Environmental Product Declaration

According ISO 14025 and EN 15804

Owner of Declaration	Hedgehog Koffie B.V.
Publisher	Hedgehog Company B.V.
Calculation number	EPD-2021-001
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Valid Unit	16 Januari 2026

HEDGEHOG COMPANY

Coffee Capsules

1. General infromation

1.1 Company

Manufacturer	Hedgehog Koffie B.V.
Production Location	-
Adress	Turbinestraat 6 1014 AV Amsterdam
Email	info@hedgehogcompany.nl
Website	www.hedgehogcompany.nl

1.2 EPD information

EPD for	Aluminium coffee capsules Biodegradable coffee capsules
Projectnumber	EPD-2021-001
Date of Issue	16-01-2021
Date of validity	16-01-2026
PCR	There are no Product Catergory Rules available for coffee capsules

1.3 Scope of declaration

This is a cradle-to-gate EPD for two coffee capsules of different materials. The life cycle stages are as shown below. (x = included, MND = module not declared)

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	MND	x	MND	MND	MND	MND	x	x	MND	x	x	x	x

1.4 Verfication of the Declaration

CEN standard EN15804, as basis for SBK Bepalingsmethode serves as core PCR. Independed verification of the declaration and data, according to EN ISO 14025:2010

☒ Internal ☐ External

2. Objective

The aim of this EPD is to generate a reliable and accurate overview of two alternative coffee capsule options. This study measures the direct environmental impact of the production, the use and the end-of-life stage of these two coffee capsules. Thus, the overall objective of this study is:

- Quantifying and comparing the environmental impact of the production, use and end-of-life of aluminium and biodegradable coffee capsules.

The results of this study can be used to support environmental conscious consumers in their decision between buying aluminium or biodegradable coffee capsules. Hence, the target audience consists of those interested in EPDs and the environmental impact of coffee. It must be noted that the data in this research is not supplier specific and based on general databases and desk research. It gives an average view in the comparison between the two capsules, but results can differ when comparing specific suppliers of both products.

3. System boundaries

The coffee capsules are produced at a location in Switzerland and are distributed to the Dutch market. The prescribed waste scenarios from the SBK Bepalingsmethode 1.0 have been used for the various materials in the product. The SBK Bepalingsmethode is aimed at conducting LCAs for the Dutch construction sector, however its waste scenarios are considered relevant for this study.

For the biodegradable capsule, the whole cup is compostable and does not need to be treated in a waste facility. However, we assume that only 50% of the end-users compost their capsules, while the other 50% still throw them out in the household waste bin.

Production stage			Building stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	MND	x	MND	MND	MND	MND	x	x	MND	x	x	x	x
Raw material supply	Transport	Manufacturing	Transport to site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction and demolition	Transport	Waste processing	Disposal	Substitution and recovery potential

In the LCA the following life cycle stages are included:

1. Raw material supply (A1)
2. Transport to production location (A2)
3. Manufacturing (A3)
4. Transport to end-user (A4)
5. Use (B1)
6. Operational energy use (B6)
7. Operational water use (B7)
8. Transport to waste processor (C2)
9. Waste processing (C3)
10. Final disposal (C4)
11. Benefits and loads beyond the system boundaries (reuse and recovery potential) (D)

In the remainder of the report, B1, B6 and B7 are reported as one single use phase (B).

The following life cycle stages are excluded as they are deemed irrelevant for the product:

