# Environmental impact calculations:

Home textile products - Upcycling scenario compared to conventional approach

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## Introduction

This study describes the environmental impact calculations from generic modelling of two lifecycle scenarios of making home textile products: Upcycling scenario (a) using textile waste from the health sector as input to produce new textile products, and Conventional (b) which is a regular approach for making Home textile products using virgin materials for the input.
Both scenarios consider cradle to grave, are using exclusively generic data, and are considering 1 kilogram (kg) textile.

**The purpose of this report**

It should be noted that the purpose of this report is only to provide a general knowledge and understanding of the difference between two ways of making Home textile products:

- Home textile products made of upcycled textile waste (Reuse of existing textile waste as raw materials)
- Home textile products made of conventional technique (Extraction of new/virgin raw material to the incineration of the waste after use)

To calculate the data and analyse the results, a software called SimaPro is used, including generic processes from the EcoInvent database. Data and assumptions on Use Phase are based on the study called *'LCA of bed sheets – some relevant parameters for lifetime assessment'* from 2012 as this is found to be the best available data representing home textile products.

## 1. How to use the results from this report

**Process**. All processes are found in the EcoInvent database in SimaPro software, and they are chosen as generic processes. Hence, It is important to consider that the numbers mentioned in Table 1 and Table 2 do not represent the values of a specific system or service. It is, however, a generic model imitating central concepts of how Amolia is producing their products.

**Environmental impact.** There are many factors to consider when applying Life cycle assessments (LCAs), thus, the values found in this report shall not be used to document any company's exact service footprints. However, as a general overview, the results do illustrate that the production setup in a supply chain such as the one Amolia has constructed, has remarkable environmental benefits compared to conventional production. Still, this does not mean that upcycling the home textile products or Amolia's function as such are sustainable, and this analysis would not support this claim.

## 2. Description of the system

As explained in the previous sections, the final textile products from the Upcycling scenario in this study such as pillow covers and linens are made of textile waste collected from the health sectors. Basically, the old or worn out fabrics that would normally go to incineration, become upcycled to new products (Figure 1).
Textile waste is collected from a hospital in Denmark and goes to the upcycling process (in this case to Amolia in Holbæk). During the process, the intact part of the textile is cut, packed and sent for further manufacturing in Poland. This process includes washing and dyeing of fabrics as well as sewing the home textile products. For selling the home textile products, the finished product is sent back from Poland to Denmark and sold in Denmark. When the customer (end user) throws the textile products away, they are taken to the incineration sites in Denmark.

