Product Carbon Footprint Report

in accordance with ISO 14067, ISO 14040 and ISO 14044

Client

Mineralplast OÜ

Kesk-Sõjamäe 5a

11415 Tallinn

Contractor and Life cycle assessor

PeoplePlanetProfit GmbH & Co. KG

Gerberstraße 7

88250 Weingarten

Table of contents

Foreword

Environmental information can be verified using various methodologies, such as Environmental Product Declarations (EPDs), Life Cycle Assessments (LCAs) or Product Carbon Footprints (PCFs).

On 11 December 2019, the EU Green Deal was presented. Among other things, the goal is to become the first continent to become climate-neutral by 2050. To this end, an ambitious package of measures for a sustainable green transition is designed to benefit Europe's people and economy. Investments in green technologies and sustainable solutions are expected to kick-start Europe's new growth strategy that will bring new opportunities for businesses.

The voluntary accounting of greenhouse gases (CO_2) is expected to make a major contribution to this.

The two standards ISO 14040 and ISO 14044 provide the basis for calculating product-related environmental impacts. ISO 14067 is the basis for the development of the PCF and provides a suitable basis for determining greenhouse gas emissions. It is in line with ISO 14040 and ISO 14044.

For goods and services, the standards specify how the balance of the environmental impact over the service life of a product is calculated - from the procurement of raw materials and production to use, disposal and recycling.

The uniformly defined requirements and guidelines are applicable to every product and support companies in developing efficient and consistent procedures for determining life cycle assessments. They gain a better overview of the environmental impact of their products and can thus more easily identify potential for reduction.

1 Summary

The database for the financial year 2023 provided the basis for the preparation of the Product Carbon Footprints (PCF). The observation was carried out for the sites Tallinn, Estonia and was documented accordingly. In doing so, 1 mt of ash compound (ash + plastic) was formed as the basis of the functional unit. Two different products were considered in the calculation.
The data was transmitted from the factory according to inputs and outputs. All data has been checked for consistency.

The PCF provides the basis for the representation of the CO_2 footprint of the products per functional unit.

The system boundaries refer to the cradle to gate life cycle.

2 Background

2.1 General Information

The LCA comprises the following four phases [1]:

- Definition of the goal and scope
- Life cycle inventory analysis
- Life cycle impact assessment
- Life cycle interpretation

The process modules that make up the product system are divided into life stages, the so-called life cycle phases, and the emitted environmental impacts are assigned to these. The PCF was calculated over the partial life cycle (cradle to grate).

2.2 Profile of the company under review

Mineralplast is a company that is dedicated to contributing to the plastics industry's shift from linear to circular economy. The company produces sustainable compounds for the plastics converters. Mineralplast offers plastic compounds with +80% of recycled content to enhance the circular economy in the fields of:

- automotive;
- building & construction;
- packaging; etc.

Export Markets of Mineralplast:

- Germany
- The Baltic States
- Scandinavia

Additional Information can be found here: https://www.mineralplast.com.

2.3 Life cycle assessor

The life cycle assessment calculation was carried out internally. The LCA calculation was supported by the external consultancy PeoplePlanetProfit GmbH & Co. KG.

2.4 Standards and regulations

ISO 14040 [2], ISO 14044 [1], ISO 14067 [3] and all the standards and regulations mentioned in the bibliography apply.

3 Definition of the goal and scope

3.1 Goal of the study

Mineralplast intends to use the life cycle assessment in accordance with ISO 14040/44 and ISO 14067 to determine the CO_2 footprint of the ash compounds. (ash + recycled-based or virgin plastic)

The environmental impact indicators are presented according to ISO 14067.
In addition, a contribution to the EU's Green Deal is to be made on a voluntary basis. The methodology of the report is therefore based on a combination of ISO 14040 and ISO 14044.
The partial life cycle from cradle to gate is considered.
The LCA results can be used for B2B communication in accordance with EN 15942. The results are primarily intended to be useful for authorities. Other user groups, such as customers, can use the results primarily for information.
The results of the study are not intended for use in comparative statements intended for publication.

3.2 Application of the PCR

According to EN 14067, applicable PCRs must be applied if available. Since this is not the case, no product category rules were included.

3.3 System boundaries and scope

3.3.1 The analysed system and its functions

The boundaries refer to ash compounds with the locations in Tallinn, Estonia. The data was recorded across various departments. These are continuously recorded independently of the life cycle assessments and the environmental impact is continuously reduced as part of the management systems.

Specific data for the supplier product oil shale ash comes from Eesti Energia AS and for the supplier product recycled plastic from WeeRec AS. The main transport routes (A2) have also been included.

No further upstream supplier data were considered, except for the purchased goods and transport routes.

