Environmental Product Declaration for asphalt mixtures from Västerås asphalt plant – Vändle

According to EN 15804:2012+A2:2019/AC:2021,
ISO 14025, ISO 14040 and ISO 14044
Programme operator: EPD International AB
EPD owner: NCC Industry Nordic AB

Date of publication (issue): 2021-10-15
Date of revision: 2022-07-11
Date of validity: 2027-07-10
Reg. no. S-P-03640

See Table 1 for all declared asphalt mixtures in this EPD.

EPD Information

Declared unit:	1000 kg product
PCR:	Product Category Rules PCR 2019:14 Construction products, version 1.11 of 2021-02-05
Programme:	The International EPD® System, www.environdec.com

Product information

General product information

The asphalt mixtures declared are manufactured at Vändle asphalt plant in Västerås, by NCC Industry, Division Asphalt in Sweden.

Asphalt plants manufacture asphalt mixtures for paving purposes. The asphalt mixtures that can be produced at the declared plant are hot mix asphalt (HMA), warm mix asphalt (WMA), soft bitumen asphalt (SA) and polymer modified asphalt (PMB).

The main components in asphalt mixtures are mineral rock aggregates and bitumen. Other materials are added, and the content varies depending on the asphalt type. These include for instance amines and fibre and they normally constitute less than 0.5 weight-% of the product. In addition, Reclaimed Asphalt (RA) is usually added to the asphalt mixture, replacing virgin aggregates and virgin bitumen. The content declaration of the asphalt mixtures declared is shown in the section Content declaration including packaging, Table 5.

The temperature class and the share of RA in the asphalt mixtures are given in Table 1: no RA, the actual annual mean share and the maximum possible share.

Table 1: Temperature class and three different shares of Reclaimed Asphalt (RA) in the asphalt mixtures declared.

#	Asphalt mixture	Temperature class	Share of RA (no RA) in weight-%	Share of RA (actual annual mean) in weight-%	Share of RA (maximum) in weight-%
1	ABT 11 160/220	HMA	0	26	50
2	ABT 11 (H) 160/220	HMA	0	19	30
3	ABb 22 70/100	HMA	0	34	50
4	ABT 11 70/100	HMA	0	28	50
5	AG 22 70/100	HMA	0	35	50
6	AG 22 160/220	HMA	0	35	50
7	ABS 16 An<6 70/100	HMA	0	9.4	10
8	ABT 16 70/100	HMA	0	30	50
9	ABT 16 160/220	HMA	0	26	50
10	ABS 16 40/100-75	PMB	0	8.2	10
11	Viacogrip 16 65/105-50	PMB	0	14	15
12	AG 16 160/220	HMA	0	27	50
13	ABS 16 An<6 45/80-55	PMB	0	0	10
14	ABS 16 An<7 70/100	HMA	0	0	10
15	ABb 16 70/100	HMA	0	0	50

At the asphalt plant, the manufacture of a typical asphalt mixture is managed from the on-site control room where adjustments are made to individual raw materials. A schematic illustration of an asphalt plant is shown in Figure 1.

Aggregates, which are obtained either from the quarry on-site or purchased from external suppliers, are stored in stockpiles of different fractions (e.g. 0/4, 4/8 and 8/11 etc). The aggregates in an individual stockpile are hauled to a cold feed bin of the asphalt plant before transported further, together with the other aggregate fractions of a given recipe, by a conveyor belt running below the bins. The mixed aggregates enter a rotating dryer drum, where the material is dried and heated to desired temperature. The heated material continues to an elevator and is further transported up to the batch tower.

The next step comprises screening using a hot screen where the heated aggregates are separated according to grain size and put into a weigh hopper. The material is mixed with bitumen, filler, fibres and other additives, such as adhesive agents (amines or cement), in the mixing chamber. When a homogeneous asphalt mixture is obtained it is transferred with a skip hoist to an insulated storage silo before being retrieved by a truck.

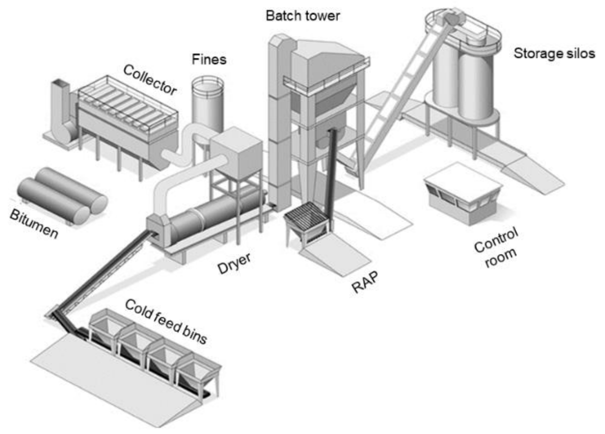

Figure 1: Schematic illustration of an asphalt plant

A schematic illustration of the production process of asphalt in general is presented in Figure 2.