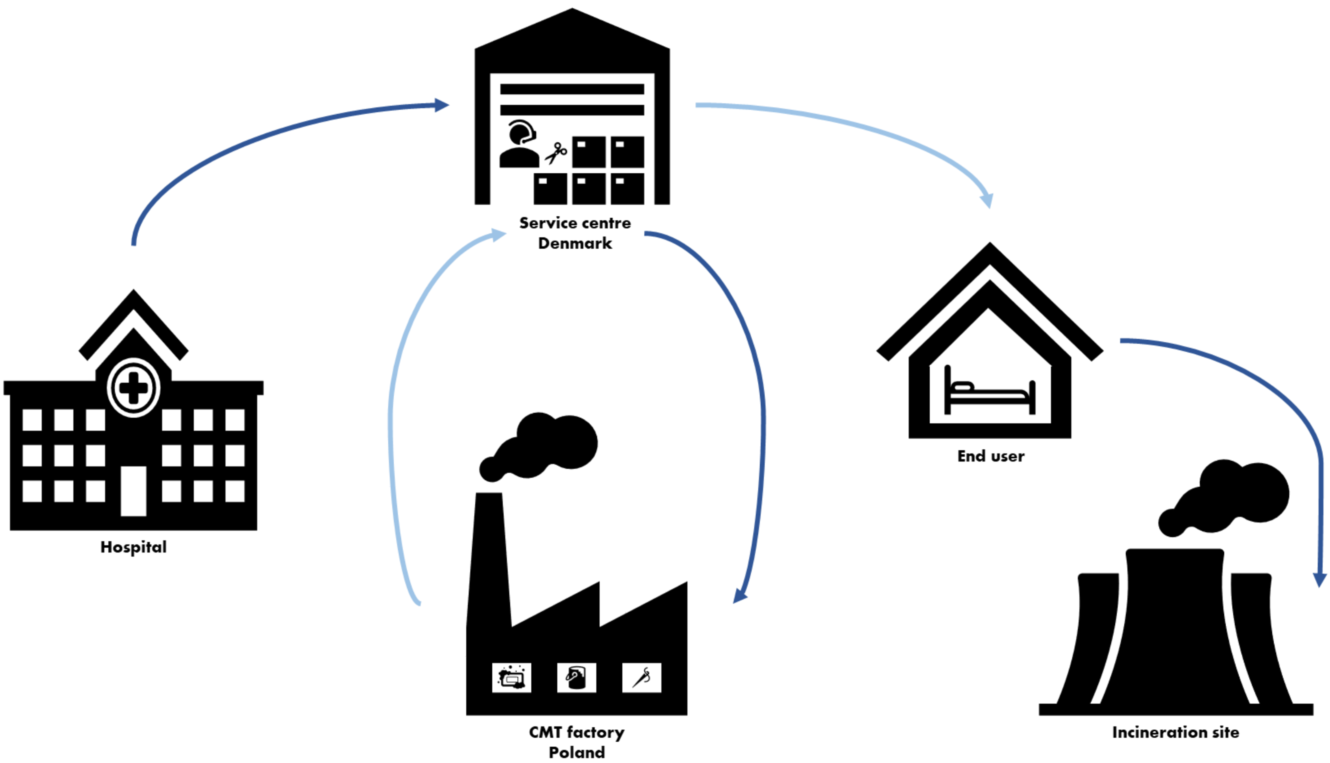


**Figure 1.** Life cycle of the textile waste after its end-of-life at the hospital.

From an environmental standpoint, 'free in impact' is a term used when waste is chosen as an alternative to the raw materials in production of a product, as done in the Upcycling scenario. This means that in the modelling of this scenario, for instance, the process of making textile products is not competing for the same input material as the other sector.

Comparing the Conventional scenario to the Upcycling scenario, the latter shows huge savings in environmental impacts. The comparison between the scenarios in terms of their impact on the environment has been provided in Table 1. As can be seen, the results from

Upcycling scenarios, shows a noticeable impact reduction in the 3 impact categories, namely Global Warming Potential, Land Use and Water Consumption.

# 3. Results

## a. Calculation of environmental impact

The analysis is done on 18 impact categories shown in Appendix A. However, 3 out of 18 are the most concerning in the textile industry that are chosen and shown in Table 1.

**Table 1.** Comparison between the environmental impact of scenarios conventional and upcycling on 3 impact categories

| Environmental impact on impact categories | Conventional scenario | Upcycling scenario (100%) | Upcycling scenario (50%) | Upcycling scenario (35%) |
|---|---|---|---|---|
| Global Warming Potential (kg CO2e) | 22,3 | 5,82 | 5,52 | 5,43 |
| Land Use (m2a crop eq) | 13,3 | 0,95 | 0,31 | 0,113 |
| Water Consumption (m3) | 5,59 | 0,135 | 0,099 | 0,088 |

The study from 2012, shows that bed sheets are assumed to be washed every 15 days **[1]** resulting in 26 washing cycles a year. This form the basis of our assumptions for the Use Phase. The CPU results, for both scenarios, are calculated assuming that one Use Phase (100%) is one year of usage, meaning 26 washing cycles before the product is discarded. Since the raw materials in the Upcycling scenario for home textile products are reused, it is assumed that there might be less durability in the textile. Hence, the CPU for 13 times and 9 times of washing cycle is also included (50% and 35%, respectively). The inclusion of these scenarios are due to the assumption that some of the final products made with waste textiles might be less durable than newly bought home textile products due to the wear and tear in the primary use phase. CPU results indicate that upcycling of the textile waste could significantly reduce the burden on the environment overall, and push towards the transition towards sustainability. This is due to the skipped stages - from fibre extraction and yarn production processes - of new textile production.

