Technical Appendix: Life Cycle Assessment of

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I. Description

The objective of this study is to establish GHG Emission Factors for high-thermal synthetic blankets adapted to the humanitarian context, and analyse the environmental impact of the product's life cycle to identify key levers for impact reduction by studying potential variations.

Blankets have one of the highest volume of procurement for humanitarian organizations. Synthetic blankets are preferred to natural materials due to their longevity and cost-effectiveness. It is assumed that blankets are used much more in humanitarian contexts – i.e. it is used not just during sleep, but as daytime covering, clothing, shelter, etc. until it can no longer be used. For this reason the lifespan of the blanket is assumed to be lower than a standard polyester product, to accommodate for "rough use".

The functional unit of this study is 5 years of use of a blanket.

II. Methodology

Life Cycle Assessment is a standard methodology used to estimate the potential environmental impacts linked to the entire life cycle of a product or system (ISO 14040, 14044, 14067). The scope in this study is a cradle-to-grave system boundary for the assessment of impact across the complete life cycle named as follows:

- Raw Material
- Production
- Supply & Distribution
- Use
- Waste Management

To perform these studies, data from the Ecoinvent 3.11 cut-off system model is used, which allocates the entire impact of the material to its primary user without any ‘rewards’ for its potential for being recycled. The results are calculated following the Environmental Footprint 3.1 indicator system in the below categories:

- Climate Change: Global Warming Potential (GWP100)
- Impact on Human Health:
  - Human Toxicity: Carcinogenic and Non-carcinogenic
  - Ionising Radiation
  - Particulate Matter Formation
  - Photochemical Oxidant Formation

The impact on human health results are weighted using the approach detailed in the EF methodology – with a percentage assigned to each sub indicator, as well as normalized for one citizen so as to aggregate and represent as a single score.

III. Key Parameters & Assumptions

The parameters of the baseline blanket are as follows

LIFE-CYCLE STAGE	PARAMETER	DESCRIPTION OF MODEL
Raw Material	Bill of Materials	Virgin Polyester from PET granulate (2kg net weight)

	Packaging	LDPE Packaging Film (70g per blanket)
Production	Manufacturing Location	Panipat, India
	Manufacturing Processes	Polyester fibre production; fabric production; colouration & treatment, finishing laundry
Supply & Distribution	Transport Chain	TRUCK – SEA – TRUCK (to DC) TRUCK from DC to distribution
Use	Lifespan	5 years
	Usage Processes	Hand washed once a year
Waste Management	Product Disposal Method	Open burning in pits (100 km transport)
	Packaging Disposal Method	Open dumping (10 km transport transport)

IV. Scenario Rationale

a. Raw Material

Materials are the most relevant category for the supply chain as stakeholders have many options available for comparison. In this study, the alternatives to the baseline are as follows:

- Recycled polyester – made from amorphous PET granulate – that retains the lifespan of the product (5 years)
- Recycled polyester that deteriorates the lifespan of the product to 3 years instead of 5
- Post-consumer waste polyester – modelled as collected "soiled" fabric that is washed and reprocessed into yarn

Note: field data shows that often the options available are not 100% of any one material – the blanket offered could be made with 50% virgin polyester and 50% anonymous recycled synthetic fabric. This would certainly lower the impact reduction potential as compared to the scenarios in this study – but the goal is to establish the maximum potential reduction possible, which is why the scenarios in all stages are drastic.

b. Production

As this is a textile, the production processes modelled are several, including fibre production, textile production, bleaching, weaving, and washing. Other processes like yarn production, sanforizing, etc were eliminated to model the production close to synthetic textiles and assume a simplistic process to produce a cost-effective product.

These processes take large amounts of heat and electricity, which were replaced with solar energy and natural gas in various combinations to produce potential impact reduction scenarios for production.

Note: modelling for solar energy was done by replacing the average (market) energy supply with a multi-Si flat-roof photovoltaic source from Ecoinvent to see an “maximum reduction” scenario, the results of this scenario are likely to be different from a real-life installation due to the variations in solar technology, losses, etc.

c. Use

No scenarios were treated for this stage beyond the change of lifespan due to material as stated above.

d. Supply & Distribution

To inform practitioners of the effect of transportation on the overall life-cycle impact, the transport chain was varied in two different ways:

- Taking diesel trucks instead of freight train to port of origin
- Using air freight instead of sea freight between ports