The dashed lines illustrate the six different methods of adding RA to an asphalt mixture. Västerås asphalt plant uses the method “parallel drum”.

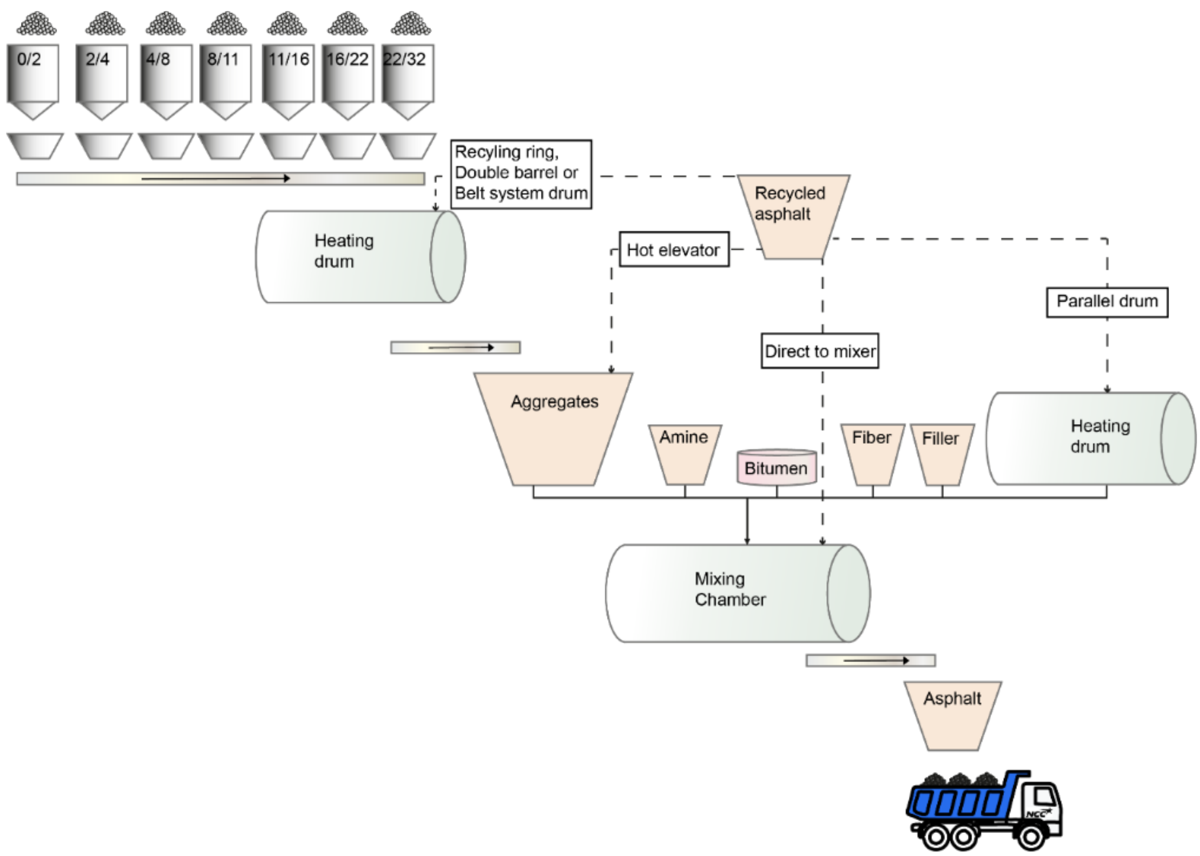

Figure 2: Illustration of the general production process of asphalt.

It is important to treat emissions (i.e. polyaromatic hydrocarbons, PAHs) generated in the dryer drum. Such emissions largely depend on production temperature, fuel type, amount and type of technique used for adding RA. Depending on technique used, PAHs created at the drying drum or at the top of the batch tower are transported for filtering at the collector.

Warm Mix Asphalt is a production method used by NCC for manufacturing of any type of asphalt but at a lower temperature compared to conventionally produced asphalt mixtures. To obtain the temperature reduction a foaming technique is used. Water is injected into the bitumen, which expands and forms a foam of bitumen in a foaming chamber. The bitumen is mechanically foamed inside the chamber where the binder increases roughly 20 times in volume before it is mixed with the heated aggregates and the reclaimed asphalt. The procedure reduces the binder viscosity and the compatibility of the asphalt mixture thus allowing it to be laid at typically 30°C lower temperature than conventionally produced asphalt. All other raw materials are added following the same principle as described for conventional asphalt production.