3.3.2 Level of data quality

Quality level	Geographical representativeness	Technical representativeness	Temporal representativeness
Very good	The processes included in the dataset are fully representative of the region specified in the metadata under "Location".	Technological aspects have been modelled exactly as described in the title and metadata, there is no significant need for improvement.	The data is not older than 0 years, as indicated in the ILCD field ("Record valid until" and the difference between "valid until" and the "reference year" is no more than 8 years).
good	The processes included in the dataset are quite representative of the region specified in the metadata under "Location".	The technological aspects are very similar to those described in the title and metadata, there is a limited need for improvement. For example: Use of generic technology data instead of modelling all individual plants.	The data is not older than 3 years, as indicated in the ILCD field ("Record valid until" and the difference between "valid until" and the "reference year" is not more than 8 years).
medium	The processes included in the dataset are sufficiently representative of the region specified in the "Location" metadata. For example, a different country has been shown, but it has a very similar electricity mix profile.	The technological aspects are like those described in the title and metadata, but there is room for improvement. Some of the relevant processes are not modelled with specific data but using proxy data.	The data is not older than 6 years, as indicated in the ILCD field ("Record valid until" and the difference between "valid until" and the "reference year" is no more than 8 years).
bad	The processes included in the dataset are only partially representative of the region specified in the metadata under "Location". For example, a different country with a very different electricity mix profile was shown.	The technological aspects differ from what is described in the title and metadata. Major improvements are needed.	The data is not older than 10 years, as indicated in the ILCD field ("Dataset valid until" and the difference between "valid until" and the "reference year" is not more than 8 years, as confirmed by the verifier(s)).
Very bad	The processes included in the dataset are not representative of the region specified in the metadata under "Location".	The technological aspects are completely different from what is described in the title and metadata. A significant improvement is needed.	The data is older than 10 years, as indicated in the ILCD field ("Dataset valid until" and the difference between "valid until" and the "reference year" is no more than 8 years).

Legend: Green = applicable

3.3.3 Functional/declared unit

The declared unit is 1 mt ash compound (ash + plastic).

The products are divided into the following product groups:

Product group	Designation
Product group 1 Virgin-based compound	80% ash + 20% PP or PE
Product group 2 Recycled-based compound	80% ash + 20% rPP or rPE

All inputs and outputs were related to this as a reference.

3.3.4 System boundaries

The basis of the study is the company itself with the locations mentioned and all inputs and outputs relating to the product. The relevant data have been determined, i.e., the boundaries refer to the mentioned location. In addition, the transport routes were accounted also.

The production of the upstream suppliers is used as an "ecological backpack" from the database, if available.

No additional data was collected from other locations or for outsourced processes. The data collection refers to the year 2023. All data was based on this base year.

Building or plant components that are not relevant for product manufacture are excluded by means of estimates (e.g. electricity consumption for IT, building heating).

3.3.5 Requirements for data types, sources, and quality

The data collection was carried out as thoroughly as possible. Due to the many years of quality management and the accounting software, the data was available on a good basis. The data collected is considered representative.

3.3.6 Temporal validity of the data

The data from 2023 was considered. All recordings and evaluations refer to this base year.

3.3.7 Life cycle stage Product use and application profile

The life cycle, including the scenarios, is based on EN 15804 with the following phases:

- A1 Provision of raw materials
- A2 Transportation
- A3 Production

3.3.8 Benefits and loads

All declared benefits and loads from the net flows (calculation of net flows) that leave the product system, are not regarded as co-products and have reached the end of their waste characteristics are balanced in Module A3.

Benefits are allocated for recycling and thermal recovery. The allocations and assumptions for assignment of benefits are shown below. However, there are no direct benefits based on the use and recycling of ash compounds; instead, the benefits are calculated for the production waste.

3.3.9 Allocation procedure

The following allocations occur:

- Allocations for the data as annual values in relation to the functional unit
- Use of secondary raw materials
- Allocations for recovery and recycling

The allocations, where relevant, are described in the individual chapters.

Where possible, allocations were avoided by:

- Dividing the process modules affected by the allocation into two or more separate sub-processes and collecting the input and output data relating to these sub-processes, or

- extending the product system by including additional functions relating to co-products.
- Cut-off definitions in the accounting software

3.3.9.1 Allocation procedure for reuse and recycling

See chapter 3.3.8.

- Recycling or recovery processes beyond the system boundary (after the end-of-waste properties have been reached) are included in the product system burden-free.

3.3.9.2 Allocation procedure for co-products

No allocations are used for co-products.

3.3.10 Assumptions and limitations

Umberto LCA+ incl. the current version of the Ecoinvent 3 database (v3.10) was used as the basis for the calculation. The data was all updated in 2024.

As not all data was available, the following assumptions were made.

Data gaps are replaced by corresponding data. The system boundaries are adhered to. Generic data is used where necessary.

3.3.10.1 Inputs

Energy:

- For electricity, the consumption in Estonia was taken over according to the questionnaire. Electricity, high voltage, production mix (statistics from 2020) was used as a basis.

Water:

- Fresh water is used for the compounder system (cooling and technical water). It circulates in the machine's cooling unit. Only water steam is emitted, that evaporates in the air.
- Water consumption in the social areas is not excluded.
- For water, cooling water, unspecified natural origin was assumed.

Auxiliary materials:

- No auxiliary materials are used.

Internal Transport:

- For lifting and transportation of 1 mt compound it requires 10 meters of internal transportation with a forklift. A speed of 10 km/h (means 0.001 h are required for 10 metres) is assumed, as this is considered an acceptable speed limit in indoor areas where pedestrians are regularly present. [4]
- For Forklift, machine operation, diesel, ≥74.57 kW, high load factor, GLO, diesel was assumed.