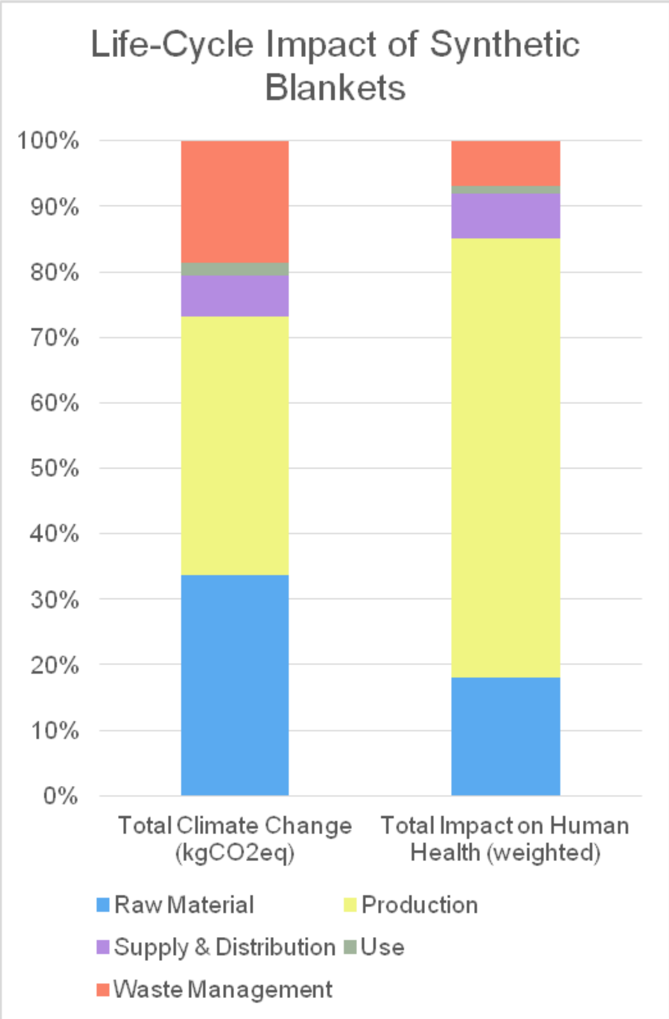
e. Waste Management

Two alternative end-of-life methods were considered in this study: municipal incineration and sanitary landfill (moist infiltration class).

The amount of water used in washing in kg was also directly input as the m3 amount of wastewater produced for this stage, with no variations.

V. Results & Discussion

The production of the blanket accounts for 40% of the GHG emissions and is the main source of impacts on human health (67%). Raw material is the second largest source of impact with 34%/18% GHG emissions/impact on human health respectively. Open burning at end-of-life accounts for 19%/7% GHG emissions/impact on human health respectively

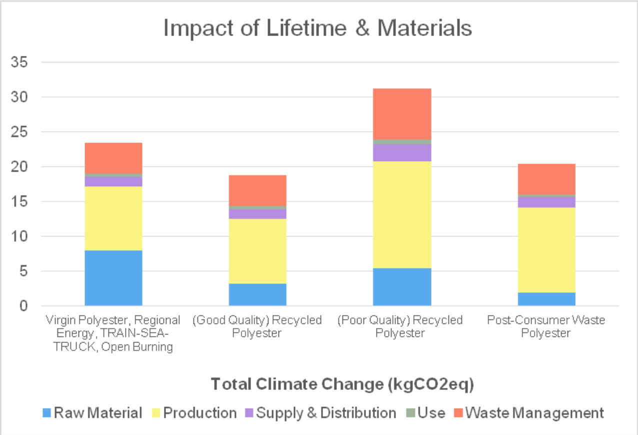


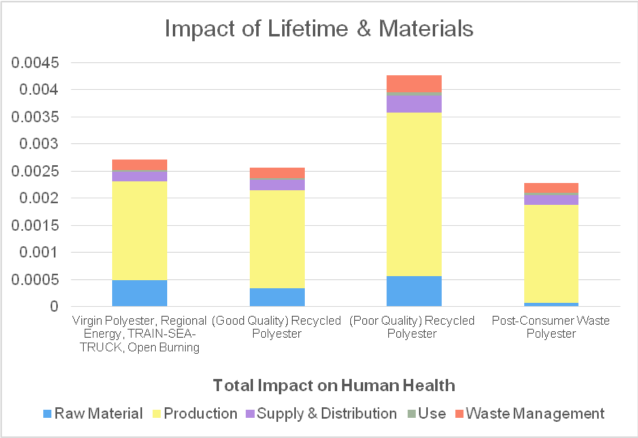
Greenhouse Gas (GHG) Emission Factors

Name	GHG Protocol Category	kgCO2eq/unit
Cradle-to-grave	N/A	23.38
Cradle-to-gate	3.1 Purchased Goods	17.08