The products declared are classified as the United Nations Central Product Classification (UN CPC) code 15330. The products declared follow the technical standards SS-EN 13108-1, SS-EN 13108-3, SS-EN 13108-5 and SS-EN 13108-7.

The geographical location of Västerås asphalt plant is shown in Figure 3.

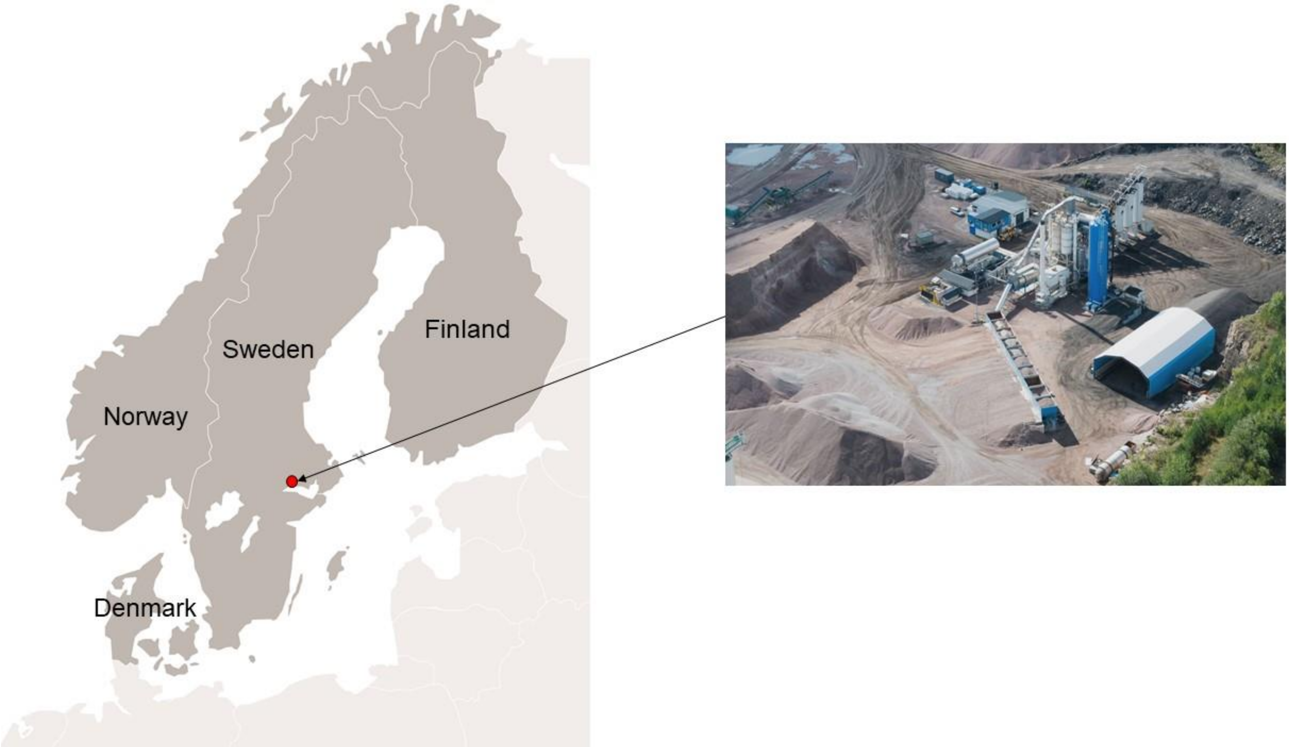

Figure 3: Map and picture showing the geographical location of the declared plant.

Declared unit

The declared unit is 1 tonne (1000 kg) of asphalt mixture.

System boundary

The system boundaries cover aspects such as temporal and geographical. The setting of system boundaries follows two principles according to EN 15804: (1) The “modularity principle” and (2) the “polluter pays principle”.

This is a “cradle to gate with modules C1–C4 and module D” EPD and it is based on a LCA model described in the background report and in the related annex (see reference list). The declared modules are A1-A3, C, D see Table 2. The product system under study is presented in Figure 4. Figure 4 is modified and originates from the PCR 2018:04 Asphalt Mixtures, version 1.03 of 2019-09-06. The figure has been slightly adjusted to be in line with EN 15804.

Table 2: Modules of the life cycle in the EPD, including geography, share of specific data (in GWP-GHG indicator) and data variation.

	Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction 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	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	SE/ EU	SE/ EU	SE	-	-	-	-	-	-	-	-	-	SE	SE	SE	SE	SE
Specific data	>90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Data that represent the current situation of the production process at the plant are used. All input data used in the LCA model (e.g. raw materials and production data) that NCC Industry has influence over are plant-specific data for the production year 2021. The geographical scope, i.e. location(s) of use and end-of-life performance, is Sweden.

The environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the Life Cycle Inventory (LCI). Personnel-related impacts, such as transportation to and from work, are neither accounted for in the LCI.

Declaration of the RSL is only possible if B1-B5 are included, i.e. RSL is not assessed.

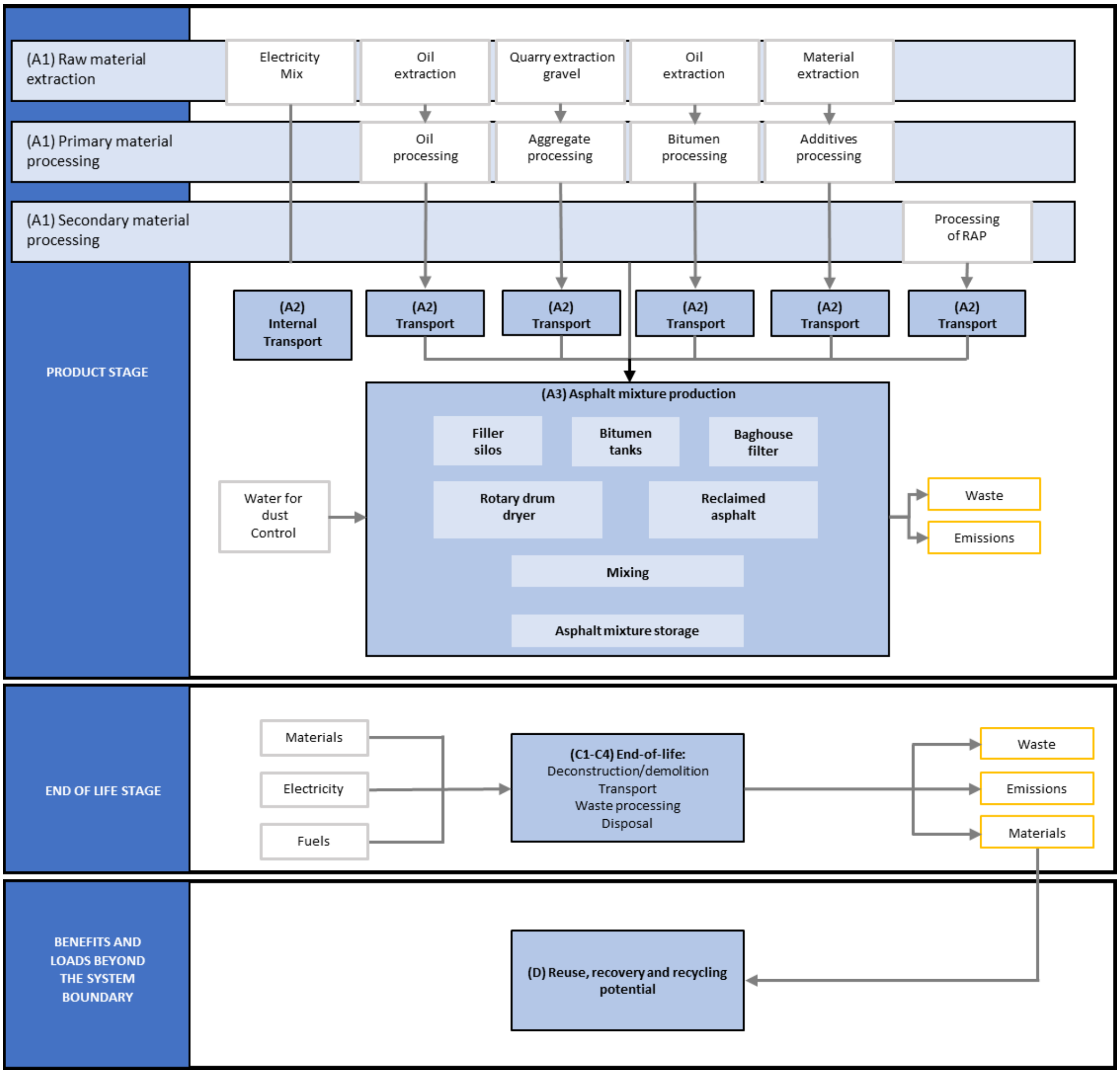

Figure 4: System boundaries for the studied product system.

Assumptions and approximations

It is possible to vary the share of RA in the asphalt mixtures. Results are presented for asphalt mixtures containing the mean share. The mean share is the actual annual average RA share in the asphalt mixtures at the plant. In addition, the result for no RA content and the maximum possible share of RA are presented for the impact category GWP-GHG. The maximum is the highest possible RA share for the given product at the plant. By doing so, the improvement potential is shown which can drive the development to demand asphalts mixtures with a higher share of RA.