Raw materials:

- Oil shale ash and recycled plastic were accounted for as a secondary material.
- Virgin Polyethylene (PE) and Polypropylene (PP) were combined as PP for virgin plastic (see chapter 4.2.3).
- For virgin plastic, Polypropylene, granulate, RER, production was assumed.
- The pyrolysis or oil shale ash is a waste product in the oil shale pyrolysis plant operated by Eesti Energia AS (see ISCC PLUS Self-Declaration for Waste and Residues). This is normally landfilled nowadays. To use the ash in Mineralplast, no further treatment steps are needed. Therefore, the ash used is assumed to be free of environmental impacts and enters the product system without any burdens.
- Recycled Polyethylene (PE) and Polypropylene (PP) were combined as PE for recycled plastic, due to their similar properties in processing and since there is no recyclate data set for PP in the database.
- For recycled plastic, Polyethylene, high density, granulate, recycled, Europe without Switzerland, production was assumed.

Packaging:

- For big-bag for packaging (made of PP), Polypropylene, granulate, RER, production was assumed. The net weight of one big-bag (with the volume of 1 mt ash compound) is approx. 4 kg.
- The big bags are modelled as single-use packaging, as there is no data basis for reuse.

3.3.10.2 Outputs

Wastewater:

- Water loss was modelled as Water, emissions to air, unspecified.

Waste:

- Production waste (lumbs material) were modelled as municipal solid waste, RU, incineration as it is are not hazardous and it's used for energy recovery. The Russian data set was used because there was no country-specific data set for Estonia and Russia is a neighbouring country.

3.3.11 Cut-off criteria

It can be assumed that the neglected materials or energies and water per value do not exceed 1 percent. The sum of the neglected processes is less than 5 percent.

No processes were excluded.

Note:

If the mass of the substances containing biogenic carbons in the product is less than 5% of the mass of the product, the declaration of the biogenic carbon content may be omitted.

If the mass of biogenic carbon in the packaging is less than 5% of the total mass of the packaging, the declaration of the biogenic carbon content of the packaging may be omitted.

3.3.12 Losses

The following losses occur over the life cycle after waste treatment, for example due to transportation or material losses:

Scenario	Unit	Losses
A3	kg	0

This only applies to waste that has reached the end of its life cycle.

4 Life cycle inventory analysis

4.1 Product description

The recycling-based compounds produced by Mineralplast contain:

- Pyrolysis ash (a residue material that is landfilled today)
  by that Mineralplast substitutes the natural mineral fillers (e.g. chalk or talcum powder).
- Recycled plastics (rPP; rLDPE; rHDPE)
  by that Mineralplast partially substitutes the virgin polymers.

Figure 1: Picture of recycling-based compound produced by Mineralplast

The recycling-based sustainable raw materials (the pyrolysis ash & recycled plastics) are collected locally, with a minimal environmental impact.

4.2 Manufacturing process

The manufacturing process is as follows:

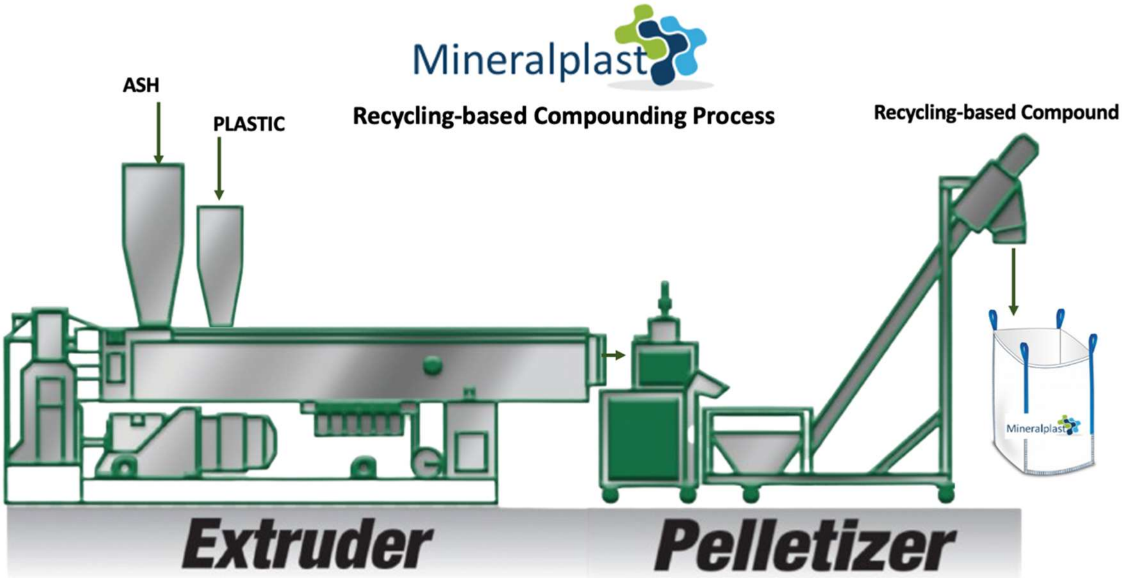

Figure 2: Manufacturing process

The two products go through the same manufacturing process and differ only in their composition.

