CLOTHING AS A SERVICE

Overview of the environmental impact of leasing a pair of jeans

[redacted]

1. Main objective of the study

Product-service systems (PSS) are systems in which companies, rather than selling a product, meet their client's needs through a service that fulfil a specific utility/function. PSS, defined as a competitive system of products, services, supporting networks and infrastructure, have been perceived as a promising solution to shift towards more sustainable modes of production and consumption (Mont, 2004).

In this business model innovation, the producer has incentives to design a durable product, since he will retain ownership of it and will make sure it is extensively used (sometimes through several users) before being refurbished or eventually recycled. If employed on a global level, it is assumed that product service systems could lead to reduced resource use and waste generation, since fewer products are manufactured for the same user satisfaction created (unep, 2001).

An increasing number of examples can be found in the literature showing the environmental benefits of PSS: Chemical Management Systems (CMS), DBFOs, ESCOs, to name a few, have shown some interesting positive impact. Some sectors however have been less explored. When looking at the fashion/textile industry for instance, there is little case on the sustainable impact of shifting to a servicizing approach.

The main objective of this paper is to explore further to what extent the introduction of a PSS in a fashion company can generate environmental benefits. In that respect we explore the case of "clothing as a service" and in particular wearing jeans as a service.

2. Scope and boundaries of the study

The study explores some aspects of the life cycle of a pair of jeans with a focus on the post-purchase, as it is in this phase that somehow more PSS innovation can be introduced.

The study then looks at the business model from Mud Jeans, a Dutch company who started a “lease a jean” programme in which the jean can be returned to the organisation at the end of the contract. Jeans can then be recycled (into new fabric and then turned into new products, such as hoodies or bags). The business model of the company is described. A first system map / stakeholder map of the solution is developed.

This study does not constitute by any means a complete life cycle assessment of a leased pair of jeans. It however gathers first elements of appreciation around such PSS with the use of an eco-audit, performed to validate some of the preliminary assumption.

Finally, a critical review of the eco-audit tool is presented and reflections on the future of this business model conclude the paper.

3. Clothing as a service: fact from the system

First, the section introduces the bill of materials of a pair of jeans. Secondly, a closer look at cotton production highlights main societal issues related to the main material of a jean. Third, a summary of LCA studies related to jeans production explores the most important impact. These are summarized in a meta matrix at the end of the section.

3.1 Bill of materials

The following tables summarizes key materials from a pair of jeans.

Material	Unit
Cotton	**600g**
Rivets	**3,6 g**
buttons	**14 g**
Double thread	**10,4 g**
lining	**37,5 g**

Figure: Overview of material for a pair of jeans (source Ademe 2006)

Since cotton constitute the larger amount of material in a pair of jeans, the following section explore some issues related to cotton production**.**

3.2 Cotton: overview of societal challenges

About 20 million tonnes of cotton are produced each year in around 90 countries. China, United States, India, Pakistan, Uzbekistan and West Africa account for over 75% of global production.

Cotton represents nearly half the fibre used to make clothes and other textiles worldwide, with much of the rest coming from synthetic products (source: 2003 WWF report Thirsty Crops).

Main environmental impacts of cotton production

Water impacts: It can take more than 20,000 litres of water to produce 1kg of cotton; equivalent to a single T-shirt and pair of jeans. 73% of global cotton harvest comes from irrigated land (as documented in the WWF report *The Impact of Cotton on Freshwater Resources and Ecosystems*).

Chemicals: Agriculture is the largest source of pollution in most countries. 2.4% of the world's crop land is planted with cotton and yet it accounts for 24% and 11% of the global sales of insecticide and pesticides respectively. Unsafe use of agricultural chemicals has severe health impacts on workers in the field and on ecosystems that receive excess doses that run-off from farms.

Genetic Engineering: The use of genetically-modified (GM) cotton varieties has increased remarkably in recent years reaching 20% (67.7 million ha) of the global crop area in 2002. Several of the major cotton-producing countries cultivate a significant percentage of their cotton fields with GM varieties that are resistant to some insect pests and/or tolerant of certain herbicides.

River Basin impacts: Unsustainable cotton farming, with massive inputs of water and pesticides, has already been responsible for the destruction of large-scale ecosystems such as the Aral Sea in central Asia and the deteriorating health and livelihoods of people living there. Cotton is also one of the most 'thirsty' crops in several large River Basins (see *Agricultural Water Use and River Basin Conservation*) including the Indus River in Pakistan, the Murray-Darling Basin in Australia, and the Rio Grande in United States and Mexico.

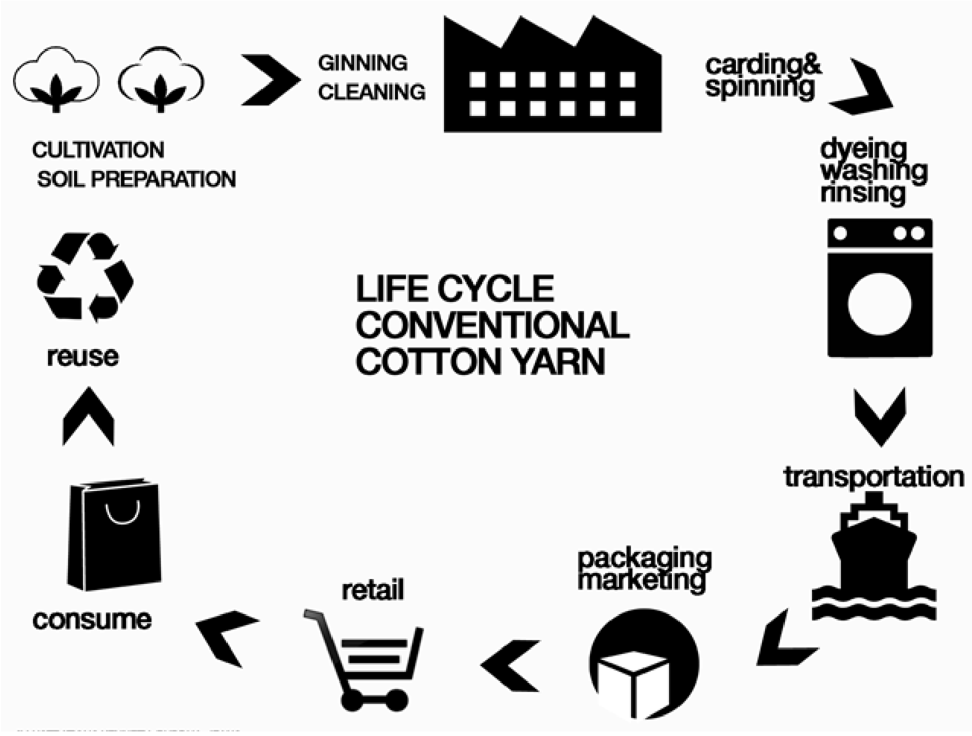


Figure 2: Life cycle phases of cotton yarn

Actions towards sustainable cotton production

Recent initiatives have help shifting towards more sustainable cotton production practises. One of it is called the GOTS.

GOTS: Organic Textile Standards

The Global Organic Textile Standard (GOTS)[1] is recognised as the world's leading processing standard for textiles made from organic fibres. It defines high-level environmental criteria along the entire organic textiles supply chain and requires compliance with social criteria as well.