1. Construction (A5)
2. Use (maintenance, repair, replacement and refurbishment) (B2-B5)
3. Deconstruction (C1)

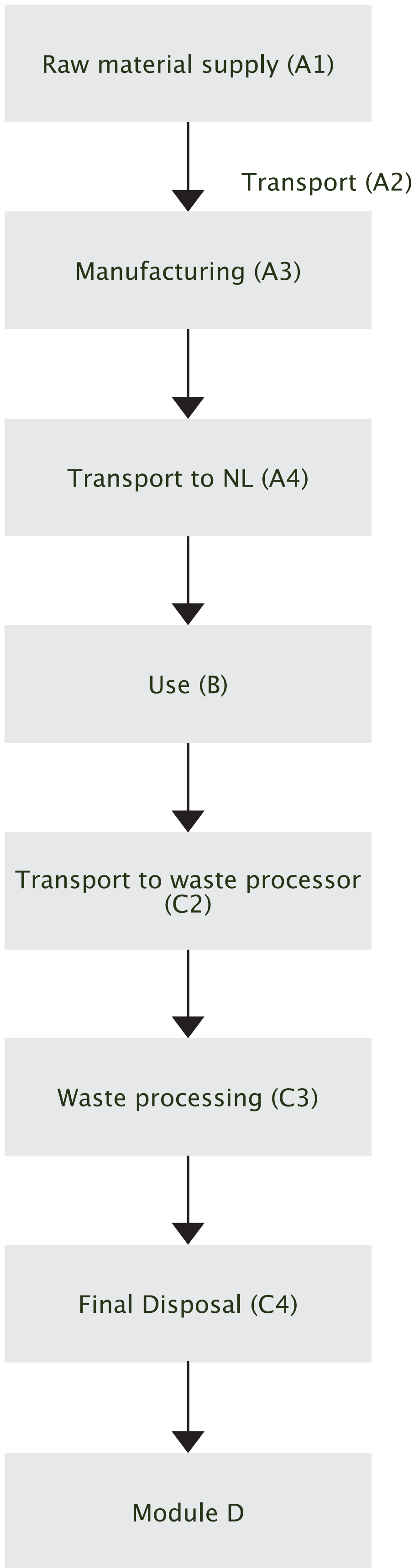

Figure 1: Life cycle stages of the coffee capsules

4. Calculation rules

4.1. Production and transport (A1-4)

The inventoried data used to model modules A1-4 of the aluminium coffee capsule production is collected from Li (2018).

Material	Amount (kg)
Aluminum	confidential
Pet	confidential
LDPE	confidential
Solid bleached Board	confidential

For the biodegradable alternative, data is collected from Kooduvalli et al. (2020).

Material	Amount (kg)
Polylactide	confidential
Kraft paper	confidential
Solid unbleached board, SBB, at plant/RER	confidential

Next to that, the amount of coffee that is encapsulated is modeled in this study. According to one of the largest coffee capsule suppliers, one coffee capsule contains 7 grams of coffee (Nespresso, 2021). Both product systems are assumed to be produced in Switzerland, and transport distances are estimated based on this production location.

4.2. Use phase (B)

The use phase of both coffee capsules consists of making coffee with a capsule compatible coffee machine. This machine uses approximately 28.77 Wh of electricity to heat up the coffee, and 110 ml of water to make the coffee (The Green Pods, 2021: Nespresso, 2021).

4.3. End-of-life (C2-4, D)

The end-of-life phase consists of the disposal - the waste processing - and the loads and benefits of the recycling and incineration of the product outside the system boundary.

Aluminium capsules

After disposal, it is assumed that the aluminium and cardboard packaging are recycled according to the appropriate waste treatment scenarios of the Netherlands. For both of these materials, the part that is not recycled is incinerated.

Material	Recycling percentage
Paper (cardboard)	90%
Aluminium	97%

By making use of the Nationale Milieudatabase waste scenarios, the amount of aluminium and wood chips (base material for paper pulp) that are saved due to end-of-life treatment can be calculated. This recycled material thus prevents the use of virgin materials in the next lifecycle.

The plastic content, as well as the small share of aluminium and packaging paper that are not recycled are assumed to be incinerated with energy recovery. The avoided energy inputs are calculated based on the Dutch energy mix (EBN, 2019).

Energy source	Dutch energy mix
Fossil	85%
Renewable	15%

Biodegradable capsules

After the biodegradable capsules are used, they are suitable to be composted. However, not all users actually compost the capsules. It is assumed that 50 percent of the end-users actually compost the capsules, while the remaining capsules are thrown out in the generic household trash bin. Thus, this share of the capsules is treated according to the standard waste treatment process in the Netherlands.

The packaging material is treated similar to the cardboard for the aluminium capsules. The disposed capsules, as well as the small share of packaging paper that is not recycled are assumed to be incinerated with energy recovery.

Biogenic carbon content

For the biodegradable capsules, polylactide (PLA) is used as the main material. The biogenic carbon content of PLA is 1.833 kg CO_2/kg (Morão & De Bie, 2019).

5. Representativeness

The used database references for the both product alternatives are representative for the geographical area of Europe, as the capsules are produced in Europe. Further downstream processes take place in the Netherlands and are covered by European and Dutch references from Ecoinvent v3.5 and the Nationale Milieudatabase v3.1.

6. Results

6.1 Environmental profiles

In Table 3 and 4 the environmental profiles for the coffee capsules are presented. The environmental indicators that are selected are based on the SBK bepalingsmethode. By making use of this method, shadow costs are assigned to different impact categories which results in a single environmental cost indicator (ECI) for the products. This method is specifically designed for the building sector, but for demonstration purposes this study also follows this method. Additionally, only set 1 of the SBK bepalingsmethode is used, as this is the set that is used to calculate the ECI.

The following environmental parameters are used to calculate the ECI.

ADPE (abiotic depletion potential of minerals/elements) expressed in kg Sb eq.

ADPF (abiotic depletion potential of fossil fuels) expressed in kg Sb eq.

GWP (global warming potential) expressed in kg CO2 eq.

ODP (ozone layer depletion potential) expressed in kg CFC-11 eq.

POCP (photochemical ozone creation potential) expressed in kg C2H4 eq.

AP (acidification potential) expressed in kg SO2 eq.

EP (eutrophication potential) expressed in kg $(PO4)^{3}-$ eq.

HTP (human toxicity potential) expressed in kg 1,4-DB eq.

FAETP (freshwater aquatic ecotoxicity toxicity potential) expressed in kg 1,4-DB eq.

MAETP (marine aquatic ecotoxicity toxicity potential) expressed in kg 1,4-DB eq.

