Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

Mastic Asphalt

from

Gjutasfaltföreningen

Programme:	The International EPD® System, www.environdec.com
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 *Construction products (EN 15804:A2),* version 1.2.5.
PCR review was conducted by: *The Technical Committee of the International EPD® System. Review chair: Claudia A. Peña, University of Concepción, Chile. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com.*
Life Cycle Assessment (LCA)
LCA accountability: *Thomas Eknor Morrell, Niclas Silfverstrand, Yevgeniya Arushanyan, Ramboll Sweden AB*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier  Third-party verifier: Martin Erlandsson, IVL Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation

factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD:
Gjutasfaltföreningen (GAFS)

Contact:
sekreterare@gjutasfalt.se
ordforande@gjutasfalt.se

Description of the organisation:
GAFS, in Sweden, is a branch organisation that seeks to increase knowledge regarding cast asphalt and it's benefits in the building industry.

GAFS was founded in 1976. On their website www.gjutasfalt.se you can find information regarding cast asphalt and research projects within the area and the organisations members. GAFS consists of 3 manufacturers: NCC Industry, DAB Group and Duo Asfalt who have all participated in the LCI of this EPD.

Product-related or management system-related certifications:
SS EN 13108-21

Name and location of production site(s):
Kungälv, Sweden
Ringsted, Denmark
Landvetter, Sweden
Stockholm, Sweden

Product information

Product name:
Mastic Asphalt

Product identification:
Swedish name: Gjutasfalt

Product description:
Mastic Asphalt is water resistant and resilient with a life span of 50+ years (Gjutasfaltföreningen, 2021). This makes it suitable for outdoor application where it will be submitted to continuous stress and weather conditions. Mastic Asphalt (usually with a max grain size 8 or 11mm) gives a bituminous water-resistant layer with high strength and resilience.

UN CPC code:
37930 Articles of asphalt or of similar material

Geographical scope:
Sweden, Denmark

LCA information

Declared unit:
1 ton of Mastic Asphalt.

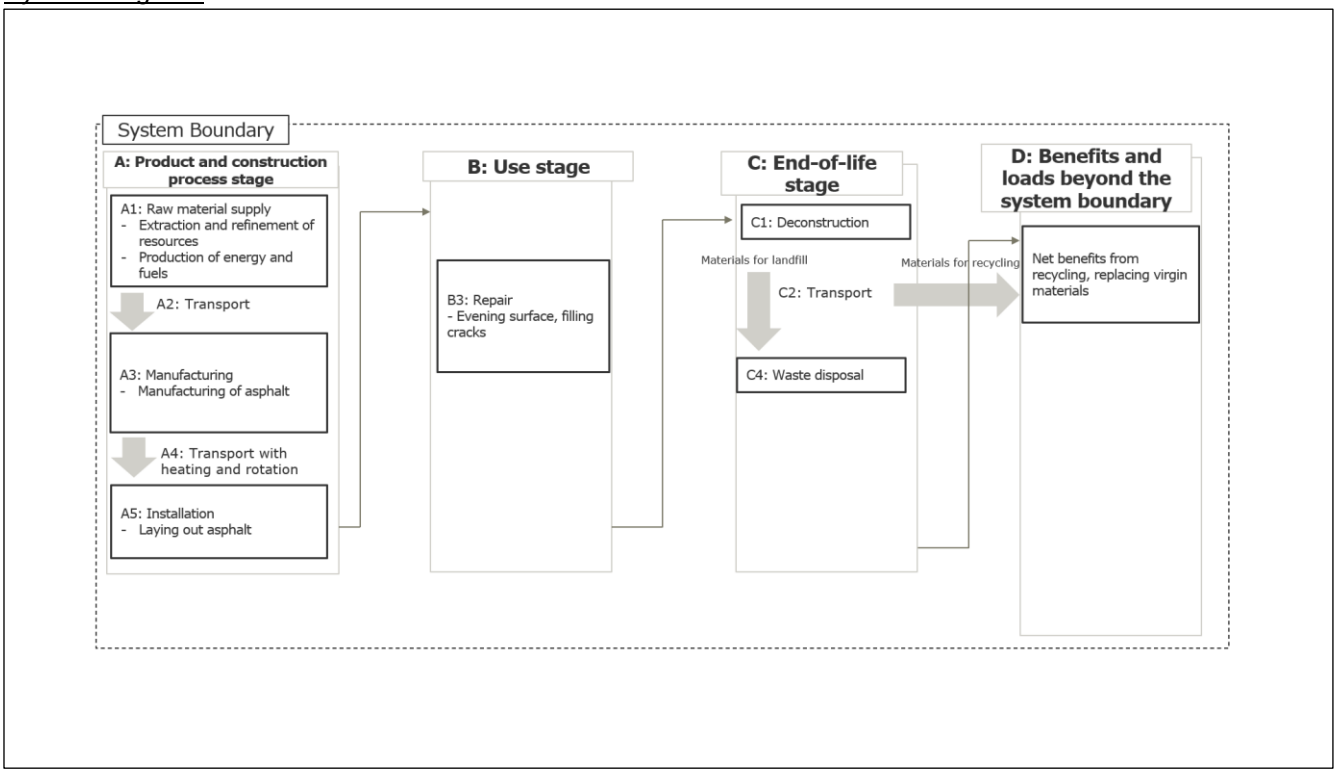
Reference service life:
Reference service life is not declared in this study but the product lasts for 50+ years (Gjutasfaltföreningen, 2021).