Only textile products that contain a minimum of 70% organic fibres can become GOTS certified. All chemical inputs such as dyestuffs and auxiliaries used must meet certain environmental and toxicological criteria. The choice of accessories is limited in accordance with ecological aspects as well. A functional waste water treatment plant is mandatory for any wet-processing unit involved and all processors must comply with minimum social criteria. The key criteria of GOTS, its quality assurance system and the principles of the review and revision procedure are summarised in this section.

3.3 LCA of jeans: overview from existing studies.

In 2006, French environment agency ADEME conducted the LCA of a pair of jeans[1]. The results show that most striking environmental issues in the life cycle of a pair of jeans are related to water consumption (in the production and use phases) and the toxic risks to the aquatic environment. These impacts are mainly generated during the culture of (intensive) cotton. Other key environmental issues concern the use of non-renewable resources, the consumption of primary energy, the photochemical pollution (responsible for ozone peaks in the urban areas), the sediment ecotoxicity and the production of household waste.

Some issues are specific to the production stage, others issues are specific to the use phase. Some relate to several phases:

Production phase: The main sources of impact of the production are related to the use of non-renewable resources (electricity consumption), water consumption (irrigation of cotton fields), depletion of the ozone layer (fuel consumption of agricultural machinery and transport vehicles), and aquatic ecotoxicity (use of herbicides and insecticides for Cotton cultivation);

Use phase: This is the predominant phase in terms of consumption of primary energy (electricity consumption for washing jeans trousers) human toxicity (detergent and electricity consumption for washing the pants), terrestrial ecotoxicity (electricity consumption for washing denim pants) and solid waste (washing-related waste, packaging and the worn jeans ending up in landfill);

Mixed phases: for global warming, air acidification, photochemical pollution, eutrophication and sediment ecotoxicity, potential impacts on the environment is evenly divided (about 50/50) between the production phase, the use and end of life phase

Impact of usage behaviour in the usage phase: In the assessment, several scenarios were implemented in the study to analyse the sensitivity of the result based on specific usages. The usage behavior can influence the overall impact of indicators.

The following recommendations apply to reduce the overall impact of the usage phase:

---

[1] http://www.biois.com/en/non-class-en/lca-pair-of-jeans.html

- Use your pants as long as possible
- Optimize the washing frequency
- Limit the number of dry cleaning;
- Limit the use of dryers;
- Direct your pants to a re-employment sector to extend its lifetime.

Other usage patterns can have a strong influence:

The choice of organic cotton pants can greatly reduce impacts in terms of aquatic ecotoxicity (-90%).

The purification of aqueous effluents after finishing and treatment of the pants can strongly influence the impact in terms of eutrophication (by a factor 1.5). Choosing pants produced in countries where the law requires plants to treat their effluent water can limit eutrophication. (The consumer does not have the information today to make this choice)

In terms of use, washing pants in a class washing machine A, at low temperature, optimizing the frequency of washing, ironing and avoid as much as possible dryers limits the consumption of primary energy and limit certain toxic hazards (including terrestrial ecotoxicity).

Summary of key indicators

Leading American jeans manufacturer Levi's conducted several life cycle assessments on different models. The following image summarizes main indicators:

REGULAR STRAIGHT 505® JEANS / STEEL (LESS WATER) (PC9 00505-0352)

IMPACT CATEGORY	QUANTITY
Global Warming Potential	15 Kg CO2 - equivalents
Energy Use	170 Megajoules
Renewable Energy	15%
Water Use	5.9 Cubic meters
Land Occupation	6.6 Square meter x year
Qualified Sustainably Grown Fiber	0%
Primary Waste	0.09 Kg
Materials Efficiency	87%
Recycled Content	1%
Eutrophication	0.004 Kg Phosphorous-equivalents
Land Transformation	0.002 Square meters
Restricted Substance List Compliance	Full Adherence (Legal Minimum/Adherence with phase out chemical use/ Full adherence with no phase out chemicals)

Figure 2: overview of main impacts related to life cycle of a jeans (levis)

The results of the LCA are summarized in the following meta-matrix.

3.4 Meta matrix

The following matrix gives a first glimpse of the possible impact of jeans through its Life cycle.

Impact category	***Materials production***	***Manufacturing***	***Use-phase***	***End-life***	***Transport***
M – Materials *Selected materials in the system and the environmental impacts of production*	Cotton Rivets (copper) Buttons + farm equipment (tractors, etc..)	Dedicated manufacturing facilities to treat cotton.	Water (for washing) Jeans can be washed from more than 200 times during a lifetime. Materials for washing machine production Packages related to detergents	Landfill of worn pants Landfill of detergent packages	Materials to build vehicles Plane/boat/trucks used in the transport of raw material and finished product (cotton not produced in europe) from production to distributor

E – Energy *Used energy in the system and the environmental impacts of production*	Energy used in plant growing (vehicles)	High energy level (10% of whole LC)	Energy to wash the jeans (50 to 60% of the total energy)	Landfill	Energy related to transportation (fuel)
T – Toxicity *Toxicity of different chemical substances and processes related to the system*	Use of Insecticides Use of Pesticides	Waste in production phase	Washing powders (water toxicity) Waste related to packaging of washing detergents	Might release chemicals if not correctly dealt with at end of life	

A – Socio-cultural *Socio-cultural dimension related to the system, such as labor, context of use, etc. Also: Aesthetics & ethics*	Country of production might not be in line with WLO standards	Country of production might not be in line with WLO standards	Issues related to owning or not the pants. Issues related to wearing already warned clothes.	High societal costs of managing waste	

4. Clothing as a service : the Mud Jeans PSS concept

4.1 Context

Recovery rates in the textiles industry tend to be low, with around 25% of textiles recovered per year in the EU.[2] After learning about business models like that of Turntoo, in which manufacturers retain ownership of their own products, and consumers only pay for the performance, rather than for the raw materials that went into the product, Mud Jeans CEO, van Son realised that the most reliable way of getting his product back was to avoid selling it in the first place. In order to retain control of the materials, van Son decided to begin leasing Mud Jeans, with a number of options available.

4.2 How does it work?

At Mud Jeans you can rent your jeans for a year, after that you have 3 options; 1) keep it, 2) switch it, 3) send back. Even when you decide to keep the jeans, you can return them once they are worn out. The company uses all the materials for the creation of new fashion items. The goal is to build a circular fashion industry.

When you return your jeans at the end of the lease contract, mud jeans will reuse the denim fabric and make a new piece of fashion out of it. One part of the jeans will be recycled; they are shredded and blended with organic cotton out of which a new denim yarn is born.

From this yarn mud jeans can create new jeans or other products such as hoody's. Another part will be upcycled; these jeans find a new owner via The Wall of Jeans or are used for the bag collection.

