Technical Appendix: Comparative Life Cycle Assessment of Single-use and Reusable Face Masks Type I | Review

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I. Description

This analysis aims to enhance understanding of the item's impacts on climate, human health, and plastic leakage. It also identifies potential levers to reduce these impacts. However, assessing the feasibility of implementing these levers falls outside the scope of this project.

By no means is it suggested that life-saving assistance to the most vulnerable populations across the world should be reduced for decarbonisation purposes. Effective emissions and other impact reductions should not result in any reduction in the quality, quantity or timeliness of assistance, but rather should explore ways to reinforce or maintain aid, while identifying low-carbon, sustainable, and resilient alternative options.

This study aims to establish GHG Emission Factors for single-use face masks – intended for use in a Type I-compliant context, i.e. by patients or other individuals – adapted to the humanitarian supply chain, analyse the environmental impact of the product’s life cycle and identify key levers for impact reduction through a comparison with reusable face masks.

The functional unit of this study is 20 uses of a face mask in Type-I context.

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 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 products considered in this study are as follows

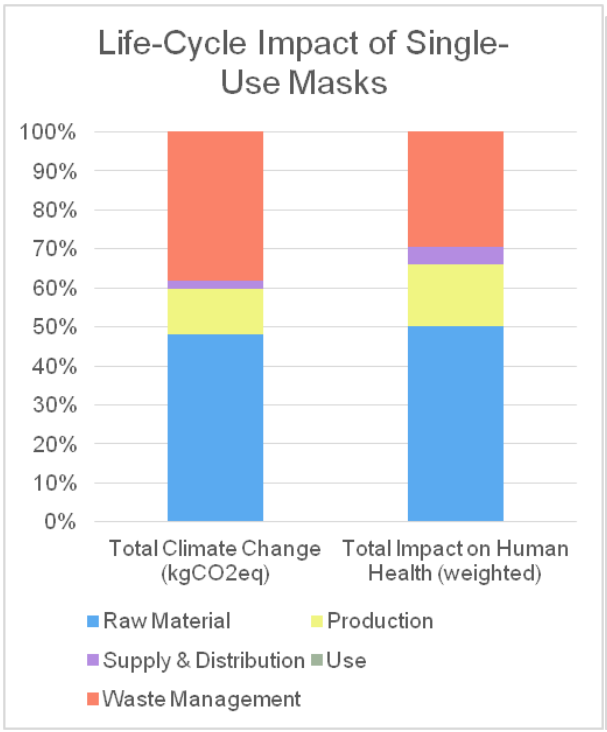
LIFE CYCLE STAGE	PARAMETER	Single Use Face Mask	Reusable Face Mask
Raw Material	Bill of Materials	5g polypropylene single use face mask (Type II) Polypropylene, polyester and aluminium	110g cotton face mask (Type I) Cotton, polyurethane and polyester
Production	Manufacturing Location	China	
	Manufacturing Processes	Modelled using energy use only (Literature)	
Supply & Distribution	Transport Chain	TRUCK transport of materials to factor SEA shipping of product to regional distribution centre TRUCK transport to distribution location	
Use	Lifespan	1 use	20 uses
	Usage Processes	None	Washing machine and drying (60°C) for cotton mask.

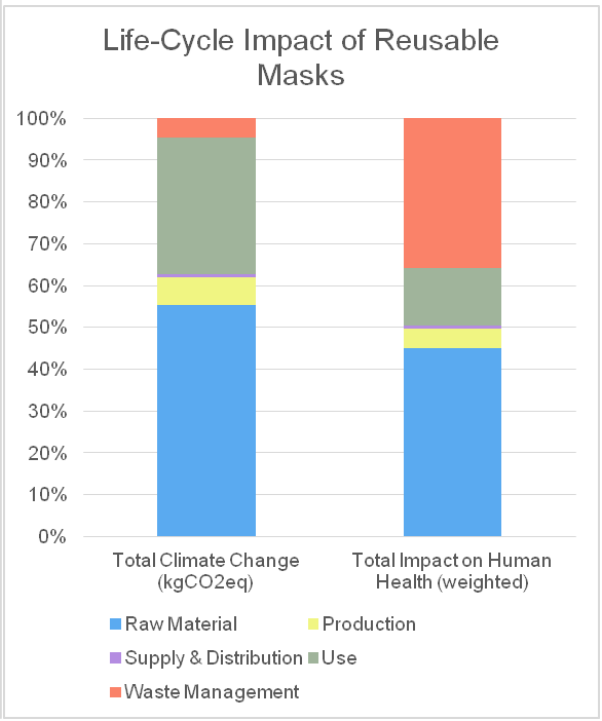
Waste Management	Product Disposal Method	Open burning