The content of aggregate and bitumen in RA is assumed to 95.2% aggregates and 4.8% bitumen on average.

The RA replacing virgin aggregates is assumed to have the same fraction sizes (0/2, 2/4 etc) as the fractions of virgin aggregates in the asphalt mixtures. This is a conservative assumption since RA is normally replacing small size-fractions of aggregates which have a higher environmental impact than larger fractions.

PAHs emitted to air during production are approximately 40 mg per tonne asphalt produced. This is based on that bitumen heated to about 150°C emits PAHs less than 10 mg/kg*h heated (The German BITUMEN Forum 2016). The hot bitumen is contained in a closed system so no direct emission to air occurs at the asphalt plant, except when the asphalt is transported in contact with outside air. According to measurements and expertise judgments on-site, the time when the asphalt mixture is exposed to air is about five minutes. This time frame is a very conservative estimate. This means that the total direct PAH emissions to air during production are on average 40 mg/tonne asphalt produced.

Allocation

The asphalt manufacturing process does not produce any co-products.

During normal production in an asphalt plant, steady-state in terms of mass flow or temperatures rarely exists. Instead there are numerous transients with varying extensions and time delays. In addition, there are ad-hoc adjustments within a specific asphalt mixture because of e.g. weather and transport distance. Therefore, the heat required for specific asphalt mixtures cannot simply be inferred from statistical production data. Instead, allocation between mixtures are based on yearly sums of produced amounts of asphalts and used energy, which is subsequently allocated to mixtures according to a thermodynamic model of asphalt heating described in Ekblad and Lundström (2013). The allocation model is described in the background documentation to this EPD.

Concerning the manufacture of various mixtures, four temperature classes are defined with respect to their annual average production temperature, as summarized in Table 3. The average temperature for each class is based on local experience and requirements in standards. Production temperatures can vary slightly between plants.

Table 3: Temperature classes and corresponding average production temperatures.

Temperature class	Annual average production temperature [°C]
Polymer modified (PMB)	180
Conventional hot mix asphalt (HMA)	160
Reduced temperature, warm mix asphalt (WMA)	150
Soft asphalt (SA)	100

Cut-offs

The cut-off criteria are 1% of the renewable and non-renewable primary energy usage and 1% of the total mass input of the manufacture process (according to the EN 15804 standard).

In the assessment, all available data from the production process are considered, i.e. all raw materials used, utilised ancillary materials, and energy consumption using the best available LCI GaBi datasets.

The following cut-offs have been made:

– The packaging for the input materials used in the production process are negligible.

– Lubricants used in the asphalt plant production are negligible.

Software and database

The LCA software GaBi Professional and its integrated database from Sphera has been used in the LCA modelling. See the list of references.

Electricity in manufacturing

If the electricity in module A3 accounts for more than 30% of the total energy in stage A1 to A3, the energy sources behind the electricity grid in module A3 shall be documented, including the LCA data of grams CO2 eq./kWh. The information is given in Table 4. However, it is difficult to track if the criterion is met.

Table 4: Electricity in manufacturing (A3).

Energy source	LCA data (g CO_2 eq./kWh)
Hydropower	14.3

Data quality

The primary data collected by the manufacturer are based on the required materials and energy to manufacture the product. The data of the raw materials are collected per declared unit. All necessary life cycle inventories for the basic materials are available in the GaBi database or via EPDs. No generic selected datasets (secondary data) used are older than ten years. No specific data collected is older than five years and represent a period of about one year. The representativeness, completeness, reliability and consistency are judged as good.

About NCC

NCC is one of the leading construction and property development companies in the Nordic region, with sales of 5.2 billion Euro and approximately 13 000 employees in 2021. With the Nordic region as its home market, NCC is active throughout the value chain – developing commercial properties and constructing housing, offices, industrial facilities and public buildings, roads, civil engineering structures and other types of infrastructure. NCC also offers input materials used in construction and accounts for paving and road services.

NCC's vision is to renew our industry and provide superior sustainable solutions. NCC aims to be the leading society builder of sustainable environments and will proactively develop new businesses in line with this.

NCC works to reduce both our own and our customers' environmental impact and continues to further refine our offerings with additional products and solutions for sustainability. In terms of the environment, this entails that NCC, at every step of the supply chain, is to offer resource and energy-efficient products and solutions to help our customers reduce their environmental impact and to operate more sustainably.