V..Results By Category

Raw Material



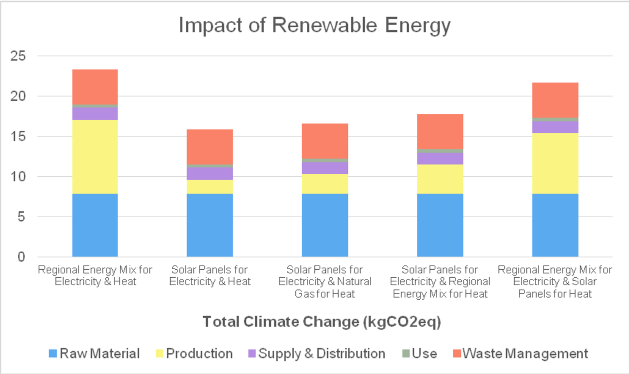


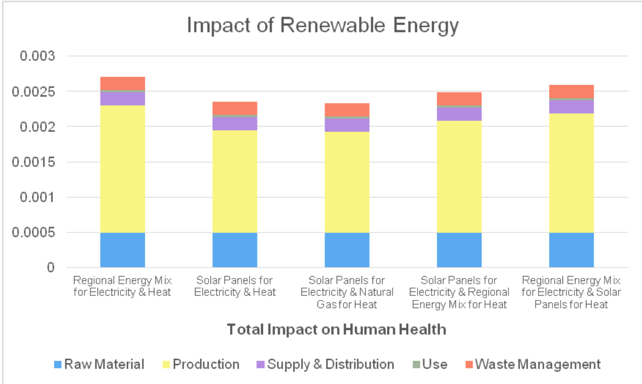
Extending the lifetime of the product can lead to a significant reduction in environmental impact, which can be accomplished by improving product quality (by eco-design, etc.) and maintaining the product during the use phase.

Using recycled PET instead of virgin PET to produce the polyester can reduce the impact of the raw material stage by 50% – however since the production phase is massively impactful, the overall reduction is approximately 20% in climate change and 5% impact on human health. However if the recycled PET compromises the lifespan of the blanket (e.g. 3 yrs lifetime instead of 5) the total impact can increase by 33%/57% in climate change & human health respectively

Using post-consumer waste textile reduces the impact of raw material stage by 75% -- however since it requires additional processes/yarn production, the overall reduction is lower than that of the good quality recycled PET polyester scenario: 13%/16% reduction in climate change & human health respectively

Energy Supply





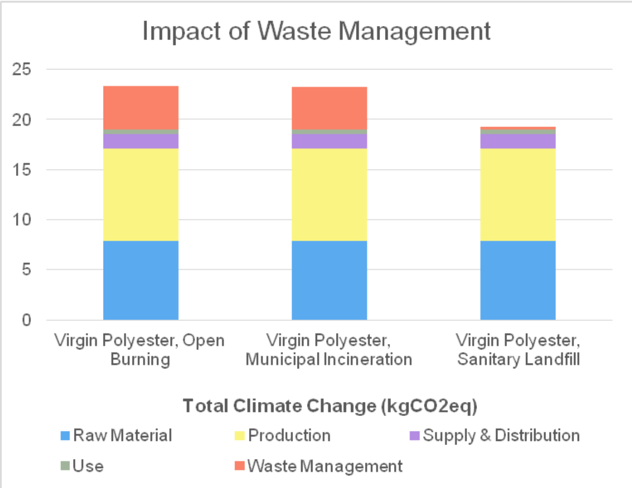
Switching the energy source used for electricity or heat during the production phase can significantly reduce environmental impacts—especially when fossil fuel–intensive sources are replaced with low-carbon alternatives.