As shown, the Upcycling scenario (100%) has a considerably lower impact on Global Warming Potential compared to the Conventional scenario (5,82 kg CO2e and 22,3 kg CO2e, respectively). The environmental burden on Land Use is 14 times less in the Upcycling scenario (100%). Water Consumption environmental impact has also improved from 5,59 m3 to 0,135 m3, when the input is reused textile waste.

## b. Process contribution

The most contributing processes in the environmental impact arising from Upcycling scenario are described based on the abovementioned impact categories in 4.a:

**Global Warming Potential.** Apart from the incineration of 1 kg of textile, the largest contributor to the total Global Warming impact is energy consumption in Poland, both for heat and power. Transportation between Denmark and Poland has the third highest contribution.

**Land Use.** Energy source to generate overall electricity is the largest process that contributes to the impact on the Land Use category.

**Water Consumption.** The amount of water used during source irrigation, washing of the covers and dyeing the textile, have the largest impact on the total impact on Water Consumption, respectively. After that, wastewater produced during textile dyeing is the largest contributor.

### c. Calculation of Cost Per Use

Cost per use (CPU) of the Use phase for washing the home textile products are indicated in Table 2.

**Table 2.** Comparison between cost per use impact of scenarios conventional and upcycling on 3 impact categories

| CPU on impact categories | Conventional scenario (100%) | Upcycling scenario (100%) | Upcycling scenario (50%) | Upcycling scenario (35%) |
|---|---|---|---|---|
| Global Warming Potential (kg CO2e/use) | 0,85 | 0,22 | 0,42 | 0,6 |
| Land Use (m2a crop eq/use) | 0,52 | 0,036 | 0,02 | 0,125 |
| Water Consumption (m3/use) | 0,21 | 0,005 | 0,007 | 0,009 |

CPU is calculated based on the following equation:

$$CPU = \frac{Environmental\ impact\ result\ of\ each\ impact\ category}{number\ of\ washing}$$

## 4. Details of the modelling

Analyses of data for both scenarios are based on consequential modelling; meaning that the consequences for the market have been included in the calculation. The following details are only related to the upcycling scenario, as this is the main focus of this study.

The following main assumptions and estimations for generic modelling are being considered:

- 10% cut-off in the Cut-Make-Trim in Poland.

- 33% of the waste textiles transported from the hospital in Denmark to the cutting and storage facility will be used for making of the final product.
- The weight of a cardboard box for packaging has been considered to be 0.3 kg for 1 kg reusable textile waste.
- Transport within Denmark has been assumed to be newer trucks (EURO 6) **[2]** but transport between Denmark and Poland and inside Poland has been assumed to be older trucks (EURO 3) **[2]**.
- It is assumed that packaging production aligns with global production standards and technology. The gravure printing on the cardboard boxes is included.
- It is assumed that upcycled home textile products have a shorter active life than the conventional ones.
- It is assumed that the Use Phase takes place in Denmark and that the home textile products are washed using washing machines in private households.
- It is assumed that the lifetime of the home textile products is 26 washes.
- It is assumed that the home textile products are washed using detergents (0,0158 kg per kg textile), but not fabric softener.
- It is assumed that the home textile products are air dried.
- Washing temperature is assumed to be 40 degrees celsius.
- Based on a study **[3]**, the average wash load is assumed to be 3,6 kg which is 59% of a full (6kg) load.

Table 3 and Table 4 (Appendix B) includes the stages of the modelling, followed by description of the phase, the relevant chosen processes and their calculated amount.

# 5. Conclusion

This report is provided to calculate the environmental impact arising from the Upcycling scenario. This is due to:

- having a rough imitation of the overall concept behind Amolia's technique to produce new textile products,
- estimating the environmental benefit that an Upcycling approach could possibly have, compared to the Conventional approach.

The results from the calculation indicate that reusing the textile waste as input, to produce new products, has a great advantage and less harmful impact on the environment. These results remain the same despite the fact that the lifespan of home textile products made of upcycled textile might be shorter.

Nevertheless, it is important to note that the results of this study are obtained from using generic processes and rough estimations. Therefore, they do not suggest whether any of the scenarios are sustainable. In addition, the results have no representation of any specific process, system or service.