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Also visit: https://www.ncc.com/sustainability

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Content declaration including packaging

The products do not contain any substances of very high concern (SVHC) according to REACH. Table 5 presents the content of all asphalt mixtures as ranges since it is at corporate secrecy and varies depending of the mixture. This refers to the actual annual mean share of RA. The mass of biogenic carbon in the products is less than 5%. The packaging material is negligible.

Table 5: Content declaration of the asphalt mixtures declared (ranges for declared products).

Product component	Weight, kg	Post-consumer material, weight-%	Renewable material weight-%
Reclaimed Asphalt (RA)	0 – 348 (see Table 1)	0 – 35*	0
Aggregates 0/2	93 – 274	*	0
Aggregates 2/4	30 – 137	*	0
Aggregates 4/8	0 – 206	*	0
Aggregates 8/11	0 – 203	*	0
Aggregates 11/16	0 – 431	*	0
Aggregates 16/22	0 – 167	*	0
Quality aggregates 4/8	0 – 112	*	0
Quality aggregates 8/11	0 – 201	*	0
Quality aggregates 11/16	0 – 397	*	0
Bitumen, virgin	0 – 63	0	0
Polymer modified bitumen (PMB), virgin	0 – 63	0	0
Fibre (Viatop premium)	<10	0	90
Baghouse fines	25 – 55	3 – 6**	0
Fines	0 – 43	0	0
Liquid adhesion (Amine)	<1	0	0
Packaging material	**Weight, kg**	**Weight-% (versus the product)**	
Negligible for all product components	Negligible	Negligible	

*Data is not available, probably 0.
**Could be either pre- or post-consumer material.

Environmental performance

The environmental performance results are presented for asphalt mixtures containing the actual annual mean share of RA.

The results of the life cycle assessment based on the declared unit for asphalt mixtures containing the actual annual mean share of RA are presented in Table 6 and 7 (core environmental indicators), Table 8 and 9 (resource use) and Table 10 and 11 (waste categories and output flows).

In addition, the result for GWP-GHG is presented for asphalt mixtures containing no RA and the potential maximum share of RA. This is presented in Table 14 and 15.

Table 6: Results of the LCA (modules A1-A3) – Core environmental indicators per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA).

Core environmental indicators			1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Impact category		Unit	A1-A3	A1- A3	A1- A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Climate change	Total	kg CO_2 eq.	23	23	19	23	18	18	37	22
	Fossil	kg CO_2 eq.	23	23	19	23	18	18	36	22
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.026	0.027	0.026	0.026	0.025	0.025	0.077	0.026
	GWP-GHG	kg CO_2 eq.	22**	23**	19**	23**	18**	17**	36**	21**
Ozone depletion		kg CFC 11 eq.	8.6E-08	8.6E-08	8.6E-08	8.6E-08	6.5E-08	6.5E-08	8.6E-08	8.6E-08
Acidification		mol H+ eq.	0.19	0.19	0.15	0.19	0.14	0.14	0.25	0.18
Eutrophication aquatic freshwater		kg P eq.	6.8E-04	6.8E-04	6.8E-04	6.8E-04	6.0E-04	6.0E-04	7.1E-04	6.8E-04
Eutrophication aquatic marine		kg N eq.	0.058	0.060	0.049	0.059	0.046	0.045	0.084	0.056
Eutrophication terrestrial		mol N eq.	0.56	0.58	0.46	0.57	0.43	0.43	0.85	0.54
Photochemical ozone formation		kg NMVOC eq.	0.16	0.16	0.12	0.16	0.12	0.11	0.22	0.15
Depletion of abiotic resources - minerals and metals		kg Sb eq.	3.2E-05	3.2E-05	3.2E-05	3.2E-05	2.5E-05	2.5E-05	3.3E-05	3.2E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	2363	2435	1579	2421	1457	1413	2848	2180
Water use		m^3 world eq. deprived	5.0	5.1	4.1	5.0	4.0	4.0	5.6	4.8

Core environmental indicators			9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Impact category		Unit	A1-A3	A1- A3	A1- A3	A1-A3	A1-A3	A1-A3	A1-A3
Climate change	Total	kg CO_2 eq.	22	38	32	19	51	33	24
	Fossil	kg CO_2 eq.	22	38	32	19	51	33	24
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.026	0.030	0.029	0.025	0.084	0.048	0.028
	GWP-GHG	kg CO_2 eq.	21**	37***	31***	19**	51***	32**	24**
Ozone depletion		kg CFC 11 eq.	8.6E-08	8.6E-08	8.6E-08	6.5E-08	8.6E-08	8.6E-08	8.6E-08
Acidification		mol H+ eq.	0.18	0.31	0.26	0.15	0.36	0.25	0.21
Eutrophication aquatic freshwater		kg P eq.	6.8E-04	7.3E-03	5.7E-03	6.0E-04	7.5E-03	7.0E-04	6.8E-04
Eutrophication aquatic marine		kg N eq.	0.057	0.082	0.070	0.049	0.11	0.081	0.064
Eutrophication terrestrial		mol N eq.	0.54	0.80	0.67	0.47	1.1	0.81	0.62
Photochemical ozone formation		kg NMVOC eq.	0.15	0.22	0.18	0.13	0.27	0.22	0.17
Depletion of abiotic resources - minerals and metals		kg Sb eq.	3.2E-05	3.2E-05	3.2E-05	2.5E-05	3.3E-05	3.2E-05	3.2E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	2194	3113	2394	1712	3370	3069	2573
Water use		m^3 world eq. deprived	4.8	24	19	4.3	25	5.9	5.3

