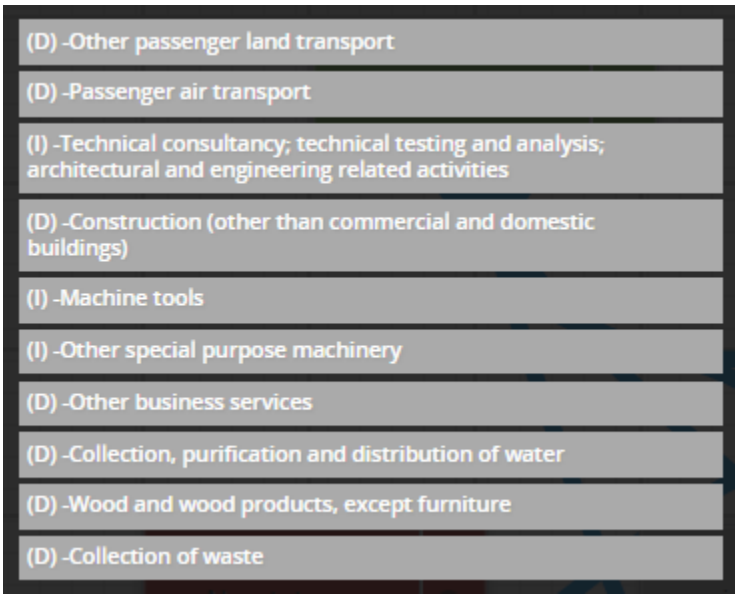

Figure 9: Missing Inputs added to the supply chain using SCEnATi for the Wooden Window Frame

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

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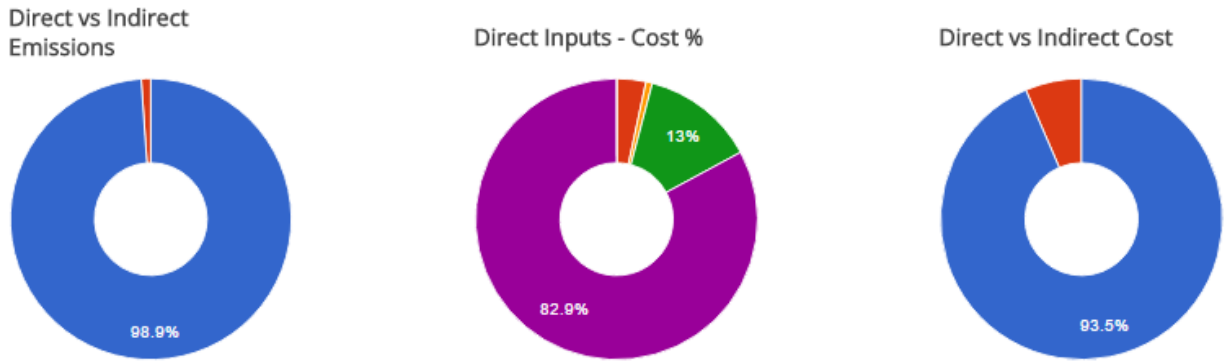

Figure 10: Direct and Indirect emissions charts from SCEnATi for the Wooden Window Frame

Figure 8 shows that the carbon hotspots in the Koby Glass Window using a Wooden Window Frame with reduced energy use at Teesside Glass remain as the Wooden Window Frame (as in Scenario 1).

Figure 10 shows that the indirect emissions associated with the product remain the same as in Scenario 1 (1.1%); the highest direct cost is still attributed to the transportation of the wooden frame but has increased by 0.1% to 82.9%. SCEnATi reports that the total emissions are 141.02kg and the total cost is £45.15 for 1m^2 of the Koby Glass Window with a Wooden Window Frame with reduced energy use at Teesside Glass. Although this may not seem like a huge improvement, for 120,000 m2 that is a reduction of 2,400 kg of CO2 and a saving of £1,200.

5 Final conclusions

This work has outlined the environmental impacts of the Koby Double Glazing Window from 2G Inc. Using the SCEnATi decision support tool is can be seen that the original supply chain leads to 485.67 kg of CO2. The supply chain was then amended to take into account the supply of wooden frames from the Czech Republic; this led to an overall decrease in carbon associated with the supply chain despite the increased travel of the window frames. Finally, it was assumed that a 5% improvement could be made by the supplier, Teesside Glass, in terms of their gas and electricity use; this led to a further improvement in carbon impact. There are other possible improvements that could be made to the supply chain that could be investigated, including material substitutions and further energy efficiency improvement. Overall, the SCEnATi decision support tool is a useful way of visually displaying the carbon impacts of a supply chain.

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References

[1] thyssenkrupp- The Technology & Materials Company website, http://www.thyssenkruppaerospace.com/materials/aluminum/aluminum-plate/weight-calculations.html Accessed 23/11/16 15:53

[2] BOAL UK website, http://www.boalgroup.com/boal-extrusie/boal-uk Accessed 24/11/16 09:34

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