Time representativeness:
Data represents the year 2022.

Database(s) and LCA software used:
LCA calculations were performed with the LCA software LCA for Experts (version 10.7.0.183), using life cycle inventory (LCI) data from Professional database and Ecoinvent 3.8. For the bitumen Eurobitume, 2021 data has been used. This dataset is not entirely compliant with EN15804 and is not recommended to be used for EPDs, however, it is a common practice to use it for asphalt EPDs and therefore it was used for this EPD to ensure comparability with other asphalt EPDs.

Description of system boundaries:
Cradle to gate with options, modules C1–C4, module D and with optional modules (A1–A3 + C + D and additional modules). The additional modules in this EPD are A4, A5 and B.

System diagram:



Product stage, A1-A3:
The product stage comprises the acquisition of all raw materials, products and energy, transport to the production site, production processes, packaging, and waste processing up to the end-of-waste state or final disposal.

More specifically, this module includes the upstream processes of extraction and processing of raw materials and the transportation of the input materials to the four production sites included in the study. Furthermore, it includes the core processes of producing the final product – Mastic Asphalt, including the impacts from extraction and processing of fuels and auxiliary materials and their transportation to the production site. The module also includes the production of purchased electricity used at the production site.

Construction process stage, A4-A5:
The transportation of the finished products to the construction site is done in trucks with heated rotating tanks. The heat and rotation are necessary for the asphalt to not dry up before being laid out. The distance to the construction sites and the amount of diesel and LPG needed for the rotating and heating the asphalt has been calculated by GAFS based on internal statistics. See Table 1 for details.

Table 1 A4 - Transport to the installation site

Scenario information	Unit	Quantity
Diesel	liter	1.51
LPG	kg	0.79
Distance	km	79.53
Capacity utalisations	%	100.00
Bulk density of transported products	kg/m3	2.27
Volume capacity utalisation factor	Factor=1 or <1 or ≥1	1.00

Laying out asphalt is done with the help of dumpers driven on HVO. The amount of HVO used to lay out the asphalt has been calculated by GAFS based on internal statistics. Losses equal to 1% of the finished product have been estimated by GAFS over the reporting year. Both the production and waste management of these materials have been accounted for within A5 to conform with EN 15804. See Table 2 for details.

Table 2 A5 - Installation of the product

Scenario information	Unit	Quantity
Ancillary materials for installation	kg	0.00
Water use	m3	0.00
HVO	kg	0.37
LPG	kg	0.70
Waste materials input	kg	10.00
Waste materials output	kg	10.00
Direct emissions to ambient air, soil and water	kg	Not measured

Use stage, B1-B7:
No impacts from use, maintenance, replacement and refurbishment have been included, since there are no activities associated with these life cycle stages during Mastic Asphalt's life time.
The eventual repair (B3) is included based on internal statistics. See Table 3 for details.

Table 3 B3 - Repair

Scenario information	Unit	Quantity
Repair process	Filling cracks and evening surfaces	NA
Inspection process	NA	NA
Repair cycle	year(s)	1,00
Ancillary materials	kg	0,00
Waste materials	kg	0,00
Water use	m3	0,00
LPG	kg	0,10

End of life, C1-C4:
Mastic Asphalt is sold on two markets, Sweden and Denmark. The end-of-life scenario is modelled to fit both the Swedish and Danish market.
Module C1 comprises the deconstruction of the Mastic Asphalt, which includes the removal of the asphalt from the ground through excavation.

According to European Asphalt Pavement Association (EAPA) about 90% of the removed asphalt is reclaimed, out of this about 37% is used in new asphalt production of different types and 63% is used as unbound road layers or for other applications. As a conservative assumption in this study all the recycled asphalt is assumed to be further used as unbound road layers instead of limestone, sand, and own filler. This is seen as a conservative assumption as bitumen, the material with the highest environmental impact, is assumed not to be recycled. The remaining 10% of the removed asphalt is sent to a landfill. See Table 4 End-of-life.

Table 4 End-of-life

Scenario information	Unit	Quantity
Assumptions for transportation	km to recycling and landfill	100
Recycling process	kg to recycling	900
Disposal process	kg to landfill	100

Module C2 includes the transport between the deconstruction site and either recycling facility or landfill. The distance of 100 km was assumed both for transport to recycling and to a landfill, since no specific information is available.