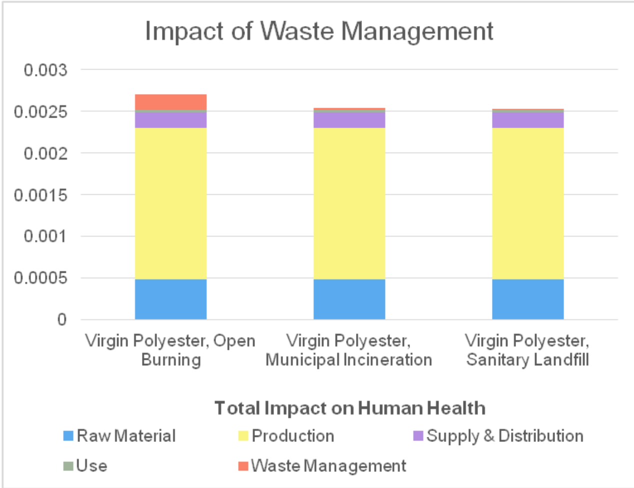
Producing blankets using solar power for both electricity and heat from an on-site photovoltaic (PV) installation, instead of the average Indian electricity mix (which consists of approximately 75% coal), reduces GHG emissions by 32% and human health impacts by 13%.

Using a mix of solar panels for electricity and natural gas for heat reduces 29% in GHG emissions and 14% in human health impacts.

Individually, replacing only electricity with solar power (and average heat production) shows 24%/8% reduction in climate change & human health respectively, while replacing only heat production with solar power (with average grid electricity) shows 7%/4% reduction in climate change & human health respectively.

Waste Management



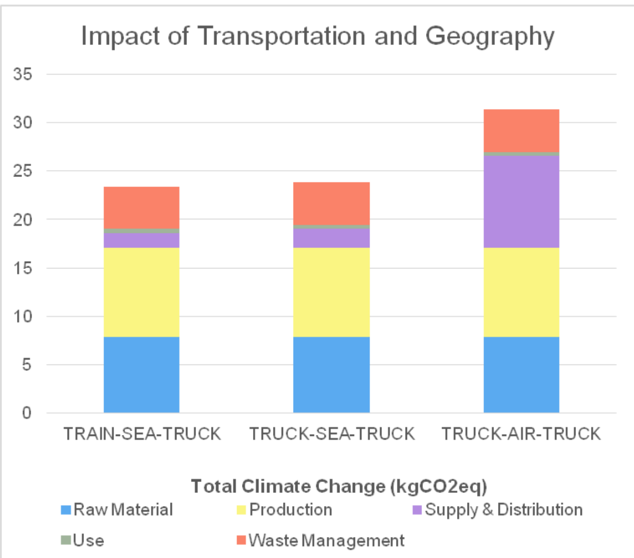


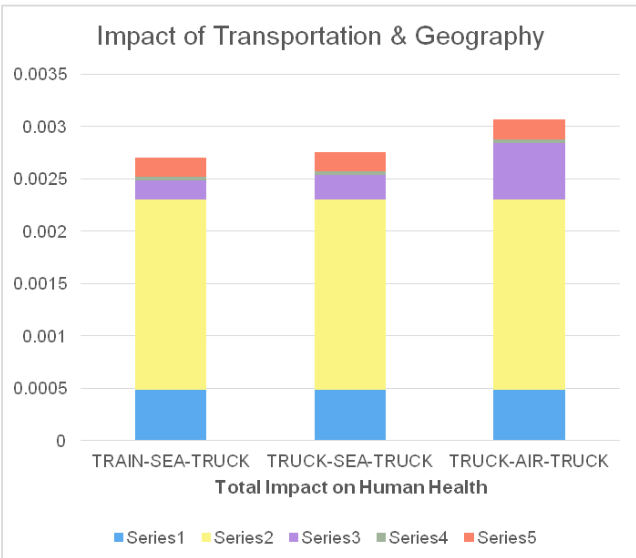
Burning plastic waste in a municipal incineration plant rather than openly will not reduce GHG emissions but will reduce impacts on human health if the plant has the adequate filters.

There is a small improvement when considering municipal incineration for climate change (1%) but larger for human health (6%).

A sanitary landfill achieves a greater reduction in climate change (18%) and has comparable reduction in human health to municipal incineration (7%), making sanitary landfills the preferred waste management method within the scope of the LCA (see slide 6 for more information).