4.3 Data collection

The following data was used to calculate the life cycle assessments. Due to the assumptions and allocations mentioned in section 3.3.10, some of the data was summarized.

description	Process	Total consumption	unit	Transport	comment
Inputs					
Energy sources					
Electricity consumption	Energy for compounding and production facility itself	400,0000	kW	Grid connection	1 mt of compounding (80% oil shale ash and 20% plastic) requires 400 kW electricity (Estonian energy mix 2023)
Water					
Water consumption	Cooling water in the compounder	1,5000	litre	Directly from central water system	1 mt of compounding requires 1,5 litre of water (that 100% circulates in the machine's cooling unit)
Auxiliary materials					
Forklift	Forklift usage per 1mt/of compound	10,0000	meters	Transportation at the production site	For lifting and transporation of 1 mt compound (a big-bag) it requires 10 meters of transportation at the production site
Raw materials / preliminary products					
Oil Shale Ash	Main secondary raw material	0,8008	mt	207 km	1 mt of compounding requires 0,8 mt of Oil Shae Ash (transported from Enefit Power oil production site in Auvere to Mineralplast compounding site in Tallinn, Estonia.) with conventional SILO car (FTL: 24mt)
Recycled plastic	rPP or rPE	0,2002	mt	37,8 km	1 mt of compounding requires 0,2 mt of recycled (transported from company Weerec OÜ, Kuusalu)
OR Virgin plastic	PP or PE	0,2002	mt	40 km	1 mt of compounding requires 0,2 mt of virgin plastic (transported from company Telko Eesti OÜ, Keila warehouse)
Packaging					
Big-bag for packaging	1 mt big-bags	1,0000	big-bag	10,3 km	1 mt of compounded granultes requires 1 big-bag (transportated from big-bag production Jumbostrap OÜ, Tammsaare tee
	1 mt big-bags	4,0000	kg	10,3 km	
Outputs					
Product (s) / production quantities					
1. Oil Shale Ash - Compound 80/20 (100% re	80% Oil Shae Ash + 20% of rPP or rPE	1,0000	mt	EXW	Product No 1: 100% recycled compound, only sold on EXW terms.
2. Oil Shale Ash - Compound 80/20 (80% rec)	80% Oil Shae Ash + 20% of PP or PE	1,0000	mt	EXW	Product No 2: 80% recycled compound, only sold on EXW terms.
Sewage					
Water circulates 100% (nothing left into the sewage) only steam is generated	Cooling water steam	1,500	litre	Evaporates in the air	1 mt of compounding causes 1 litre of water steam that evaporates in the air
Waste / disposal route					
Production waste (pieces of plastic, mixture of the compound etc.)	waste generated during the compounding process (Lumps material)	0,001	mt	10 km	1 kg of production waste is generated during the production of 1 mt compound. This is delivered to waste management plant where it's used for Energy Production (at IRU Power Plant, Maardu, Estonia).

Figure 3: Questionnaire A1-A3

Emissions to air and soil are not taken into account as no regulatory limits are known to have been exceeded (no regulatory obligation to measure).

4.3.1 Reference service life

No reference service life (RSL) was determined.

Requirement	Description
Declared product properties (per life cycle stage)	According to general product documentation (composition and TDS).
Application regulations and parameters	All procedures of Mineralplast are in accordance with applicable legal regulations and internal company regulations, also in line with the ISCC PLUS certificate.
Installation quality	Not given, as there is no installation of the products.
External conditions	All products of Mineralplast must be handled in accordance with the relevant Material Safety Data Sheet (MSDS).
Internal conditions	All products of Mineralplast must be handled in accordance with the relevant Material Safety Data Sheet (MSDS).
Conditions of use	All products of Mineralplast must be handled in accordance with the relevant Material Safety Data Sheet (MSDS). No additional conditions of use are required.
Inspection/maintenance/cleaning	No requirements are given for the use of Mineralplast products.

Table 1: Declared technical and functional performance

4.3.2 Life cycle phases

As far as possible, the life cycle phases are shown in full using scenarios. The life cycle phases are based on EN 15804.

4.3.2.1 A1 Extraction of raw materials

The data for the extraction of raw materials originate, if available, from upstream suppliers and the raw materials, auxiliary materials, etc. These were modelled in the software.

4.3.2.2 A2 transport to the manufacturer

The upstream transport routes come from various logistics data as an average.

The average transportation distances to the plant are determined in the company. The values used are shown in the following overview.

Pre-product	Distance	
Oil shale ash	207	km
Virgin plastic	40	km
Recycled plastic	38	km
Big-bag	10	km

A lorry (freight, > 32 t metric ton, 16 t payload, EURO 3, diesel) is used. The occupancy rate is 53% (according to the Umberto data set). The Euro standard mix as well as the workloads are representative of common supply chain situations and can therefore be applied.

Other transport routes were not considered, either because they are marginal and have no relevant impact on the balance sheets or because they were not available.

4.3.2.3 A3 Production

The production-relevant data is presented in chapter 4. It also includes the complete waste treatment up to the end of the waste status or disposal.

The transport of waste generated in A3 is modelled with the following scenario: Transport to collection point with a lorry (freight, > 32 t metric ton, 16 t payload, EURO 3, diesel), 53 % loaded, 100 km.

4.3.3 Materials / composites

The materials included are as follows:

Material	Mass in kg per declared unit
Ash	800
Plastic (recycled or virgin)	200

The packaging per product is as follows:

Material	Mass in kg per declared unit
PP	4

4.3.4 Biogenic carbon

The biogenic carbon content in the product and packaging is less than 5 percent, so it is shown accumulated at the bottom of the LCIA table.

4.2 Data calculation

4.2.1 Data validation

Data validation was carried out for all data provided. The data was checked for both validity and consistency. The inputs and outputs were analysed for this purpose.

4.2.2 Reference of the data to a process module and a functional / declared unit

All data relates to the functional units indicated. These were collected as an annual average and calculated for the respective functional units. In this analysis, care was taken to ensure that the data is collected separately by share.