There is no waste processing in C3 since neither further recycling nor landfill require processing.

Module C4 comprises the disposal of asphalt, within which the processes connected to landfill are included.

Re-use, recovery and recycling potential, D:
In general, module D includes reuse, recovery and/or recycling potential, expressed as net impact and benefits. In this case, the module D includes the benefits generated by avoiding extraction of limestone, sand, and own filler. The ratio between these is based on the ratio between the input of the materials. No processes for recycling are included since the application would be using the reclaimed asphalt in unbound road layers, which doesn't require further crushing after the removal process. The material substituted in module D is the production of gravel, which is commonly used as an unbound road layer, in the amount 1:1.

Additional LCA information

Cut-off rules
General cut-off criteria as defined in EN15804 are followed. Life cycle inventory data shall according to EN 15804 include a minimum of 95% of total inflows (mass and energy) per module. No known inflows were left out.

Data quality
The dataset from Eurobitume (2020 + 2021 update) has been applied for bitumen. This dataset is not entirely compliant with the EN15804 due to allocation used, however, a lot of asphalt EPDs are using the Eurobitume data from 2019 (3rd edition) (Eurobitume, 2020) despite the fact that it is not compliant with EN15804. To ensure the comparability with other asphalt EPDs it was decided to use Eurobitume data even in these EPDs, however the 2019 data was complemented with the update from 2021 (3.1 edition, Eurobitume, 2021).

Aside from bitumen all processes with a significant impact have high quality datasets.

Allocation
All 4 production sites have provided site specific data regarding material use and its transportation, and energy use for the production of Mastic Asphalt. The energy consumption for production of one tonne of product was allocated by dividing the total energy consumption of 2022 with the total amount of produced cast asphalt (3 different product types combined).

The tumbling of aggregates creates a by-product which is used as a filler in other products produced on the sites. Approximately 1% the material entering the tumbling process becomes by-product. The impact of the process that might be allocated to the by-product is seen as insignificant. All of the impact is therefore allocated to the Mastic Asphalt process and counted as 0 for the by-product.

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	SE, DK, PL	SE, DK, PL	SE, DK	-	-	-	-	SE, DK	-	-	-	-	SE, DK	SE, DK	SE, DK	SE, DK	SE, DK
Specific data used	65%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	+/- 36%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Content information

Product components	Weight, kg	Post-consumer material, weight-%	Biogenic material, weight-% and kg C/kg
Bitumen	76-78	0	0
Lime stone	235-243	0	0
Sand	257,75-280	0	0
Aggregates	400-431,25	0	0
TOTAL	1000	0	0
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/kg**
TOTAL	0	0	0

The product does not, independent of site, contain any of the substances listed on the "Candidate List of Substances of Very High Concern (SVHC) for authorisation" (http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp).

Results of the environmental performance indicators

Mandatory impact category indicators according to EN 15804

Results per 1 metric tonne												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B2**	**B3**	**B4-B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO2 eq.	8.98E+01	1.30E+01	4.83E+00	0.00E+00	3.83E-01	0.00E+00	6.20E-01	8.63E+00	0.00E+00	1.79E+00	-1.80E+00
GWP-biogenic	kg CO2 eq.	1.05E-03	5.57E-04	4.92E-03	0.00E+00	4.98E-04	0.00E+00	1.60E-06	2.55E-02	0.00E+00	1.12E-02	4.38E-02
GWP-luluc	kg CO2 eq.	9.78E-02	9.02E-02	3.50E-03	0.00E+00	1.58E-05	0.00E+00	5.56E-03	8.00E-02	0.00E+00	1.12E-03	-7.70E-03
GWP-total	kg CO2 eq.	8.94E+01	1.31E+01	4.78E+00	0.00E+00	3.84E-01	0.00E+00	6.25E-01	8.73E+00	0.00E+00	1.80E+00	-1.76E+00
ODP	kg CFC 11 eq.	2.23E-06	1.53E-12	1.27E-07	0.00E+00	3.32E-14	0.00E+00	7.81E-14	1.12E-12	0.00E+00	3.20E-07	-1.16E-11
AP	mol H+ eq.	4.48E-01	6.00E-02	3.21E-02	0.00E+00	6.26E-04	0.00E+00	3.14E-03	1.46E-02	0.00E+00	9.28E-03	-9.19E-03
EP-freshwater	kg P eq.	3.54E-03	3.71E-05	2.09E-04	0.00E+00	1.92E-07	0.00E+00	2.19E-06	3.16E-05	0.00E+00	1.48E-04	-9.02E-06
EP-marine	kg N eq.	2.33E-01	2.76E-02	2.06E-02	0.00E+00	2.26E-04	0.00E+00	1.47E-03	5.71E-03	0.00E+00	1.22E-02	-3.24E-03
EP-terrestrial	mol N eq.	1.84E+00	3.06E-01	1.44E-01	0.00E+00	2.49E-03	0.00E+00	1.63E-02	6.55E-02	0.00E+00	3.34E-02	-3.58E-02
POCP	kg NMVOC eq.	3.91E-01	8.02E-02	2.80E-02	0.00E+00	7.94E-04	0.00E+00	4.11E-03	1.30E-02	0.00E+00	9.86E-03	-8.81E-03
ADP-minerals & metals*	kg Sb eq.	1.39E-04	6.73E-07	6.73E-06	0.00E+00	4.13E-09	0.00E+00	3.95E-08	5.69E-07	0.00E+00	3.45E-06	-1.87E-07
ADP-fossil*	MJ	4.58E+03	1.75E+02	1.32E+02	0.00E+00	5.44E+00	0.00E+00	8.18E+00	1.18E+02	0.00E+00	2.53E+01	-2.79E+01
WDP*	m3	1.87E+01	1.25E-01	1.34E+00	0.00E+00	9.60E-04	0.00E+00	7.25E-03	1.04E-01	0.00E+00	1.12E+00	-1.91E-01
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption											