IV. Results & Discussion

The impact distribution of the single-use face mask aligns with that of other single-use plastic products, with contributions spread across all life cycle stages.

In contrast, the reusable face mask shows a more concentrated impact: for climate change, the main contributors are raw materials and the use phase; for human health, impacts are primarily driven by materials and end-of-life treatment. The emission factor of the reusable mask is higher before comparing on a function, largely due to its higher weight.





Greenhouse Gas (GHG) Emission Factors: Single-Use Face Masks

Name	GHG Protocol Category	gCO2eq/unit
Cradle-to-grave	N/A	33.2
Cradle-to-gate	3.1 Purchased Goods	20.0

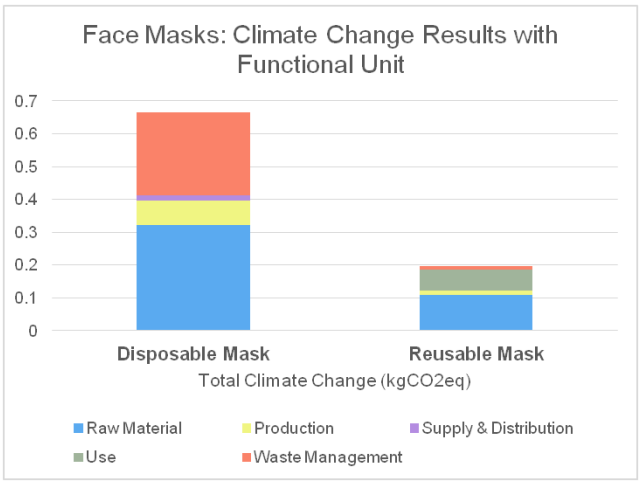
Greenhouse Gas (GHG) Emission Factors: Reusable Face Masks

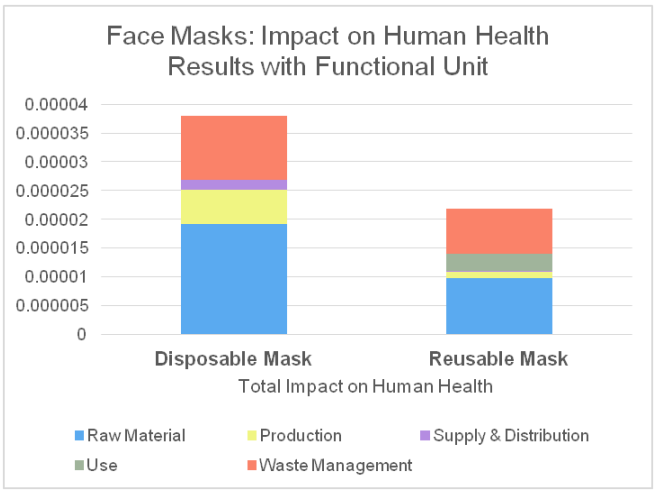
Cradle-to-grave	N/A	196
Cradle-to-gate	3.1 Purchased Goods	121

Switching from a disposable mask to a reusable face mask can reduce the climate change impact by 70%, from about 670 grams of CO2e to 200 grams, to answer the functional unit of 20 uses. The impact on human health can be reduced by 42%.

Note: This assessment does not cover face masks used in surgical unit or medical contexts by health workers, but for the Type I face mask use case according to EN 14683:2019+AC:2019.

V. Conclusion





To switch from single-use to multi-use masks can achieve significant impact reductions:

- 70% climate change
- 42% human health

This solution applies only to masks not used by healthcare workers, where reuse is permitted.

Deploying reusable masks at scale would require a logistics system to collect, wash, and track the number of uses for each mask throughout its lifespan.

VI. Bibliography

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