4.2.3 Sensitivity analyses

4.2.3.1 Polypropylene (PP) vs. Polyethylene (PE)

The manufacturer can use two different materials (PP or PE) for the plastic part in the compound. The environmental impact of the products was compared using 1 kg of each variant. The differences are as follows, with PP representing the basis (100%).

PCF	PE
Climate change - Total	+2%

Although polyethylene (PE) tends to have the higher CO_2 value than polypropylene (PP) and would therefore represent the worst case for the virgin plastic part in the ash compound, PP is still used in the modelling. This is because they have a comparable value (the difference is only around 2%), the application of PE as virgin plastic in the ash compound results in a deviation of only +1% of the PCF total and most customers demand an ash compound with PP. The inclusion of the market requirement ensures that a representative value is determined. This plastic part is therefore considered representative and are used for the assessment.

5 Life cycle impact assessment

The impact assessment relates to the environmental impacts mentioned. The significant parameters were identified on the basis of the results of the quantification of the results in accordance with the life cycle inventory phases and the impact assessment.

The environmental impact indicators are bases on ISO 14067.

Consistency and sensitivity analyses were taken into account when assessing completeness.

Standardization of the results was not the aim of the study and is therefore not relevant. In addition, standardization of the data can lead to misleading statements.

5.1 Preliminary assessment and deviation from the average

No preliminary assessment was carried out as the products are listed in different tables.

5.2 Selected impact categories and the method for impact assessment

The method used as a basis was the technical committee ISO/TC 207/SC 7 "Greenhouse gas management and related activities" document ISO 14067:2018 - Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification. This document sets out principles, requirements and guidelines for quantifying and reporting a product's carbon footprint (CFP) in a manner consistent with international life cycle assessment standards (ISO 14040 and ISO 14044). [3] The LCIA factors were selected in accordance with the current version of the Umberto LCA+ life cycle assessment software.

The following indicators are presented as results in accordance with ISO 14067:

- Product Carbon Footprint; split by fossil, biogenic, land use and aviation

5.2.1 Climate change and the greenhouse effect

"The main driver of climate change is the greenhouse effect [9]". Due to the greenhouse effect, the average surface temperature of the Earth is about 33

Kelvin higher than without this effect. Long-wave thermal radiation emanating from the sun hits the earth's surface and is reflected by it as short-wave radiation. Through the atmosphere, some of this thermal radiation is reflected again and does not leave the atmosphere again. As a result, there is an increase in temperature. The trace gases carbon dioxide and water vapor are the main contributors to this. Other climate-relevant gases include methane, ozone and synthetic chemicals that are persistent and can also contribute to the greenhouse effect.

In addition to the natural greenhouse effect, various factors contribute to the anthropogenic, i.e. man-made, greenhouse effect. These factors are, for example, combustion of various energy sources, livestock breeding, production of a wide variety of products without exhaust gas purification, etc.

The effect indicator is the amplification of infrared radiation (W/m^2), i.e., radiation in the range of 10 to 15 µm. As a result, there is an increase in the temperature in near-Earth space; also called global warming. This subsequently leads to longer dry periods, coral death, or even to the melting of glaciers as possible endpoints of action. Due to the global warming potential, the relevant emissions or trace gases can be weighed up and weighted. The weighting is based on 1 kg of carbon dioxide. For example, methane is equivalent to 25 kg of carbon dioxide. Since the lifetime of the individual greenhouse gases varies, the time horizon is set at 100 years. Methane has an average lifespan of 12 years. Accordingly, methane can remain in the atmosphere for up to 12 years and cause damage.

No carbon dioxide from probiotic or biological sources is included in the life cycle assessment, as this contribution was only recently removed from the atmosphere and is returned to the atmosphere after a relatively short time during combustion or aerobic degradation. [3]

5.3 Restriction notes

According to EN 15804, there are no restriction notices for global warming potential (GWP).

5.4 Results of the impact assessment

The results of the impact assessment are relative statements. The results of the impact assessment do not make any statements about endpoints of the impact categories, exceedances of threshold values, safety margins or risks.

5.5 Assignment of the life cycle inventory results to the selected impact categories (classification)

There are no life cycle inventory results in the study that are not mass and energy flow data. The life cycle inventory results from the questionnaire were assigned to the impact categories using the Umberto LCA+ software. All life cycle inventory results were assigned to the impact categories.

5.6 Calculation of the impact indicator values (characterization)

The impact indicator values were calculated using the latest version of the Umberto LCA+ software and the Ecoinvent 3.10 database.

6 Results of the assessment including conclusions and limitations

The results of the impact assessment are relative statements. The results of the impact assessment do not make any statements about endpoints of the impact categories, exceedances of threshold values, safety margins or risks.

The balances could be calculated using the data provided. This comprehensive study provides a representative statement and can be communicated internally and externally. However, due to the confidentiality of the data, it is recommended that only the results and not the LCA data (basic data) itself be communicated.

As this report contains confidential information, publication is also not recommended.

6.1 Interpretation of the results

The differences in the environmental impact of the products lie in the different raw materials. In particular, the use of plastic (virgin vs. recycled) has an influence on this. Due to the re-use of recycled plastic in the recycled-based compound, this product has the lower values. Since the upstream chain of raw material oil shale ash is omitted due to its property as a secondary material without further processing (burden-free), this raw material has no influence on the environmental impact.