4.3 THE PRODUCT:

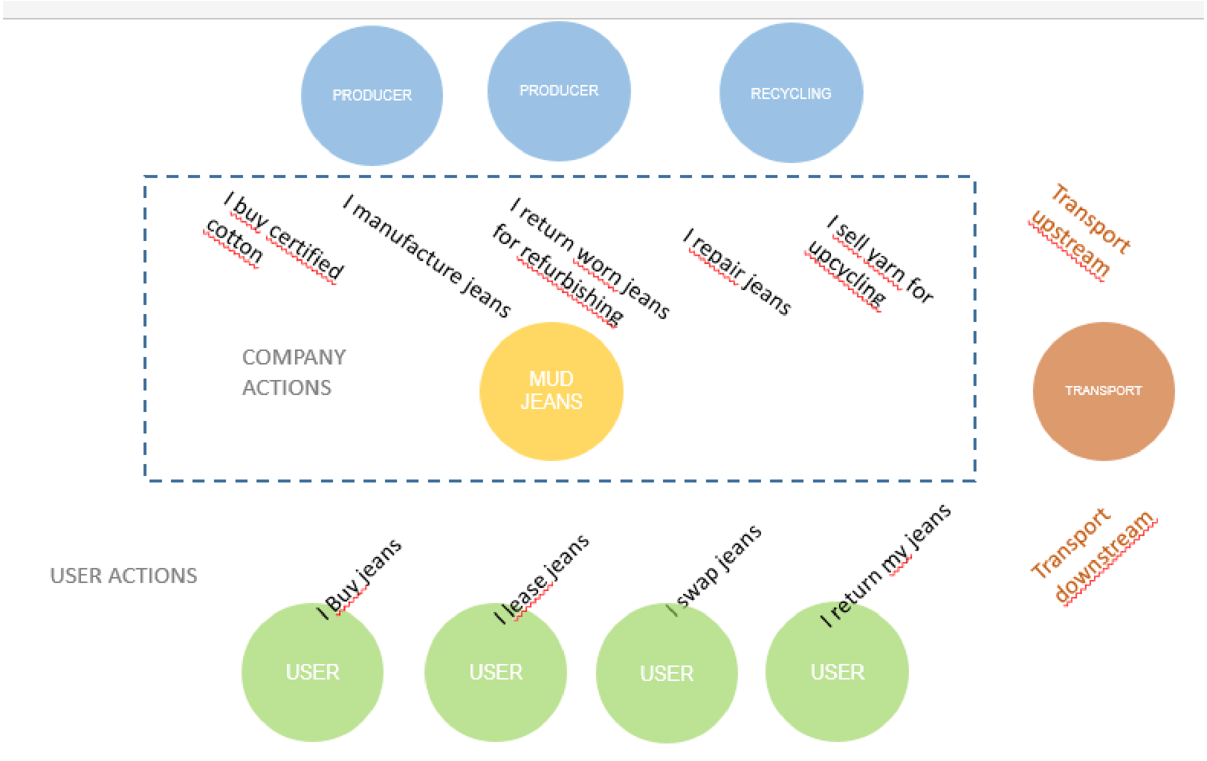
- The cotton used for the jeans is 100% GOTS certified. 30% of the denim already has recycled content.
- The jeans are produced in Italian factories, not far away from dutch company headquarters , to have low CO_2 emissions.

- the packaging is made out of recycled materials. Even the labels are made out of waste-cotton, which will otherwise be thrown away.
- The information on the labels is all printed with ecological ink.

THE SERVICE:

- Users can choose to lease Mud Jeans for €5 / month.
- At the end of the contract, users can swap their jeans for a new pair and lease for another year pay for four extra months at €5 each as a 'deposit', after which the user can wear the Jeans as long as he likes, or end the relationship by returning the jeans to Mud
- Free repairs are included in the offering.
- For those who have decided to keep the jeans, the company offers financial incentives to return items, to encourage recovery.

4.4 SYSTEM MAP



5. Ecoaudit of mud jeans

The objective of the ecoaudit exercise is to find out if the PSS model of mud jeans is relevant in terms of environmental impacts

5.1 Scenarios and hypothesis

4 scenarios are built which alter end of life (related to the use phase)

Scenarios 1: conventional jeans.

Produced in Asia.

End of life: 50% is ending in landfill.

Usage: jeans are washed 18 times per year.

Scenario 2: mud jeans

Introduced variables:

- Produced in Europe (Italy)
- End of life: 75% is remanufactured

Scenario 3: mud jeans reused

Introduced variable

- End of life: 100% is reused (through the swapping/reuse scheme)