## Bibliography

**[1]** De Saxce, M., Pesnel, S. and Perwuelz, A., 2012. LCA of bed sheets–some relevant parameters for lifetime assessment. Journal of Cleaner Production, 37, pp.221-228.
**[2]** European Emission Standard
**[3]** Faberi, S., Pressuto, M., Stamminger, R., Scialdoni, R., Mebane, W. & Esposito, R. (2007) Preparatory study for eco-design requirements of EuPs. LOT 14 Domestic washing machines & dishwashers. Final Report Task 3–5–1. 373.

**Appx. A**

## Description of Impact Categories

| | Name of impact category | Description | Potential Ecological risks |
|---|---|---|---|
| 1 | **Land use (m2a crop eq)** | Measures changes in the quality of soil and landscape change patterns. | Measuring the impact related to land use includes the direct, local impact of land use on terrestrial species via (1) change of land cover and (2) the actual use of new land. Change of land cover directly affects the original habitat and thereby the local species. The land use itself (i.e. agricultural and urban activities) prevents many species from inhabiting the land.<br><br>The impact category includes measuring in Potentially Disappeared Fraction of Species (PDF) per annual crop equivalent, ang the negative effects during land -relaxation (after the land is used).<br><br>Biodiversity may also be affected indirectly by land use, as a change of land cover and land use intensification may lead to increased emissions of greenhouse gases from biomass burning, fertilizer application and soil disturbance, and may therefore contribute to climate change.<br><br>Measuring land use includes the following potential ecological risks:<br>Biodiversity decrease for species (+ geneteic level and generaelt ecossytem)<br>Changes in regional and global climate du to land changes or albedo e.g. deforsitation / desertation may reduce preciptaton<br>Soil erosion and desertation (or genereal dry land), resulting in reduced food production<br>Water rise and loss of drought landscapes<br>Changes in water cycles |
| 2 | **Water consumption (m3 water)** | Measures the consequences of the water deprivation for humans and ecosystems. | Water consumption represents freshwater withdrawals which are evaporated, incorporated in products and waste, transferred into different watersheds, or disposed into the sea after usage.<br><br>The indirect water consumption (consumptive use).<br>Water consumption measures the consequences of reduction in freshwater availability having impact on both human health and terrestrial ecosystems.<br><br>Too little irrigation will lead to reduced crop production, following an decrease in crops and resulting in malnutrition among the local population.<br><br>Water consumption impacts on terrestrial ecosystems are modelled via a potential reduction in vegetation and plant diversity. Reduction in blue water (water in lakes, rivers and aquifers) will potentially also reduce the available green water (soil moisture) and thus lead to a reduction in plant species. The fractions of freshwater fish<br>that disappear due to water consumption are estimated based on species discharge relationships at river mouths. |
| 3 | **GWP (kg CO2 eq)** | Indicator of potential global warming due to emissions of greenhouse gases to air (including carbon dioxide, methane, nitrous oxide, and fluorinated gases (F-gases)).<br><br>Divided into 3 subcategories based on the emission source: (1) fossil resources, (2) bio-based resources and (3) land use change. | For the impact category climate change, the damage modelling is subdivided into several steps.<br>The following consequences of green house gas emissions are taken in account following these steps; CO2eq emissions results in increased atmospheric concentration of greenhouse gases (ppb), increased radiative forcing capacity and lastly increased global mean temperature.<br><br>Increased global temperature will ultimately results in damage to human health and ecosystems, in which the damage to human health, terrestrial ecosystems and freshwater ecosystems is inlcuded as estimation. |