In both cases, the plastic used has a major influence on the main environmental impacts of the production. However, the significance changes depending on whether it is virgin or recycled material: If virgin plastic is used, it is the main driver of the values. For recycled plastic, it is the second most important driver. Electricity consumption plays a more important role in this case.

The transport of the raw materials should also be mentioned as a subordinate factor.

The balance was assessed over the partial life cycle (cradle to gate). The use and re-use phases were not declared.

The following diagram shows the proportions of selected parameters (PCF total) in the PCF.

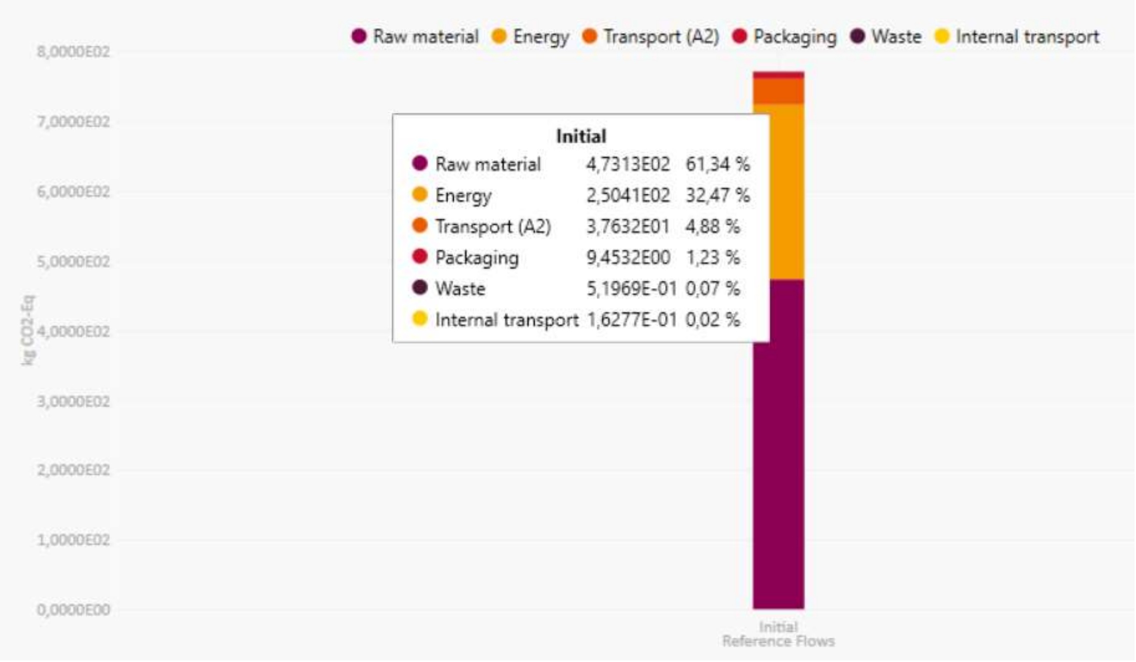

Figure 4: Shares of sources and sinks on the PCF (virgin-based compound)

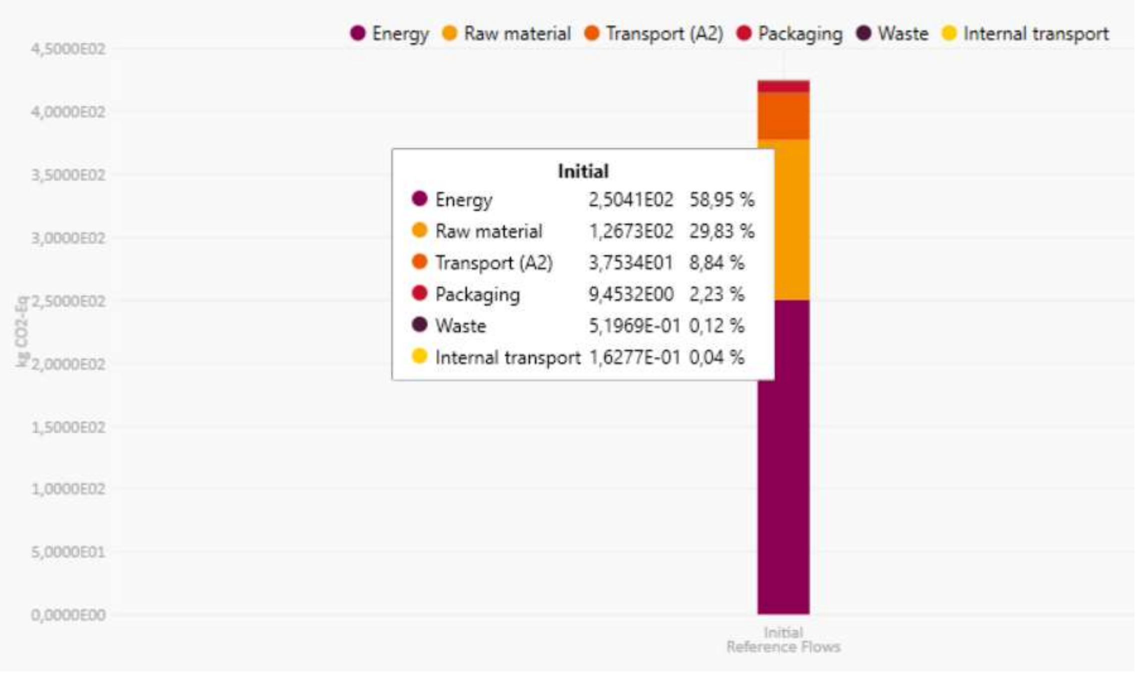

Figure 5: Shares of sources and sinks on the PCF (recycled-based compound)

6.2 Comparison

As the ash compound produced by Mineralplast offers a sustainable alternative to virgin (fossil)-based chalk with virgin plastic compound, a brief (comparison was added to the report.