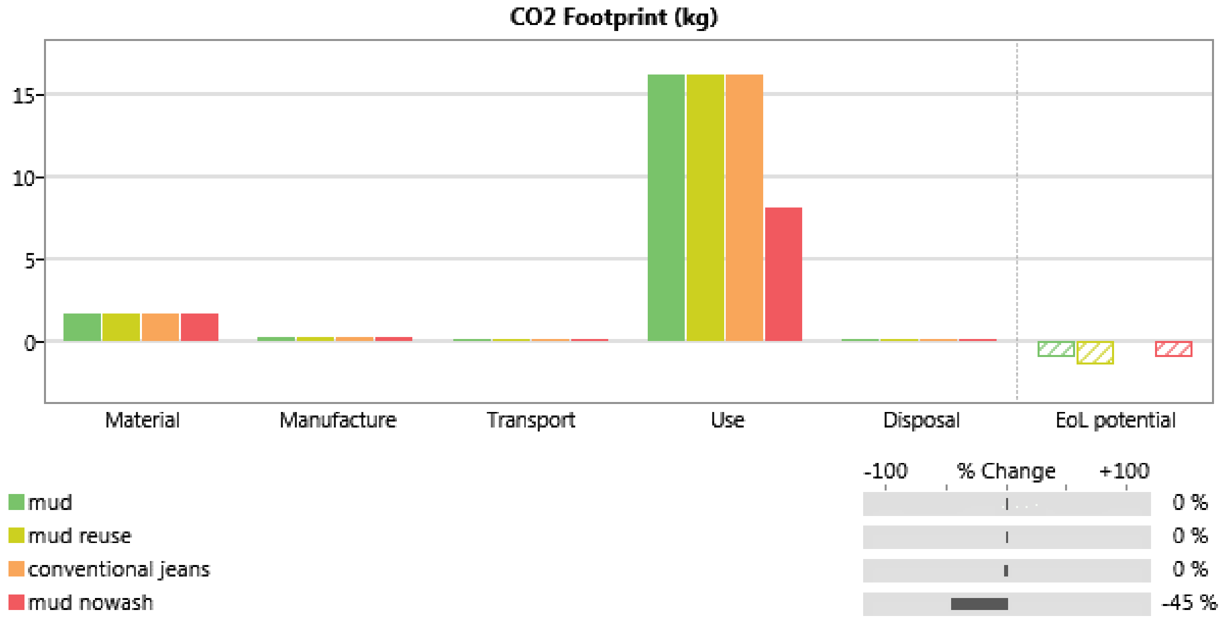
Scenario 4: mud jeans nowash

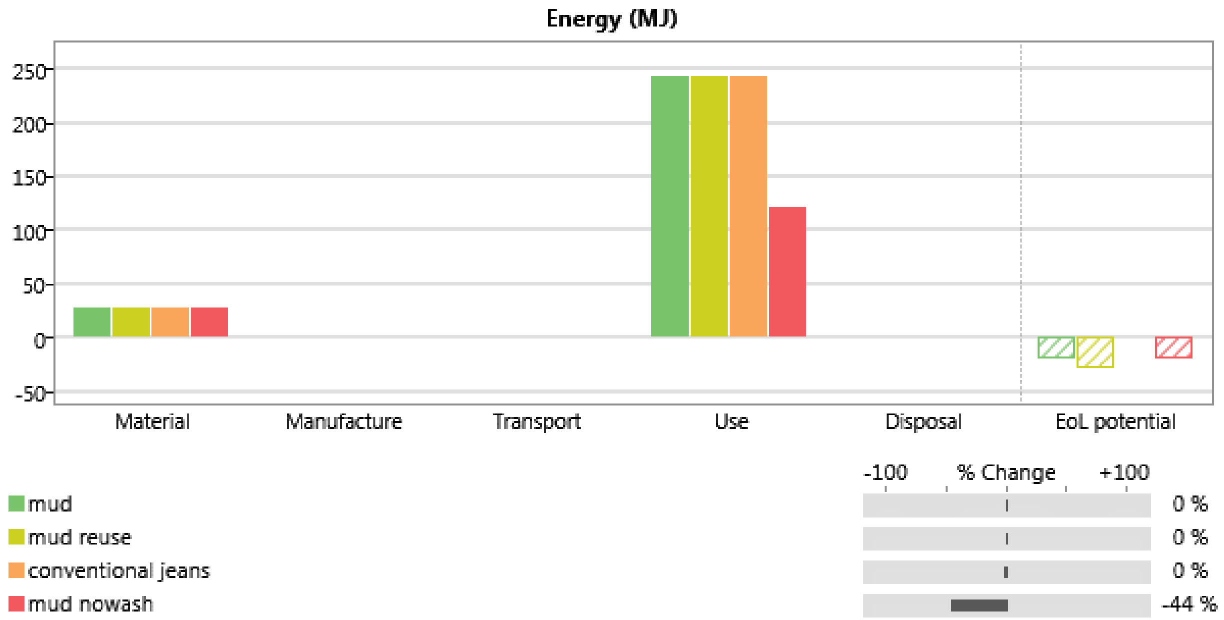
Introduced variable

- End of life: 75 is remanufactured. In the use phase, jeans are washed 50% less than in conventional use.

5.2 Learnings

The following table gives an overview of ecoaudit (translated into CO2eq emissions) according to the scenarios.





In the 3 first cases (conventional, mud, mud reuse) the variables only impact the EOL potential. (transportation impact between conventional jeans and mud jeans barely makes any change.)

The two scenarios that include the reuse and remanufacture of jeans (mud and mud reuse) (as presented in the business model of mud jeans) show some interesting result that may offset the CO_2 impact from production.

However, when looking at the broad picture, it seems that the main phase of impact when looking at energy and co2 emissions is related to the usage phase, and most specifically to the electricity used to wash the jeans. In scenario 4, the number of yearly washes is reduced by 50%. The overall impact of this behaviour change is tremendous, which leads to interesting questions about the relevance of the PSS model VS a proper customer awareness on a self limitation of washing.

6. Limitations of the exercise

The exercise was performed using ecoaudit tool from the CES edupack software.

The software has the following limitations which did not allow for a proper assessment.

Production phase:

There is no possibility to include organic cotton as a variable

The recycled cotton percentage is 0% whereas recent technologies now allow for the integration of recycled content in the production on denim (mud jeans uses 30% of recycled content).

Usage phase:

in eco audit,the usage phase is only related to the energy used during that phase. Extending the lifetime of a product (from 4 to 8) impacts the energy use without impacting the production phase (for instance, one scenario would have 1 pair of jeans used 8 years, vs 2 jeans produced and worn each for 4 years to produce the same function). Currently the tool doesn't not automatically allows for such approach, which may lead to false interpretations.

Limitation of studied impacts.

Obviously, as demonstrated in the results of complete LCA studies, there are bigger impact than energy use when looking at a pair of jeans. Water use for instance, remains totally out of the scope in the ecoaudit tool even though it is extremely relevant.

7. Recommendations for an improved PSS model.

Mud jeans has looked at the production phase with strong care: use of certified jeans, production facilities located near clients. It also has looked at the end of life issue with innovative approaches promoting reuse and remanufacture.

However it may make sense to explore to what extent the business solution might really focus on the usage phase, and help customers reduce the impact related to washing. A few set of answers should be explored further

How do we engage customers in washing their jeans less often?

How do we engage customers to wash at low temperature?

Ideations sessions could look at specific strategies

- awareness campaigns (challenge: the no-wash jeans month)
- technological solutions: introduction of sensors telling customer when their jeans should be washed… change of color of label when jeans need a wash…
- product design could look into biomimicry solutions (self washing materials).
- Marketing could look at creating value around “dirty jeans”
- Etc…

These solutions could be integrated into the current PSS solution and strengthen the brand value proposition.