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Additional mandatory and voluntary impact category indicators

Results per functional or declared unit												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B2**	**B3**	**B4-B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	Kg CO_2 eq.	8.94E+01	1.31E+01	4.78E+00	0.00E+00	3.83E-01	0.00E+00	6.25E-01	8.71E+00	0.00E+00	1.79E+00	-1.81E+00

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Resource use indicators

Results per functional or declared unit												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B2**	**B3**	**B4-B7**	**C1**	**C2**	**C3**	**C4**	**D**

PERE	MJ	3.41E+02	9.85E+00	1.62E+01	0.00E+00	2.65E-02	0.00E+00	5.95E-01	8.56E+00	0.00E+00	4.29E-01	-9.05E+00
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	3.41E+02	9.85E+00	1.62E+01	0.00E+00	2.65E-02	0.00E+00	5.95E-01	8.56E+00	0.00E+00	4.29E-01	-9.05E+00
PENRE	MJ	1.31E+03	1.76E+02	1.30E+02	0.00E+00	5.45E+00	0.00E+00	8.21E+00	1.18E+02	0.00E+00	2.53E+01	-2.80E+01
PENRM	MJ	3.19E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.87E+03	-3.19E+02	0.00E+00
PENRT	MJ	4.51E+03	1.76E+02	1.30E+02	0.00E+00	5.45E+00	0.00E+00	8.21E+00	1.18E+02	-3.19E+03	2.53E+01	-2.80E+01
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	7.63E-01	1.09E-02	3.47E-02	0.00E+00	3.79E-05	0.00E+00	6.52E-04	9.38E-03	0.00E+00	2.62E-02	-8.28E-03
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water											

Waste indicators

Results per functional or declared unit											
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B2**	**B3**	**B4-B7**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	4.98E-01	6.95E-10	1.00E-02	0.00E+00	3.61E-11	0.00E+00	2.54E-11	3.66E-10	0.00E+00	0.00E+00	6.82E-10
Non-hazardous waste disposed	kg	8.15E+00	2.43E-02	1.72E-01	0.00E+00	5.08E-04	0.00E+00	1.25E-03	1.80E-02	0.00E+00	1.00E+02	-3.75E+01
Radioactive waste disposed	kg	5.99E-02	3.03E-04	8.69E-04	0.00E+00	6.89E-06	0.00E+00	1.54E-05	2.21E-04	0.00E+00	0.00E+00	-1.92E-03

Output flow indicators

Results per functional or declared unit												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B2**	**B3**	**B4-B7**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.00E+02	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Information related to sector EPD

The EPD is a sector EPD for GAFS based on 4 sites: Kungälv - Sweden, Ringsted – Denmark, Landvetter – Sweden and Stockholm - Sweden. The 4 different sites have been separately modeled in the LCA software LCA for Experts and the results have then been averaged according to the respective site's production volumes over the year. The results are representative for the production of an average product from GAFS.

References

- Arushanyan, Y., Silfverstrand, N., Eknor Morrell, T., Althoff Palm, D. Underlying LCA for Environmental Product Declaration EPD® -GAFS Asphalt Products. Ramboll, 2023
- General Programme Instructions of the International EPD® System. Version 4.0.
- PCR 2019:14. Construction Products. 1.2.5
- EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- ISO 14025 on Type III Environmental declarations.
- ISO 14040 and ISO 14044 on Life Cycle Assessments (LCA).
- Gjutasfaltföreningen, 2021. Inventering av Parkeringdäck: Gjutasfalt som Slitlager

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