For the purposes of comparability, the same properties were applied to the chalk-plastic compound as to the ash compound: a mixture of 80% chalk and 20% plastic. Against the same background, polypropylene was also assumed for the plastic content and all process-related consumption was taken from the ash compound manufacturing process (electricity consumption, internal transport, packaging, transport of virgin material and waste).

The environmental impact of the products was compared using 1 mt of each variant. The differences are as follows, with virgin-based ash compound representing the basis (100%).

PCF	Virgin based chalk compound
Climate change - Total	+37

It can be seen that a high amount of CO_2 emissions can be reduced by using oil shale ash, which is generally landfilled today, instead of chalk.

Insofar as PE is used as virgin plastic in the chalk compound, there is an even higher deviation of +39% of the PCF total compared to the ash compound with virgin PP.

6.3 Temporal validity

If there are no significant changes to the manufacturing methods or processes, the study is valid for 5 years from the date of publication.

6.4 Extended information (optional information)

A graphical representation of the results of the study can be found in chapter 6.1.

6.5 Documentation procedure

All references used are documented in the bibliography. Manufacturer information used can be requested directly from the company. All calculations were carried out on the basis of applicable laws and standards.

6.6 Consistency check

Audit	Information	Assessment	Action
Data source	Manufacturer	Ok	none
Data accuracy	Good	Ok	none
Data age	1 year	Ok	none
Technological coverage	State of the art	Ok	none
Time-related	Current	Ok	none
Coverage	Estonia plus upstream suppliers	Ok	none

6.7 Critical review

The critical review was conducted and documented by internal technical expert Patrick Wortner.

An additional external review can be carried out by recognised institutions. This increases credibility.

6.8 Results of the study

6.8.1 Key environmental indicators

Production A1 – A3	Unit	Virgin-based compound	Recycled-based compound
PCF total	kg CO2 e	775,75	439,04
PCF fossil	kg CO2 e	771,31	424,81
PCF biogenic emissions	kg CO2 e	202,89	207,10
PCF biogenic removals	kg CO2 e	-198,78	-193,11
PCF land use	kg CO2 e	0,33	0,24
PCF Aviation	kg CO2 e	6,69E-06	3,35E-06

PCF – Product Carbon Footprint (ISO 14067)

7 Bibliography

[1] Beuth Verlag GmbH, “ISO 14044:2006-07 - Umweltmanagement - Ökobilanz - Anforderungen und Anleitungen (ISO 14044:2006); Deutsche und Englische Fassung EN ISO 14044:2006,” Berlin, 2006.

[2] Beuth Verlag GmbH, “ISO 14040:2006-07 - Umweltmanagement - Ökobilanz - Grundsätze und Rahmenbedingungen,” Berlin, 2006.

[3] Beuth Verlag GmbH, “DIN EN ISO 14067:2018 - Treibhausgase - Carbon Footprint von Produkten - Anforderungen an und Leitlinien für die Quantifizierung,” Berlin, 2018.

[4] CLAITEC SOLUTIONS, S.L., “What should the speed limit of a forklift be?,” claitec.com, 17 Juni 2020. [Online]. Available: https://claitec.com/en/speed-limit-forklift/. [Accessed 11 12 2024].

[5] Beuth Verlag GmbH, “ ISO 14067:2018-08 - Treibhausgase - Carbon Footprint von Produkten - Anforderungen an und Leitlinien für Quantifizierung,” Berlin, 2018.

[6] Europäische Kommission, “Ursachen des Klimawandels,” 10 April 2021. [Online]. Available: https://climate.ec.europa.eu/climate-change/causes-climate-change_de. [Accessed 29 March 2023].

[7] Climate Service Centers Germany, “Wiki Klimawandel,” Hessisches Ministerium für Wissenschaft und Kunst (HMWK), 2020. [Online]. Available: https://wiki.bildungsserver.de/klimawandel/index.php/Treibhauseffekt. [Accessed 2021 05].

[8] ecoinvent, “ecoinvent Database,” Zurich, 2023.

8 List of figures

9 Appendix

Appendix A - Life cycle assessment representation

The representations of Umberto LCA+ are listed below. The basic data for the respective LCA changes accordingly as described in section 4.3. These are not visible on the screenshots, so only one image is shown.

