



# EcoProfile of recycled ABS flakes GB, gate-to-gate, post-consumer

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**May 2025**

<b>LCA method overview</b>	
<b>Background database</b>	Ecoinvent v3.10
<b>Dataset type</b>	Cut-off, unit processes
<b>Declared unit</b>	'Production of 1 kg of mechanically recycled ABS flakes'
<b>ISO conformity</b>	ISO 14040 and 14044 structure, internal review
<b>LCIA method</b>	Environmental Footprint 3.1
<b>Software</b>	openLCA 2.4
<b>System boundary</b>	Gate-to-gate



## 1 BACKGROUND INFORMATION

- The primary purpose of this document is to present an average life cycle inventory (LCI) and impact assessment (LCIA) for mechanical recycled acrylonitrile-butadiene-styrene (rABS) flakes as result of the Horizon Project PRIMUS. The project seeks to provide a comprehensive understanding and data of the environmental impacts associated with mechanically recycled plastics.
- rABS is a versatile material known for its wide array of applications in electronics, toys and the automotive industry. The usage of mechanically recycled ABS reduces the use of fossil fuels and energy compared to the production of primary ABS.
- Mechanical recycling of WEEE plastics waste involves collection, sorting, shredding, sorting to remove non-plastics (via magnetic separation and eddy-current separation) and grinding to produce rABS flakes. Density separation can be used to removed material with brominated flame retardants.
- The documentation of the method followed in the herein presented EcoProfile follows the main principles of the ISO 14040-14044 standards and was internally reviewed by PlasticRecyclersEurope and experts from the VTT Technical Research Centre of Finland. It is intended for LCA practitioners and sustainability researchers and stakeholders in the field of plastic recyclates.
- Details for the methodology used for this EcoProfile can be found in the accompanying methodology publication. Datasets can be downloaded from openLCA Nexus in JSON-LD and ILCD formats.

## 2 MODEL DESCRIPTION

- This EcoProfile represents an average of European industry for mechanical rABS production, adapted to a regional process located in Great Britain through the method described in the accompanying methodology document. Data was collected from 3 sites in 2022 in France, the Netherlands and the United Kingdom, represents the recycling of a mix of household wastes and ELV-WEEE wastes, and 29.6% of the European installed mechanical recycling capacity of those waste streams. The European coverage has been calculated per waste-stream, as displayed in Table 2 of the accompanying methodology document.
- The herein generated EcoProfile embodies a life cycle inventory in a 'gate-to-gate' fashion for the production of ABS plastic recycle flakes. The product under investigation is **1 kg of recycled ABS flakes**. The main production steps in mechanical recycling are included in the system boundaries of the EcoProfile are visualised in Figure 1.

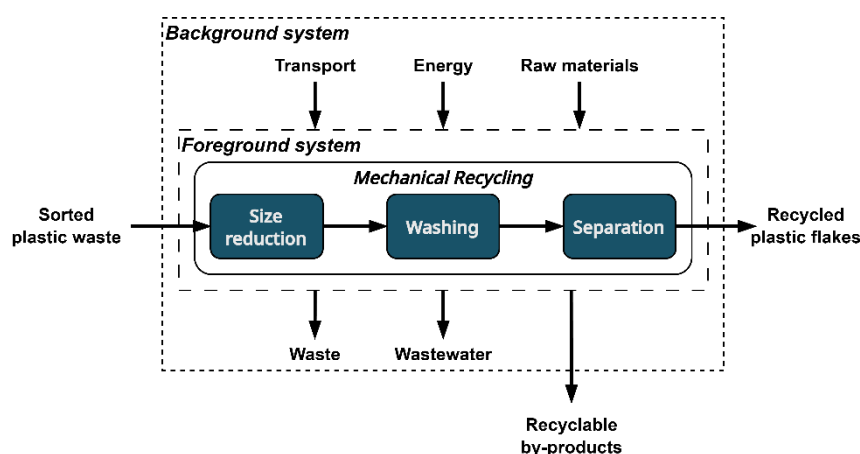


Figure 1: System description and boundaries. Following the PRE recycling scheme.

- The functional unit of the rABS EcoProfile is '**Production of 1 kg of mechanically recycled ABS flakes, obtained from WEEE waste, at gate, unpackaged, representing British production**' where the reference flow of the rABS EcoProfile provided is '**1 kg of rABS flakes, unpacked**'.
- Generally, a complete LCI was aimed for, though some neglectable amounts of secondary outputs had to be cut-off. For multi-output processes physical allocation was used as described in our methodology.
- The collected primary data was combined with secondary data (for transport, energy, chemicals, and water) from the ecoinvent 3.10 cut-off LCA database. The life cycle inventory and impacts were calculated using the CED, EF 3.1 and PLEX methods.