* This indicator is set to zero, due to inconsistencies in the dataset used delivered by Sphera. Though, net result over the life cycle is zero since carbon uptake and emission is zero during a life-cycle.
** The default value in the Swedish Transport Administration´s tool Klimatkalkyl is 49 kg per tonne asphalt mixture (6.5% bitumen) for A1-A3 (Trafikverket, Klimatkalkyl version 7.0, 2021)
*** There is no default value in Klimatkalkyl for this type of asphalt mixture (polymer modified bitumen based). It is however expected to give higher impacts than other asphalt mixtures.

Table 7: Results of the LCA (modules C and D) – Core environmental indicators per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA). S1=Scenario 1, S2=Scenario 2.

			1-15				1	2	3	4	5	6	7
Core environmental indicators			All asphalt mixtures				ABT 11 160/220	ABT 11 (H) 160/220	ABb 22 70/100	ABT 11 70/100	AG 22 70/100	AG 22 160/220	ABS 16 An<6 70/100
Impact category		Unit	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D
Climate change	Total	kg CO_2 eq.	2.2/0.65	3.0	NR	0	-11	-11	-6.9	-11	-6.4	-6.2	-13
	Fossil	kg CO_2 eq.	2.2/0.65	3.0	NR	0	-11	-11	-6.9	-11	-6.4	-6.2	-13
	Biogenic*	kg CO_2 eq.	0/0	0	NR	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.017/5.2E-03	0.025	NR	0	-2.1E-03	-2.5E-03	-2.2E-03	-2.0E-03	-2.2E-03	-2.2E-03	6,8E-03
	GWP-GHG	kg CO_2 eq.	2.2/0.65	3.0	NR	0	-10	-11	-6.8	-11	-6.3	-6.1	-13
Ozone depletion		kg CFC 11 eq.	2.8E-16/8.1E-17	6.0E-16	NR	0	-1.2E-11	-1.3E-11	-1.1E-11	-1.2E-11	-1.1E-11	-1.1E-11	-2.2E-12
Acidification		mol H+ eq.	5.5E-03/1.6E-03	0.010	NR	0	-0.12	-0.13	-0.083	-0.12	-0.077	-0.075	-0.15
Eutrophication aquatic freshwater		kg P eq.	6.5E-06/1.9E-06	9.1E-06	NR	0	-4.1E-08	-7.8E-08	-1.3E-07	-2.6E-08	-1.5E-07	-1.5E-07	3.3E-06
Eutrophication aquatic marine		kg N eq.	2.4E-03/7.3E-04	4.7E-03	NR	0	-0.030	-0.032	-0.021	-0.030	-0.020	-0.020	-0.039
Eutrophication terrestrial		mol N eq.	0.027/8.2E-03	0.053	NR	0	-0.33	-0.35	-0.24	-0.34	-0.22	-0.22	-0.43
Photochemical ozone formation		kg NMVOC eq.	7.7E-03/2.3E-03	9.3E-03	NR	0	-0.11	-0.11	-0.074	-0.11	-0.069	-0.067	-0.13
Depletion of abiotic resources - minerals and metals		kg Sb eq.	1.6E-07/4.8E-08	2.7E-07	NR	0	-9.5E-08	-1.1E-07	-8.2E-08	-9.2E-08	-8.5E-08	-8.5E-08	-2.5E-08
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	28/8.4	41	NR	0	-2205	-2277	-1423	-2262	-1307	-1263	-2528
Water use		m^3 world eq. deprived	0.11/5.5E-03	0.028	NR	0	-2.6	-2.7	-1.7	-2.6	-1.6	-1.5	-2.8