Annexes: Ecoaudit report of the scenarios

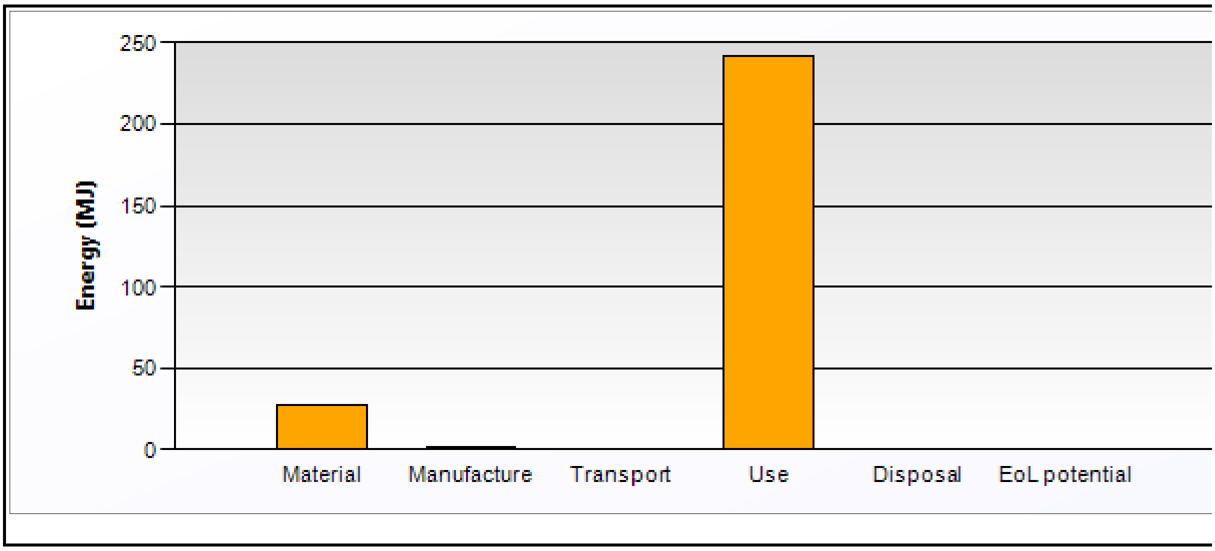
CES 2014 EDUPACK

Eco Audit Report

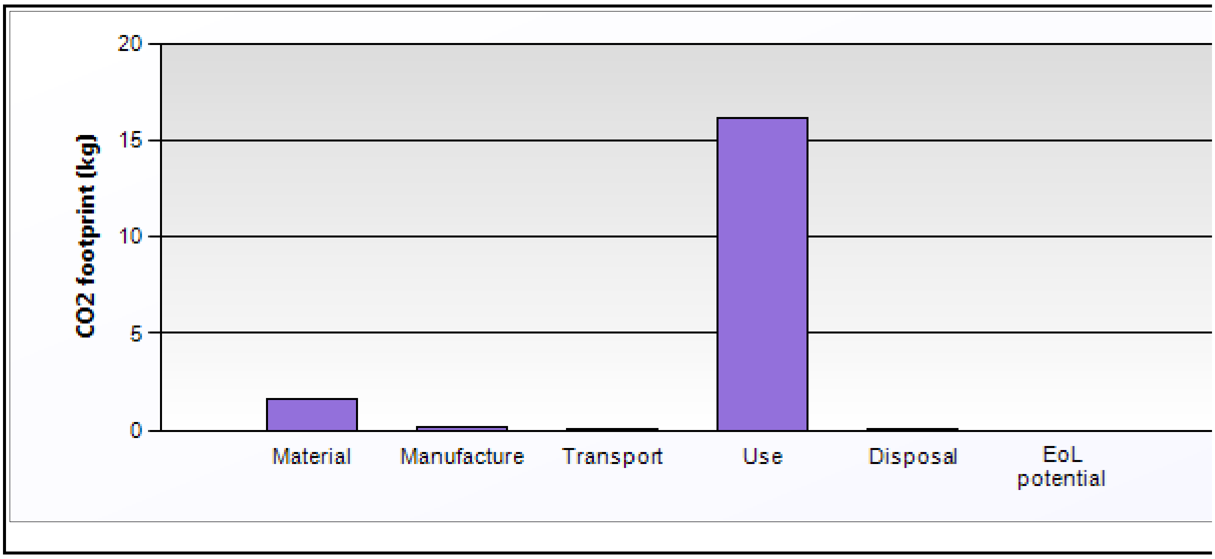
Product Name conventional jeans

Product Life (years) 4

Energy and CO2 Footprint Summary:



Energy Details...



CO2 Details...

Phase	Energy (MJ)	Energy (%)	CO2 (kg)	CO2 (%)
Material	28	10,3	1,58	8,8

Manufacture	1,7	0,6	0,135	0,8
Transport	0,664	0,2	0,0472	0,3
Use	242	88,8	16,1	90,1
Disposal	0,12	0,0	0,0084	0,0
Total (for first life)	**272**	**100**	**17,9**	**100**
End of life potential	0		0	

Eco Audit Report

Energy Analysis

Energy and CO2 Summary

	Energy (MJ/year)
Equivalent annual environmental burden (averaged over 4 year product life):	68,1

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Energy (MJ)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	27	98,1
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,54	1,9
Total				**2**	**0,62**	**28**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	Energy (MJ)	%
cotton	Fabric production	-	0,6 kg	1,6	91,9
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,14	8,1
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**1,7**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Energy (MJ)	%
china>NL	Sea freight	5e+03	0,49	74,1
Nl>NL	Light goods vehicle	2e+02	0,17	25,9
Total		**5,2e+03**	**0,66**	**100**

Breakdown by components

Component	Mass (kg)	Energy (MJ)	%
cotton	0,6	0,65	97,6
rivets	0,015	0,016	2,4
Total	**0,62**	**0,66**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	Energy (MJ)	%
Static	2,4e+02	100,0
Mobile	0	
Total	**2,4e+02**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Landfill	50,0	0,12	100,0
rivets	None	100,0	0	0,0
Total			**0,12**	**100**

EoL potential:

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Landfill	50,0	0	
rivets	None	100,0	0	
Total			**0**	**100**

Notes:

Energy and CO2 Summary

Eco Audit Report

CO2 Footprint Analysis

Energy and CO2 Summary

	CO2 (kg/year)
Equivalent annual environmental burden (averaged over 4 year product life):	4,48

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	CO2 footprint (kg)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	1,5	97,7
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,036	2,3
Total				**2**	**0,62**	**1,6**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	CO2 footprint (kg)	%
cotton	Fabric production	-	0,6 kg	0,12	92,4
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,01	7,6
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**0,14**	**100**

Transport:

[Energy and CO2 Summary](#)

Breakdown by transport stage

Stage name	Transport type	Distance (km)	CO2 footprint (kg)	%
china>NL	Sea freight	5e+03	0,035	74,1
Nl>NL	Light goods vehicle	2e+02	0,012	25,9
Total		**5,2e+03**	**0,047**	**100**

Breakdown by components

Component	Mass (kg)	CO2 footprint (kg)	%
cotton	0,6	0,046	97,6
rivets	0,015	0,0012	2,4
Total	**0,62**	**0,047**	**100**

Use:

[Energy and CO2 Summary](#)

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	CO2 footprint (kg)	%
Static	16	100,0
Mobile	0	
Total	**16**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Landfill	50,0	0,0084	100,0
rivets	None	100,0	0	0,0
Total			**0,0084**	**100**

EoL potential:

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Landfill	50,0	0	
rivets	None	100,0	0	
Total			**0**	**100**

Notes:

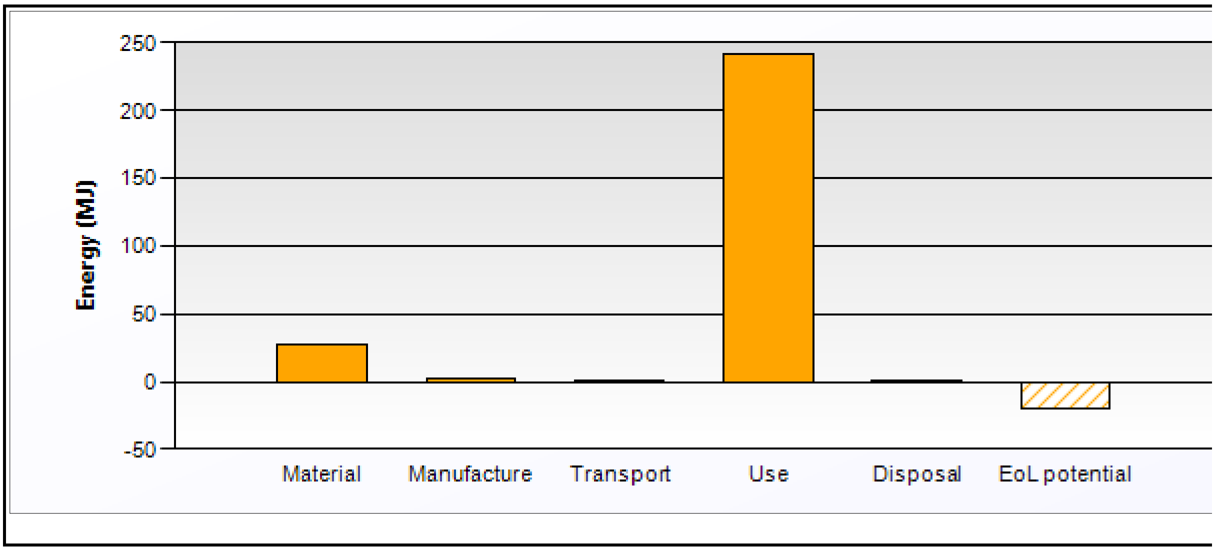
Energy and CO2 Summary

Eco Audit Report

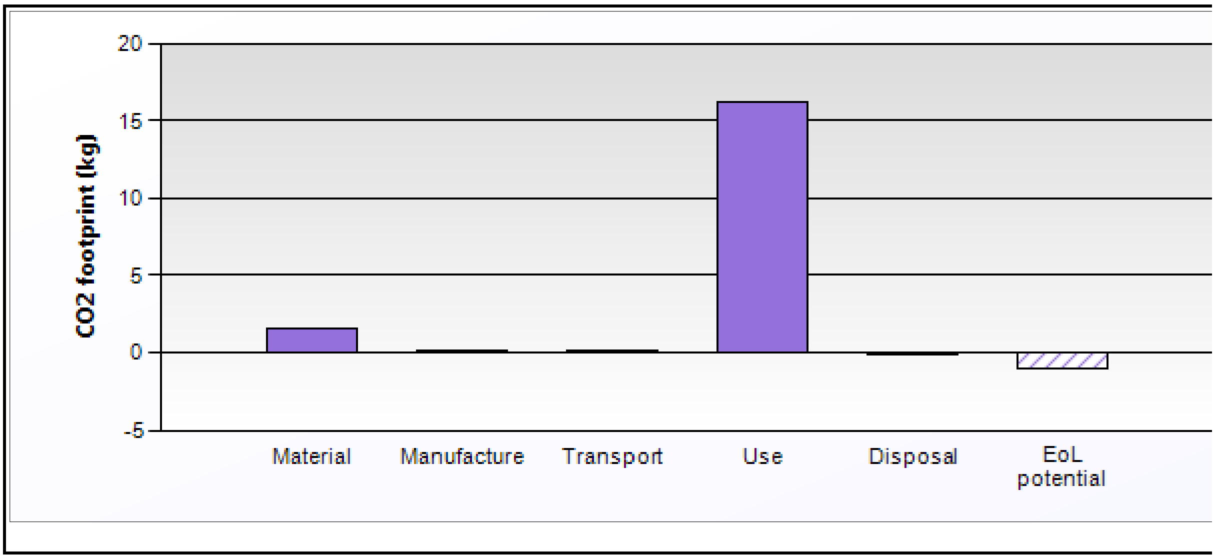
Product Name mud

Product Life (years) 4

Energy and CO2 Footprint Summary:



Energy Details...



CO2 Details...

Phase	Energy (MJ)	Energy (%)	CO2 (kg)	CO2 (%)
Material	28	10,3	1,58	8,8
Manufacture	1,7	0,6	0,135	0,8
Transport	0,956	0,4	0,0679	0,4

Use	242	88,7	16,1	90,0
Disposal	0,12	0,0	0,0084	0,0
Total (for first life)	**273**	**100**	**17,9**	**100**
End of life potential	-19,2		-1,07	

Eco Audit Report

Energy Analysis

Energy and CO2 Summary

	Energy (MJ/year)
Equivalent annual environmental burden (averaged over 4 year product life):	68,1

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Energy (MJ)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	27	98,1
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,54	1,9
Total				**2**	**0,62**	**28**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	Energy (MJ)	%
cotton	Fabric production	-	0,6 kg	1,6	91,9
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,14	8,1
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**1,7**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Energy (MJ)	%
italy>NL	14 tonne truck	1,5e+03	0,78	82,0
Nl>NL	Light goods vehicle	2e+02	0,17	18,0
Total		**1,7e+03**	**0,96**	**100**

Breakdown by components

Component	Mass (kg)	Energy (MJ)	%
cotton	0,6	0,93	97,6
rivets	0,015	0,023	2,4
Total	**0,62**	**0,96**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	Energy (MJ)	%
Static	2,4e+02	100,0
Mobile	0	
Total	**2,4e+02**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Re-manufacture	75,0	0,12	100,0
rivets	None	100,0	0	0,0
Total			**0,12**	**100**

EoL potential:

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Re-manufacture	75,0	-19	100,0
rivets	None	100,0	0	0,0
Total			**-19**	**100**

Notes:

Energy and CO2 Summary

Eco Audit Report

CO2 Footprint Analysis

Energy and CO2 Summary

	CO2 (kg/year)
Equivalent annual environmental burden (averaged over 4 year product life):	4,48

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	**Material**	**Recycled content* (%)**	**Part mass (kg)**	**Qty.**	**Total mass processed** (kg)**	**CO2 footprint (kg)**	**%**
cotton	Cotton	Virgin (0%)	0,6	1	0,6	1,5	97,7
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,036	2,3
Total				**2**	**0,62**	**1,6**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	**Process**	**% Removed**	**Amount processed**	**CO2 footprint (kg)**	**%**
cotton	Fabric production	-	0,6 kg	0,12	92,4
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,01	7,6
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**0,14**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	CO2 footprint (kg)	%
italy>NL	14 tonne truck	1,5e+03	0,056	82,0
Nl>NL	Light goods vehicle	2e+02	0,012	18,0
Total		**1,7e+03**	**0,068**	**100**

Breakdown by components

Component	Mass (kg)	CO2 footprint (kg)	%
cotton	0,6	0,066	97,6
rivets	0,015	0,0017	2,4
Total	**0,62**	**0,068**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	CO2 footprint (kg)	%
Static	16	100,0
Mobile	0	
Total	**16**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Re-manufacture	75,0	0,0084	100,0
rivets	None	100,0	0	0,0
Total			**0,0084**	**100**

EoL potential:

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Re-manufacture	75,0	-1,1	100,0
rivets	None	100,0	0	0,0
Total			**-1,1**	**100**

Notes:

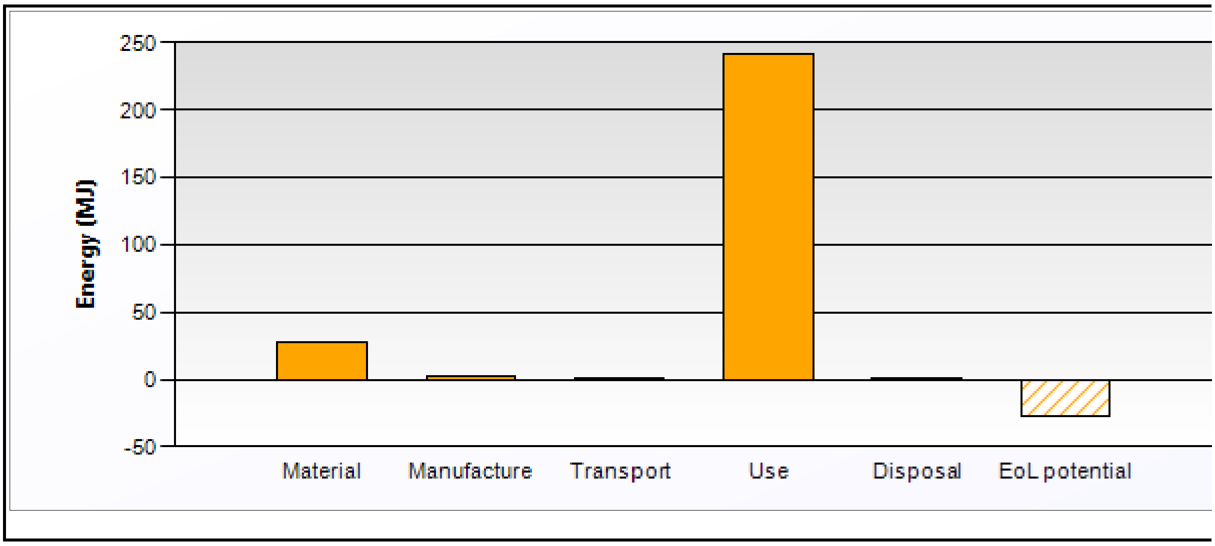
Energy and CO2 Summary

Eco Audit Report

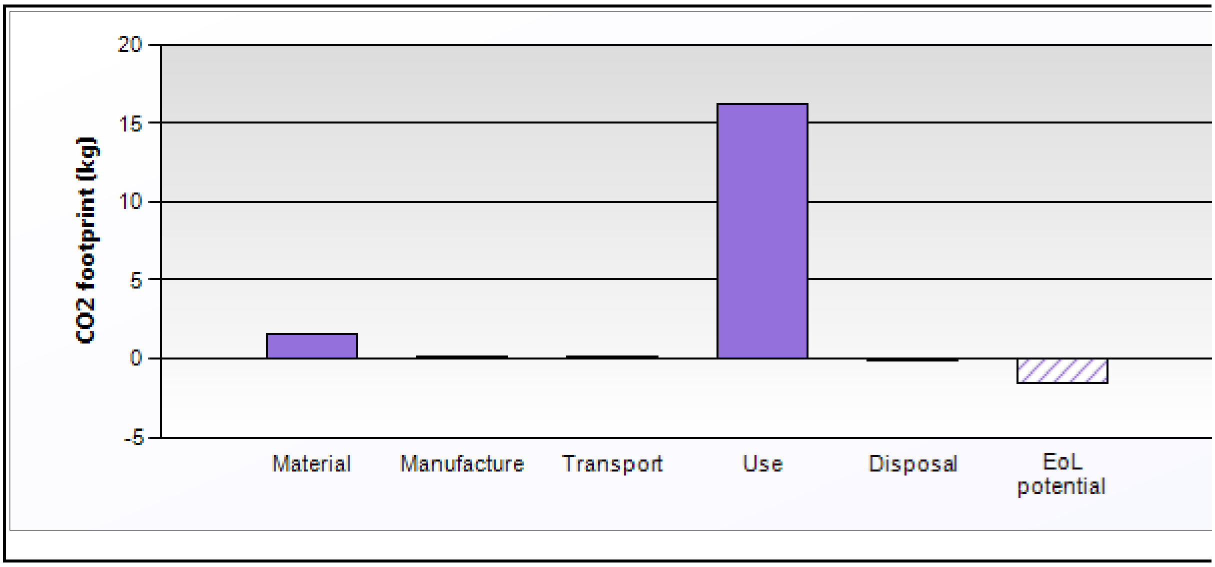
Product Name mud reuse

Product Life (years) 4

Energy and CO2 Footprint Summary:



Energy Details...



CO2 Details...

Phase	Energy (MJ)	Energy (%)	CO2 (kg)	CO2 (%)
Material	28	10,3	1,58	8,8
Manufacture	1,7	0,6	0,135	0,8
Transport	0,956	0,4	0,0679	0,4

Use	242	88,7	16,1	90,0
Disposal	0,12	0,0	0,0084	0,0
Total (for first life)	**273**	**100**	**17,9**	**100**
End of life potential	-27,4		-1,55	

Eco Audit Report

Energy Analysis

Energy and CO2 Summary

	Energy (MJ/year)
Equivalent annual environmental burden (averaged over 4 year product life):	68,1

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Energy (MJ)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	27	98,1
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,54	1,9
Total				**2**	**0,62**	**28**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	Energy (MJ)	%
cotton	Fabric production	-	0,6 kg	1,6	91,9
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,14	8,1
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**1,7**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Energy (MJ)	%
italy>NL	14 tonne truck	1,5e+03	0,78	82,0
Nl>NL	Light goods vehicle	2e+02	0,17	18,0
Total		**1,7e+03**	**0,96**	**100**

Breakdown by components

Component	Mass (kg)	Energy (MJ)	%
cotton	0,6	0,93	97,6
rivets	0,015	0,023	2,4
Total	**0,62**	**0,96**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	Energy (MJ)	%
Static	2,4e+02	100,0
Mobile	0	
Total	**2,4e+02**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Reuse	100,0	0,12	100,0
rivets	None	100,0	0	0,0
Total			**0,12**	**100**

EoL potential:

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Reuse	100,0	-27	100,0
rivets	None	100,0	0	0,0
Total			**-27**	**100**

Notes:

Energy and CO2 Summary

Eco Audit Report

CO2 Footprint Analysis

Energy and CO2 Summary

	CO2 (kg/year)
Equivalent annual environmental burden (averaged over 4 year product life):	4,48

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	CO2 footprint (kg)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	1,5	97,7
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,036	2,3
Total				**2**	**0,62**	**1,6**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	CO2 footprint (kg)	%
cotton	Fabric production	-	0,6 kg	0,12	92,4
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,01	7,6
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**0,14**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	CO2 footprint (kg)	%
italy>NL	14 tonne truck	1,5e+03	0,056	82,0
Nl>NL	Light goods vehicle	2e+02	0,012	18,0
Total		**1,7e+03**	**0,068**	**100**

Breakdown by components

Component	Mass (kg)	CO2 footprint (kg)	%
cotton	0,6	0,066	97,6
rivets	0,015	0,0017	2,4
Total	**0,62**	**0,068**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	16
Product life (years)	4

Relative contribution of static and mobile modes

Mode	CO2 footprint (kg)	%
Static	16	100,0
Mobile	0	
Total	**16**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Reuse	100,0	0,0084	100,0
rivets	None	100,0	0	0,0
Total			**0,0084**	**100**

EoL potential:

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Reuse	100,0	-1,5	100,0
rivets	None	100,0	0	0,0
Total			**-1,5**	**100**

Notes:

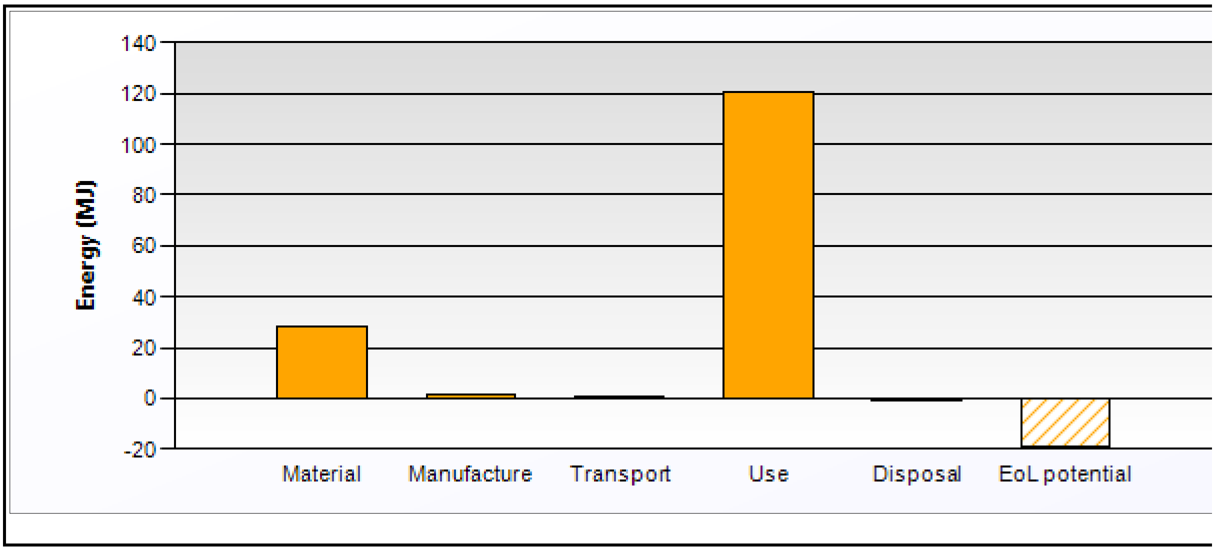
Energy and CO2 Summary

Eco Audit Report

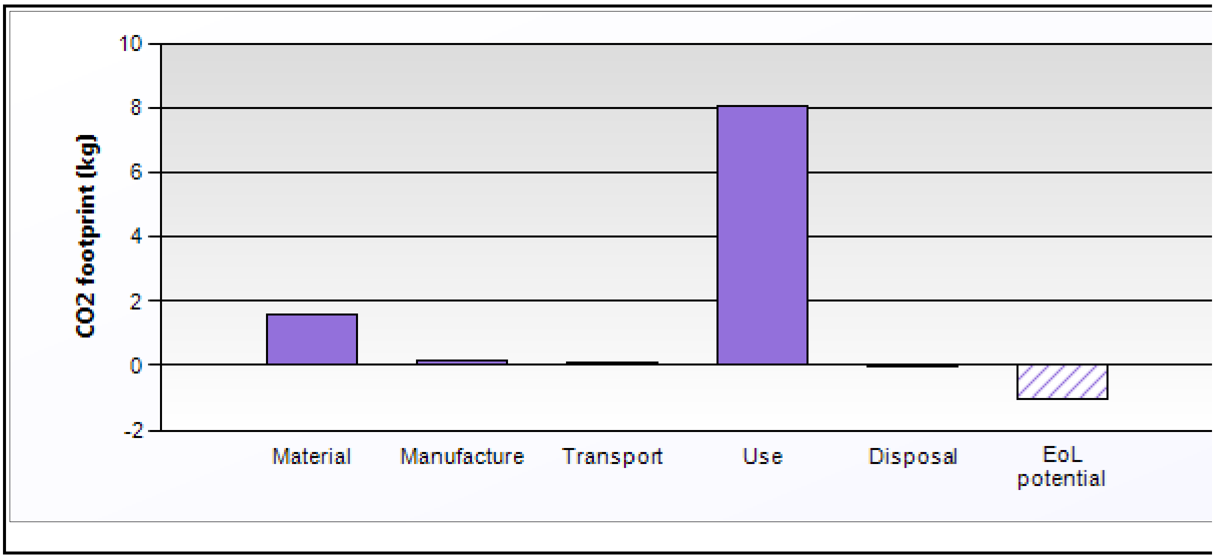
Product Name mud nowash

Product Life (years) 4

Energy and CO2 Footprint Summary:



Energy Details...



CO2 Details...

Phase	Energy (MJ)	Energy (%)	CO2 (kg)	CO2 (%)
Material	28	18,4	1,58	16,0
Manufacture	1,7	1,1	0,135	1,4
Transport	0,956	0,6	0,0679	0,7

Use	121	79,7	8,06	81,8
Disposal	0,12	0,1	0,0084	0,1
Total (for first life)	**152**	**100**	**9,86**	**100**
End of life potential	-19,2		-1,07	

Eco Audit Report

Energy Analysis

Energy and CO2 Summary

	Energy (MJ/year)
Equivalent annual environmental burden (averaged over 4 year product life):	37,9

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Energy (MJ)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	27	98,1
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,54	1,9
Total				**2**	**0,62**	**28**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	Energy (MJ)	%
cotton	Fabric production	-	0,6 kg	1,6	91,9
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,14	8,1
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**1,7**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Energy (MJ)	%
italy>NL	14 tonne truck	1,5e+03	0,78	82,0
Nl>NL	Light goods vehicle	2e+02	0,17	18,0
Total		**1,7e+03**	**0,96**	**100**

Breakdown by components

Component	Mass (kg)	Energy (MJ)	%
cotton	0,6	0,93	97,6
rivets	0,015	0,023	2,4
Total	**0,62**	**0,96**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	8
Product life (years)	4

Relative contribution of static and mobile modes

Mode	Energy (MJ)	%
Static	1,2e+02	100,0
Mobile	0	
Total	**1,2e+02**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Re-manufacture	75,0	0,12	100,0
rivets	None	100,0	0	0,0
Total			**0,12**	**100**

EoL potential:

Component	End of life option	% recovered	Energy (MJ)	%
cotton	Re-manufacture	75,0	-19	100,0
rivets	None	100,0	0	0,0
Total			**-19**	**100**

Notes:

Energy and CO2 Summary

Eco Audit Report

CO2 Footprint Analysis

Energy and CO2 Summary

	CO2 (kg/year)
Equivalent annual environmental burden (averaged over 4 year product life):	2,46

Detailed breakdown of individual life phases

Material:

Energy and CO2 Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	CO2 footprint (kg)	%
cotton	Cotton	Virgin (0%)	0,6	1	0,6	1,5	97,7
rivets	Coated copper, copper, lead coated	Typical %	0,015	1	0,015	0,036	2,3
Total				**2**	**0,62**	**1,6**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Energy and CO2 Summary

Component	Process	% Removed	Amount processed	CO2 footprint (kg)	%
cotton	Fabric production	-	0,6 kg	0,12	92,4
cotton	Cutting and trimming	-	0 kg	0	0,0
rivets	Casting	-	0,015 kg	0,01	7,6
rivets	Cutting and trimming	-	0 kg	0	0,0
Total				**0,14**	**100**

Transport:

Energy and CO2 Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	CO2 footprint (kg)	%
italy>NL	14 tonne truck	1,5e+03	0,056	82,0
Nl>NL	Light goods vehicle	2e+02	0,012	18,0
Total		**1,7e+03**	**0,068**	**100**

Breakdown by components

Component	Mass (kg)	CO2 footprint (kg)	%
cotton	0,6	0,066	97,6
rivets	0,015	0,0017	2,4
Total	**0,62**	**0,068**	**100**

Use:

Energy and CO2 Summary

Static mode

Energy input and output type	Electric to thermal
Use location	Netherlands
Power rating (kW)	0,5
Usage (hours per day)	1
Usage (days per year)	8
Product life (years)	4

Relative contribution of static and mobile modes

Mode	CO2 footprint (kg)	%
Static	8,1	100,0
Mobile	0	
Total	**8,1**	**100**

Disposal:

Energy and CO2 Summary

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Re-manufacture	75,0	0,0084	100,0
rivets	None	100,0	0	0,0
Total			**0,0084**	**100**

EoL potential:

Component	End of life option	% recovered	CO2 footprint (kg)	%
cotton	Re-manufacture	75,0	-1,1	100,0
rivets	None	100,0	0	0,0
Total			**-1,1**	**100**

Notes:

Energy and CO2 Summary