### 3 LCI RESULTS

Table 1. Summary of material and energy in- and outputs of an exemplary secondary material production process for recycled ABS flakes with a gate-to-gate boundary

<b>Incoming Material</b>	<b>Flow Quantities per 1 kg</b>
Mixed plastic waste including impurities <sup>1</sup>	1.70 kg
<b>Material inputs</b>	
calcium carbonate, precipitated	1.15E-03 kg
chemical, organic	4.40E-04 kg
polyaluminium chloride	1.30E-04 kg
sodium chloride, powder	3.43E-02 kg
sodium hydroxide, without water, in 50% solution state	4.96E-05 kg
Talcum powder	7.00E-04 kg
<b>Water consumption</b>	
tap water	2.91E-02 kg
<b>Energy</b>	
electricity, low voltage	0.772 MJ
<b>Infrastructure</b>	
waste preparation facility	2.00E-09 Item(s)
<b>Transportation</b>	
transport, freight, lorry, unspecified	4.24E-02 t*km
<b>Solid Waste</b>	
municipal solid waste	0.133 kg
raw sludge	5.08E-02 kg
waste plastic, mixture	0.377 kg
waste polyurethane	5.76E-02 kg
<b>Secondary material outputs</b>	
Waste fraction - metal - recycling cut-off	6.16E-02 kg
<b>Wastewater treatment</b>	
wastewater, average	2.82E-05 m3
<b>Probability to litter plastic</b>	
plastic litter	1.62E-03 kg

Table 2. Primary energy demand by carrier using CED method for an exemplary secondary material production process for recycled ABS flakes with a gate-to-gate boundary

<b>Energy carrier</b>	<b>Total energy input for 1kg of rABS flakes</b>
Gas, natural	0.99 MJ-Eq
Uranium	0.74 MJ-Eq
Oil, crude	0.36 MJ-Eq
Coal, hard	0.20 MJ-Eq
<b>Energy resources: non-renewable</b>	2.31 MJ-Eq
<b>Energy resources: renewable</b>	0.55 MJ-Eq
<b>Total</b>	2.86 MJ-Eq

<sup>1</sup> This value expresses an aggregation of all polymer waste streams contributing to the EcoProfile inputs. Please find the disaggregated input values per-waste stream in the disaggregated datasets.

## 4 LCIA RESULTS

Table 3. Life cycle impacts of the gate-to-gate rABS model related to 1 kg of flakes

<b>Impact Category</b>	<b>Impact assessment<sup>2</sup></b>	<b>Unit</b>
<i>Acidification</i>	6.98E-04 ± 6.47E-05	mol H <sup>+</sup> -Eq
<i>Climate change</i>	0.898 ± 0.078	kg CO <sub>2</sub> -Eq
<i>Ecotoxicity: freshwater</i>	3.26 ± 0.26	CTUe
<i>Energy resources: non-renewable</i>	2.18 ± 0.19	MJ, net calorific value
<i>Eutrophication: freshwater</i>	2.99E-05 ± 3.55E-06	kg P-Eq
<i>Eutrophication: marine</i>	1.04E-03 ± 8.31E-05	kg N-Eq
<i>Eutrophication: terrestrial</i>	2.52E-03 ± 1.88E-04	mol N-Eq
<i>Human toxicity: carcinogenic</i>	7.73E-10 ± 1.66E-10	CTUh
<i>Human toxicity: non-carcinogenic</i>	5.14E-09 ± 4.66E-10	CTUh
<i>Ionising radiation: human health</i>	5.51E-02 ± 6.12E-03	kBq U235-Eq
<i>Land use</i>	2.15 ± 0.78	dimensionless
<i>Material resources: metals/minerals</i>	2.31E-06 ± 3.93E-07	kg Sb-Eq
<i>Ozone depletion</i>	3.75E-09 ± 3.47E-10	kg CFC-11-Eq
<i>Particulate matter formation</i>	6.07E-09 ± 5.69E-10	disease incidence
<i>Photochemical oxidant formation: human health</i>	7.04E-04 ± 5.02E-05	kg NMVOC-Eq
<i>Plastic litter</i>	0.163 ± 0.016	kg
<i>Water use</i>	7.76E-02 ± 5.97E-03	m <sup>3</sup> world Eq deprived

<sup>2</sup> The uncertainty value presented here has been calculated based on the foreground data. Details are described in the methodology.