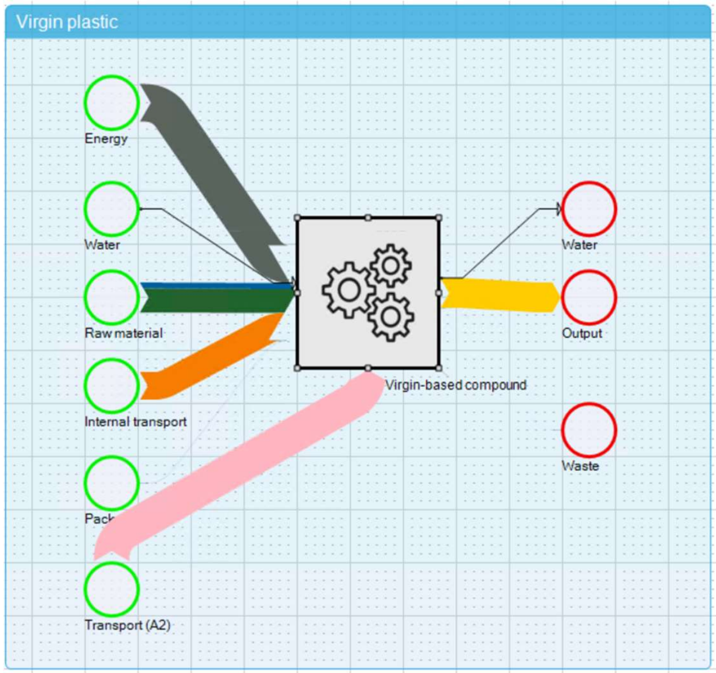

Figure 6: Life cycle A1 – A3 (Virgin-based compound)

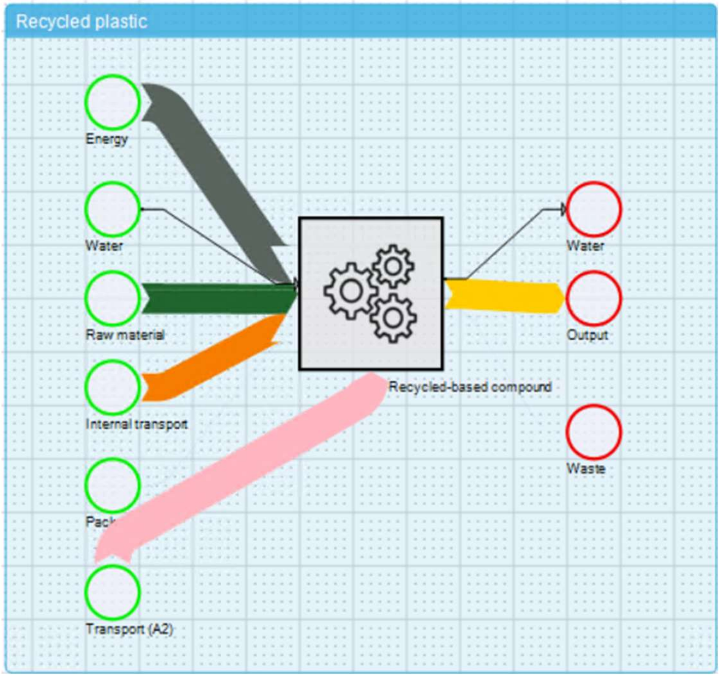

Figure 7: Life cycle A1 – A3 (Recycled-based compound)

Note: A4 - D are not shown, as these life cycle phases are considered.

As the quantities of the flows are not displayed in Umberto, the life cycle phase and the corresponding inputs and outputs are shown in the following screenshots. This allows plausibility to be checked.

Source	Input	Factor	Coefficient	Unit
Energy	electricity, high voltage (EE, electricity, high volt...		400	kWh
Internal transport	machine operation, diesel, >= 74.57 kW, high l...		0,001	hour
Packaging	polypropylene, granulate (RER, polypropylene p...		4	kg
Raw material	polypropylene, granulate (RER, polypropylene p...		200,2	kg
Raw material	polyethylene, low density, granulate (RER, poly...		0	kg
Raw material	polyethylene, high density, granulate, recycled (...		0	kg
Raw material	ash, from combustion of straw		800,8	kg
Transport (A2)	transport, freight, lorry >32 metric ton, EURO3 (...		347,8	metric ton*km
Water	Water, cooling, unspecified natural origin (reso...		0,0015	m3

Insert | Remove | 14 More

Destination	Output	Factor	Coefficient	Unit
Water	Water (emissions to air, unspecified)		0,0015	m3
Waste	municipal solid waste (RU, treatment of munici...		1	kg
Output	Pro(fi)press		1000000	g

Figure 8: Illustration of balancing model A1-A3 incl. inputs and outputs (Virgin-based compound)

Source	Input	Factor	Coefficient	Unit
Energy	electricity, high voltage (EE, electricity, high volt...		400	kWh
Internal transport	machine operation, diesel, >= 74.57 kW, high l...		0,001	hour
Packaging	polypropylene, granulate (RER, polypropylene p...		4	kg
Raw material	polypropylene, granulate (RER, polypropylene p...		0	kg
Raw material	polyethylene, low density, granulate (RER, poly...		0	kg
Raw material	polyethylene, high density, granulate, recycled (...		200,2	kg
Raw material	ash, from combustion of straw		800,8	kg
Transport (A2)	transport, freight, lorry >32 metric ton, EURO3 (...		346,9	metric ton*km
Water	Water, cooling, unspecified natural origin (reso...		0,0015	m3

Insert | Remove | 14 More

Destination	Output	Factor	Coefficient	Unit
Water	Water (emissions to air, unspecified)		0,0015	m3
Waste	municipal solid waste (RU, treatment of munici...		1	kg
Output	Pro(fi)press		1000000	g

Figure 9: Illustration of balancing model A1-A3 incl. inputs and outputs (Recycled-based compound)

Imprint

Gerberstraße 7, 88250 Weingarten

Weingarten, 12.12.2024

Vivien Zwick, M.Sc., vzwick@ppp.ms,

Life Cycle Assessor