| 4 | **Ozone formation (kg NOx eq)** | Measuring ozone formation in the troposphere. | Ozone is a secondary pollutant formed in the troposphere under the influence of sunlight when nitrogen oxides are present.<br><br>The impact category includes ozone formation, photochemical ozone formation or creation, photo oxidant formation, photosmog or summer smog. There are small differences between the five, but in essence they all address the impacts from ozone and other reactive oxygen compounds formed as secondary contaminants in the troposphere.<br><br>The negative impacts related to Ozone formation are on humans arise when the ozone and other reactive oxygen compounds in air are inhaled, and damage tissue causing respiratory diseases. Ozone formation also have negative impacts on vegetation by attacking surfaces of plants causing damage on the photosynthetic organs. Ozone formation also damage man-made materials through oxidation. |
| 5 | **Stratespheric Ozone Depletion (kg CFC-11-eq)** | Measuring Ozone Depletion Potentials (ODP) through indicators of emissions to air - Ozone Depleting Substances (ODSs) - that cause the destruction of the stratospheric ozone layer. | Ozone Depleting Substances (ODSs) emissions eventually result in damage on human health due increased UVB radiation. The radiation increases the incidence of skin cancer and cataracts, thus negatively affects human health. |
| 6 | **Ionizing Radiation (kBq Co-60 eq)** | Damage to human health and ecosystems linked to the emissions of radionuclides. | Radionuclides result in anthropogenic emissions. Radionuclides are generated in e.g. mining, processing and waste disposal (and other process involving a nuclear fuel cycle), as well as during other human activities, such as the burning of coal and the extraction of<br>phosphate rock.<br><br>Exposure to ionizing radiation, caused by anthropogenic emissions of radionuclides, can lead to damaged DNA-molecules.<br>During the effect analysis, the incidence of non-fatal cancers and the incidence of fatal cancers are distinguished from severe gentic diseases/ effects. As a final step, these are weighed in order to calculate the damage to human health in disability adjusted life years (DALY).<br><br>There are currently no impact assessment methodologies to quantify the damage caused to ecosystems by ionizing radiation. |
| 7 | **Fine particle matter formation (kg PM2.5 eq)** | Indicator of the potential incidence of disease due to particulate matter emissions. | Air pollution that causes primary and secondary aerosols in the atmosphere can have a substantial negative impact on human health, ranging from respiratory symptoms to hospital admissions and death.<br><br>Fine Particulate Matter with a diameter of less than 2.5 µm (PM2.5) represents a complex mixture of organic and inorganic<br>substances. PM2.5 causes human health problems as it reaches the upper part of the airways and lungs when inhaled. Secondary PM2.5 aerosols<br>are formed in air from emissions of sulfur dioxide (SO2), ammonia (NH3), and nitrogen oxides (NOx), among other elements |
| 8 | **Terrestrial acidification (kg SO2 eq)** | Indicator of the potential acidification of soils and water due to the release of gases such as nitrogen oxides and sulphur oxides. | Atmospheric deposition of inorganic substances (e.g. sulphates, nitrates and phosphates) cause the acidity content in the soil to change.<br><br>There is a clear defined preferred level of acidity for almost all plant species, thus a serious deviation from this optimum level is harmful for the specific kinds of species and is referred to as acidification. As a result, of the atmospheric deposition, changes in levels of acidity will cause shifts in a species occurrence, and thus biodiversity.<br><br>Major acidifying emissions are NOx, NH3 or SO2.<br><br>Atmospheric deposition being the process, whereby precipitation (rain, snow, fog), particles, aerosols, and gases move from the atmosphere to the earth's surface. |
| 9 | **Freshwater Eutrophication (kg P eq)** | Indicator of the enrichment of the fresh water ecosystem with nutritional elements, due to the emission of nitrogen or phosphor containing compounds. | Freshwater eutrophication occurs due to the discharge of nutrients into soil or into freshwater bodies and the subsequent rise in nutrient levels, i.e. phosphorus and nitrogen.<br><br>There are numerous impacts on the environment related to freshwater eutrophication. The ecological impacts derive from an increased concentration of nutrients in fresh water due to emissons, causing autotrophic organisms such as cyanobacteria and algae and heterotrophic species such as fish and invertebrates to heavily increase. Ultimately, this damage to freshwater ecosystems result in to loss of species. |