TETP (terrestrial ecotoxicity toxicity potential) expressed in kg 1,4-DB eq.

Environmental profile of aluminium coffee capsules

Indicator	Unit	A1-3	A4	B	C2-4	D	Total
ADPE	kg Sb eq	3,67E-04	4,19E-06	1,72E-05	4,57E-05	1,10E-04	5,44E-04
ADPF	kg Sb eq	4,32E-01	9,23E-03	1,37E-01	7,08E-03	-6,09E-02	5,24E-01
GWP	kg CO2 eq	9,09E+01	1,25E+00	1,85E+01	6,98E-01	-8,62E+00	1,03E+02
ODP	kg CFC-11 eq	6,68E-06	2,27E-07	9,98E-07	1,00E-07	-4,89E-07	7,52E-06
POCP	kg C2H4 eq	6,60E-02	9,51E-04	2,82E-03	8,20E-04	-3,14E-03	6,74E-02
AP	kg SO2 eq	9,35E-01	5,47E-03	4,62E-02	1,21E-02	-3,62E-02	9,62E-01
EP	kg $(PO4)^{3}-$ eq	6,64E-01	1,10E-03	1,06E-02	3,03E-03	-3,35E-03	6,75E-01
HTP	kg 1,4-DB eq	8,99E+01	4,66E-01	1,93E+00	1,55E+00	-6,16E+00	8,77E+01
FAETP	kg 1,4-DB eq	1,83E+01	1,26E-02	5,33E-02	2,41E-02	-3,78E-02	1,83E+01
MAETP	kg 1,4-DB eq	5,86E+03	4,37E+01	2,25E+02	1,38E+02	-2,89E+02	5,98E+03
TETP	kg 1,4-DB eq	5,18E-01	1,92E-03	9,45E-02	4,68E-03	-1,01E-02	6,09E-01
ECI	Euro	2,37E+01	1,45E-01	1,43E+00	2,68E-01	-1,21E+00	2,43E+01

Environmental profile of biodegradable coffee capsules

Indicator	Unit	A1-3	A4	B	C2-4	D	Total
ADPE	kg Sb eq	2,90E-04	4,91E-06	1,72E-05	1,13E-06	-6,67E-07	3,13E-04
ADPF	kg Sb eq	3,34E-01	1,08E-02	1,37E-01	1,67E-03	-1,17E-02	4,72E-01
GWP	kg CO2 eq	7,36E+01	1,47E+00	1,85E+01	3,32E-01	-1,33E+00	9,25E+01
ODP	kg CFC-11 eq	4,43E-06	2,66E-07	9,98E-07	3,88E-08	-1,60E-07	5,57E-06
POCP	kg C2H4 eq	5,71E-02	1,11E-03	2,82E-03	3,11E-04	-4,63E-04	6,08E-02
AP	kg SO2 eq	8,04E-01	6,41E-03	4,62E-02	1,22E-03	-2,42E-03	8,56E-01
EP	kg $(PO4)^{3}-$ eq	6,62E-01	1,29E-03	1,06E-02	2,60E-04	-4,82E-04	6,74E-01
HTP	kg 1,4-DB eq	5,76E+01	5,46E-01	1,93E+00	2,19E-01	-1,81E-01	6,01E+01
FAETP	kg 1,4-DB eq	1,53E+01	1,47E-02	5,33E-02	2,41E-03	-4,11E-03	1,53E+01
MAETP	kg 1,4-DB eq	2,48E+03	5,12E+01	2,25E+02	8,40E+00	-9,94E+00	2,76E+03
TETP	kg 1,4-DB eq	4,75E-01	2,25E-03	9,45E-02	4,06E-04	-1,23E-03	5,71E-01
ECI	Euro	1,89E+01	1,70E-01	1,43E+00	4,53E-02	-1,01E-01	2,05E+01

References

EBN. (2019). Energie in Nederland. Retrieved from https://www.ebn.nl/wp-content/uploads/2019/01/EBN_Infographic2019_14JAN19.pdf

Kooduvalli, K., Vaidya, U. K., & Ozcan, S. (2020). Life Cycle Assessment of Compostable Coffee Pods: A US University Based Case Study. Scientific reports, 10(1), 1-24.

Li, J. (2018). Comparative Life Cycle Assessment of Single-Serve Coffee Packaging in Ontario (Master's thesis, University of Waterloo).

Morão, A., & De Bie, F. (2019). Life cycle impact assessment of polylactic acid (PLA) produced from sugarcane in Thailand. Journal of Polymers and the Environment, 27(11), 2523-2539.

Nespresso. (2021). FAQ. Retrieved from https://www.nespresso.com/nl/nl/service-faq

PRN. (2021). Feiten en cijfers. Retrieved from https://prn.nl/prn-en-het-prn-systeem/feiten-en-cijfers/

The Green Pods. (2021). How Much Power Does A Nespresso Machine Use?. Retrieved from https://thegreenpods.co.nz/how-much-power-does-a-nespresso-machine-use/