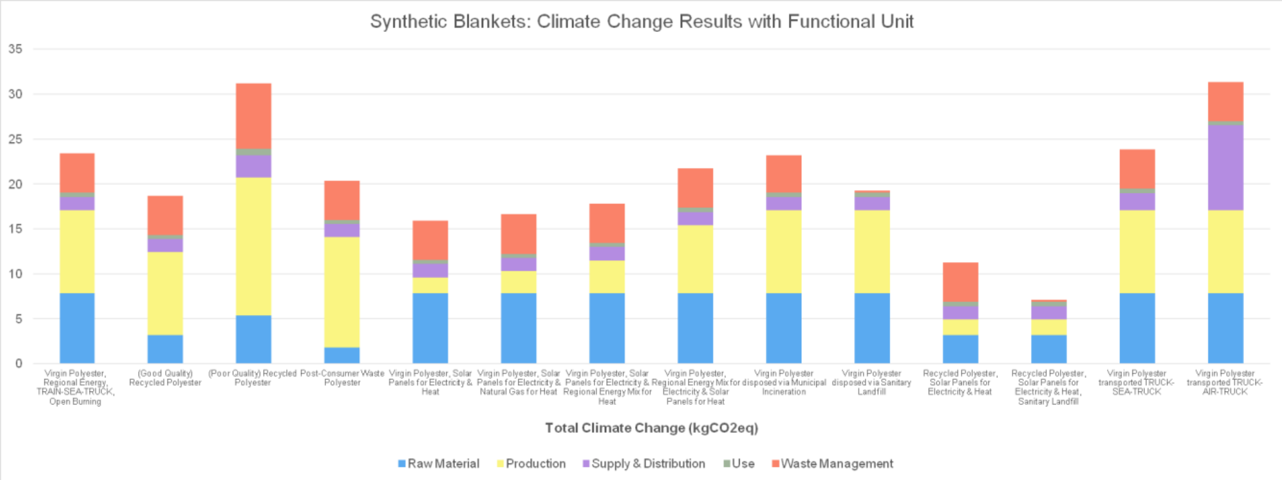
Transportation

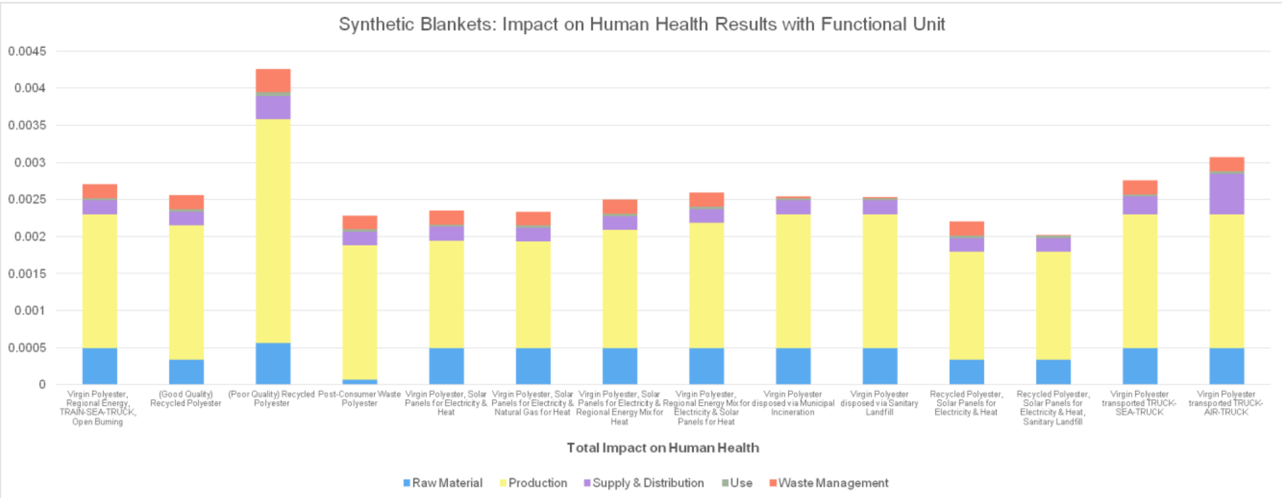




Transportation is not a significant enough share of impact to affect any change in the overall life-cycle of the blanket – replacing the freight train with a truck only increases the impact by 2% in both GHG emissions & human health, unless air freight is used, which increases the impact by 34%/13% in GHG emissions/human health respectively.

VI. Conclusion





The modelled scenarios show the following impact reductions (GHG emissions & impact on human health):

- Virgin to good quality recycled PP: 20%/6%
- Regional energy mix to solar energy for production: 32%/13%
- Open burning to sanitary landfill: 18%/7%

Therefore, combining recycled polyester, renewable energy for electricity and heat at production phase, and landfill instead of open burning account for the impact reduction of the synthetic blanket as follows:

- 70% climate change
- 25% impact on human health

VII. Bibliography

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