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|---|---|---|---|
| 10 | **Marine Eutrophication (kg N eq)** | Indicator of the enrichment of the marine ecosystem with nutritional elements, due to the emission of nitrogen containing compounds. | Marine eutrophication occurs when plant nutrients from soil leachs into marine systems, causing a heavy rise in nutrient levels i.e. phosphorus and nitrogen (N), assuming nitrogen as a limiting nutrient in marine waters.<br><br>One of the environmental consequences of increased concentration of nutrients in marine systems, is benthic oxygen depletion, which may lead to the onset of hypoxic waters and, if in excess, to anoxia and 'dead zones' - the latter being one of the most severe and widespread causes of damage to marine ecosystems. |
| 11 | **Terrestrial Ecotoxicity (kg 1,4-DCB)** | Indicator for influences of toxic substances on terrestrial ecosystems. | Terrestrial ecotoxcitiy measures the affect that toxic substances have on species on land. Ecotoxicity takes into account toxic impacts derived by following factors: (1) emitted quantity , (2) mobility, (3) persistence, (4) exposure patterns and (5) toxicity.<br><br>Impacts related to ecotoxcitiy includes potential increased mortality, reduced mobility, reduced growth or reproduction rate, mutations, behavioural changes, or changes in biomass or photosynthesis.<br><br>Terrestrial ecotoxicity is dominated by the use of pesticides to agriculture as well as the use of both sulphuric acid and steam during the process of converting land. |
| 12 | **Freshwater Ecotoxicity (kg 1,4-DCB)** | Impact on freshwater organisms of toxic substances emitted to the environment. | Ecotoxicity takes into account toxic impacts derived by following factors: (1) emitted quantity , (2) mobility, (3) persistence, (4) exposure patterns and (5) toxicity.<br><br>Freshwater ecotoxcitiy measures the affect of toxic substances has on cold-blooded species in freshwater;<br>1. Primary producers, converting sunlight into biomass via photosynthesis (i.e. phytoplankton, algae)<br>2. Primary consumers, living off primary producers (i.e. zooplankton, inverte- brates, planktivorous fish)<br>3. Secondary consumers at the upper end of the aquatic food chain (i.e. piscivorous fish<br><br>Impacts related to ecotoxcitiy includes potential increased mortality, reduced mobility, reduced growth or reproduction rate, mutations, behavioural changes, or changes in biomass or photosynthesis. |
| 13 | **Marine Ecotoxicity (kg 1,4-DCB)** | Indicator for influences of toxic substances on marine ecosystems. | Marine ecotoxcitiy measures the affect of toxic substances has on species in marine environemnts. Ecotoxicity takes into account toxic impacts derived by following factors: (1) emitted quantity, (2) mobility, (3) persistence, (4) exposure patterns and (5) toxicity.<br><br>Impacts related to ecotoxcitiy includes potential increased mortality, reduced mobility, reduced growth or reproduction rate, mutations, behavioural changes, or changes in biomass or photosynthesis.<br><br>The potential impact in the marine ecotoxcitiy may strongly depend on the **additional inputs of (essential) metals** to oceans also lead to toxic effects (Cobalt, Copper, Manganese, Molybdenum and Zinc). |
| 14 | **Human toxicity (kg 1,4-DCB)** | Impact on humans of toxic substances emitted to the environment. Divided into cancer and non-cancer related toxic substances (Human carcinogenic toxicity and Human non-carcinogenic toxicity). | Human toxicity takes into account toxic impacts derived by following factors: (1) emitted quantity (determined in the LCI), (2) mobility, (3) persistence, (4) exposure patterns and (5) human toxicity.<br><br>Measuremnets include human behaviour, such as dietary habits, influence human exposure pattern. Chemical emissions contribute or are responsible for many health issues such as non-cancer diseases, and increased cancer risks for those chemicals that are carcinogenic. |
| 15 | **Mineral resource scarcity (kg Cu eq)** | Measuring the future amount of average extra ore to be mined and the following effects on the area of protection and 'resources' caused by mineral resource consumption. | For the impact category of mineral resource scarcity, the damage modelling is subdivided into several steps; The primary extraction of a mineral resource (ME) will lead to an overall decrease in ore grade (OG), since the mines with the highes OG will be extracted first. This means that the concentration of that resource in ores worldwide in turn will increase the ore produced per kilogram of mineral resource extracted (OP) and lastly an average surplus ore potential (SOP).<br>Here, we estimated the damage to natural resource scarcity. |
| 16 | **Fossil fuel scarcity (kg oil eq)** | Measuring the long-term availability of fossil fuels. | The impact category takes in to consideration the consequences of future fossil fuel scarcity.<br><br>When all conventional oil is depleted, we will employ alternative techniques, such as enhanced oil recovery, production in alternative locations, etc. This additional production is defined as the marginal cost increase.<br><br>Fossil fuel scarcity is defined by the surplus cost derrived by the additional effort needed to extract more and more inaccessible fields of fossil fuels. |
| 16 | **Water scarcity (m3 eq water m3)** | Measuring water consumption relative to available water remaining per area in watershed. | The impact category indicates the potential of water deprivation both to humans and to ecosystems. The measurement builds on the assumption that the less water remaining available per area, the more likely another user (human or not) will be deprived.<br><br>The impact is calculated as the water availability minus the demand (AMD) for humans and aquatic systems, and how it is relative to the area. Thereafter, the value is normalised to the world average, resulting in the realtive value in comparlison with the average m3 consumed in the world. |
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| | **Sources** | | |
| | **Pré-sustaiability, Report ReCiPe update** | https://pre-sustainability.com/legacy/download/Report_ReCiPe_2017.pdf | |
| | **EcoChain** | https://ecochain.com/knowledge/impact-categories-lca/ | |

**Appendix B.** Details of the modelling.

**Table 3.** Life cycle stages of textile waste during the upcycling process. Detailed explanation of the included subjects and chosen process for modelling from EcoInvent database in SimaPro software.

| **Stage** | | **Input** | **Service** | | | **Description / Comment** |
|---|---|---|---|---|---|---|
| | | **Material** | **Water** | **Electricity** | **Transportation** | |
| **Raw materials** | **Fibre extraction** | 0 | 0 | 0 | 0 | No new input materials |
| **Manufacturing process** | **Yarn production** | 0 | 0 | 0 | 0 | Fabric is already existing |
| | **Fabric production** | **-** | Water consumption that is needed in specific processes, is included within the chosen processes | Storage: Total energy consumption (450 kwh) ÷ total weight of fabric (17600 kg) | Transport within {DK} from Bispebjerg to Holbaek | Distance: 70 km<br><br>Assumption: Assumed 66% waste that is being transported unnecessarily. |
| | **Fabric amount** | 17.6 tonnes / year (textile waste) | | 0,0255 kwh | 0,07 tkm | |
| | **Fabric production Processes** | **-** | | Electricity, low voltage {DK} market for, Conseq, U | Transport, freight, lorry 7.5-16 metric ton, euro6 {RER} market for transport, freight, | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | lorry 7.5-16 metric ton, EURO6, Conseq, U | |
| | **Cut-Make-Trim*** | *See Table 4 | | | | |
| **Use phase*** | | | | | | |
| **End-of-life** | **Incineration (1)** | | Water consumption that is needed in specific processes, is included within the chosen processes | | | Textile products end up being incinerated.<br><br>30 km from user to incineration is assumed. |
| | **Incineration amount** | - | | 1 kg | 0,03 tkm | |
| | **Incineration Process** | - | | Waste textile, soiled {CH}, treatment of, municipal incineration with fly ash extraction, Conseq, U | Transport, freight, lorry 16-32 metric ton, euro6 {RER}, market for transport, freight, lorry 16-32 metric ton, EURO6, Conseq, U | |
| | **Incineration (2)** | | | | | Single-use packaging is considered. All packages end up being incinerated in each stage.<br><br>30 km from user to incineration is assumed. |
| | **Incineration amount** | - | | 0,3 kg | 0,03 tkm | |
| | **Incineration** | - | | Waste | Transport, freight, | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Process** | | | paperboard {RoW}, treatment of, municipal incineration, Conseq, U | lorry 16-32 metric ton, euro6 {RER}, market for transport, freight, lorry 16-32 metric ton, EURO6, Conseq, U | |

**Table 4.** Detailed explanation of CMT and Use phase of Upcycling scenario, including the packaging process chosen for modelling from EcoInvent database in SimaPro software

| **Stage** | | **Description** | **Process** | **Amount** | **Unit** | **Comment** |
|---|---|---|---|---|---|---|
| **CMT** | | | | | | |
| **Electricity** | CMT energy | 2 kwh per kg fabric | Electricity, low voltage {PL}, market for, Conseq, U | 2 | kwh | Conservative estimation |
| **Water** | Water consumption that is needed in specific processes, is included within the chosen processes | | | | | |
| **Transport** | Transport from DK to PL | Truck to Poland: 1700 km * 1 kg | Transport, freight, lorry 16-32 metric ton, euro3 {RER}, market for transport, freight, lorry 16-32 metric ton, EURO3, Conseq, U | 1,7 | tkm | |
| | Transportation inside PL | From CMT to dyeing facility | Transport, freight, lorry 7.5-16 metric ton, euro3 {RER}, market for transport, freight, lorry 7.5-16 metric ton, EURO3, Conseq, U | 0,75 | tkm | Conservative estimation |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Transport back from PL to DK | Return of the finished and dyed products. 1700 km * 1 kg | Transport, freight, lorry 7.5-16 metric ton, euro3 {RER}, market for transport, freight, lorry 7.5-16 metric ton, EURO3, Conseq, U | 1,7 | tkm | |
| **Dyeing** | | Dying of 0,7 kg of fabric. | Batch dyeing, fibre, cotton {GLO}, market for batch dyeing, fibre, cotton, Conseq, U | 0,7 | kg | Generic dye process for cotton - the only option when using generic processes from EcoInvent. Assuming 70% of weight being dyed. |
| **Packaging** | | | | | | |
| **Packaging** | | Packaging of the waste textile from Denmark to Poland, Poland to Denmark and Denmark to end-users | Carton board box production, with gravure printing {GLO}, market for, Conseq, U | 0,3 | kg | Calculated based on estimation on weight of needed (kg) of cardboard for 1 kg of textile |
| **Use phase** | | | | | | |
| **Electricity** | Detergent electricity | The electricity used for detergent production process | Electricity, medium voltage, {RER}, market group for, Conseq, U | 0,25 | kWh | Conservative estimation |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Washing electricity | Electricity consumption during washing covers | Electricity, low voltage {DK}, market for, Conseq, U | 0,225 | kWh | |
| **Water** | Detergent water | The water used for detergent production process | Water, deionised {Europe without switzerland}, market for water, deionised, Conseq, U | 0,7022 | kg | |
| | Washing water | Water consumption during washing covers | Tap water {Europe without Switzerland}, Market for, Conseq, U | 6,2 | kg | |
| **Transport** | Transport within Denmark | From company to end users | Transport, freight, lorry 7.5-16 metric ton, euro6 {RER}, market for transport, freight, lorry 7.5-16 metric ton, EURO6, Conseq, U | 0,309 | tkm | |
| **Detergent** | | Detergent component including packaging and labelling | Used amount of detergent (Main process) | 0,0158 | kg | |
| | | | **Sub-processes that are forming 'main process' of detergent** | | | |
| | | | Alkyl sulphate (C12-14) {GLO}, market for alkyl sulphate (C12-14), Conseq, U | 0,1038 | | |

| | | | | | |
|---|---|---|---|---|---|
| | | Citric acid {RER}, production, Conseq, U | 0,0228 | | |
| | | Enzymes {RER}, enzymes production, Conseq, U | 0,0058 | | |
| | | Glycerine {RER}, market for glycerine, Conseq, U | 0,0285 | | |
| | | Non-ionic surfactant {GLO}, market for non-ionic surfactant, Conseq, U | 0,0591 | | |
| | | Polyethylene, linear low density, granulate {GLO}, market for, Conseq, U | 0,0466 | | |
| | | Soap {RER}, production, Conseq, U | 0,0241 | | |
| | | Sodium Hydroxide, without water, in 50% solution state {GLO}, market for, Conseq, U | 0,0231 | | |
| | | Polyethylene, high density, granulate {GLO}, market for, Conseq, U | 0,0466 | | |
| | | Polypropylene, granulate {GLO}, market for, Conseq, U | 0,0101 | | |
| | | Printed paper {GLO}, market for, Conseq, U | 0,00126 | | |

*Use phase in Table 4, includes water consumption, transportation and electricity consumption used for both use phase and detergent production as part of use phase. Therefore, grey cells in the use phase indicate processes related to the detergent production.*