			8	9	10	11	12	13	14	15
Core environmental indicators			ABT 16 70/100	ABT 16 160/220	ABS 16 40/100-75	Viacogrip 16 65/105-50	AG 16 160/220	ABS 16 An<6 45/80-55	ABS 16 An<7 70/100	ABb 16 70/100
Impact category		Unit	D	D	D	D	D	D	D	D
Climate change	Total	kg CO_2 eq.	-9.8	-9.8	-13	-10	-7.6	-15	-15	-12
	Fossil	kg CO_2 eq.	-9.8	-9.8	-13	-10	-7.6	-15	-15	-12
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	-2.0E-03	-2.2E-03	-2.6E-03	-2.6E-03	-2.4E-03	7.6E-03	7.6E-03	-3.2E-03
	GWP-GHG	kg CO_2 eq.	-9.6	-9.6	-13	-9.8	-7.5	-14	-14	-11
Ozone depletion		kg CFC 11 eq.	-1.1E-11	-1.2E-11	-1.5E-11	-1.4E-11	-1.2E-11	-2.4E-12	-2.4E-12	-1.7E-11
Acidification		mol H+ eq.	-0.11	-0.11	-0.15	-0.12	-0.091	-0.16	-0.16	-0.14
Eutrophication aquatic freshwater		kg P eq.	-5.2E-08	-7.1E-08	-4.3E-08	-1.2E-07	-1.4E-07	3.7E-06	3.7E-06	-1.6E-07
Eutrophication aquatic marine		kg N eq.	-0.028	-0.028	-0.037	-0.030	-0.023	-0.043	-0.043	-0.035
Eutrophication terrestrial		mol N eq.	-0.31	-0.31	-0.41	-0.33	-0.26	-0.48	-0.48	-0.39
Photochemical ozone formation		kg NMVOC eq.	-0.098	-0.099	-0.13	-0.10	-0.081	-0.15	-0.15	-0.12
Depletion of abiotic resources - minerals and metals		kg Sb eq.	-8.8E-08	-9.5E-08	-1.0E-07	-1.0E-07	-9.7E-08	-2.7E-08	-2.7E-08	-1.3E-07
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	-2022	-2036	-2721	-2065	-1561	-2819	-2819	-2407
Water use		m^3 world eq. deprived	-2.3	-2.4	-3.1	-2.4	-1.9	-3.2	-3.2	-2.8

* This indicator is set to zero, due to inconsistencies in the dataset used delivered by Sphera. Though, net result over the life cycle is zero since carbon uptake and emission is zero during a life-cycle.

Table 8: Results of the LCA (modules A1- A3) – Resource use per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA).

Use of resources		1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Parameter	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	306	308	304	305	300	300	351	305
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	48	0
Total use of renewable primary energy	MJ, net calorific value	306	308	304	305	300	300	399	305
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	268	272	229	271	217	215	444	259
Use of non-renewable primary energy as raw materials	MJ, net calorific value	2095	2163	1350	2150	1240	1198	2404	1922
Total use of non-renewable primary energy	MJ, net calorific value	2363	2436	1579	2421	1458	1413	2849	2181
Use of secondary material	kg	316	232	360	330	373	373	174	350
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.23	0.24	0.21	0.23	0.20	0.20	0.24	0.22

Use of resources		9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105- 50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Parameter	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	306	372	344	302	376	348	324
Use of renewable primary energy as raw materials	MJ, net calorific value	0	48	16	0	48	48	16
Total use of renewable primary energy	MJ, net calorific value	306	420	360	302	424	396	340
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	260	546	453	230	723	390	283
Use of non-renewable primary energy as raw materials	MJ, net calorific value	1934	2568	1942	1482	2647	2679	2290
Total use of non-renewable primary energy	MJ, net calorific value	2194	3114	2395	1712	3371	3070	2573
Use of secondary material	kg	306	163	208	306	89	89	38
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.23	0.69	0.56	0.21	0.70	0.25	0.25

Table 9: Results of the LCA (modules C and D) – Resource use per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA). S1=Scenario 1, S2=Scenario 2.

Use of resources		1-15 All asphalt mixtures				1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100
Parameter	Unit	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	1.6/0.47	2.3	NR	0	-13	-15	-11	-13	-11	-11	-8.3
Use of renewable primary energy as raw materials	MJ, net calorific value	0/0	0	NR	0	0	0	0	0	0	0	0
Total use of renewable primary energy	MJ, net calorific value	1.6/0.47	2.3	NR	0	-13	-15	-11	-13	-11	-11	-8.3
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	28/8.4	41	NR	0	-109	-114	-72	-112	-67	-65	-137
Use of non-renewable primary energy as raw materials	MJ, net calorific value	0/0	0	NR	0	-2095	-2163	-1350	-2150	-1240	-1198	-2392
Total use of non-renewable primary energy	MJ, net calorific value	28/8.4	41	NR	0	-2205	-2277	-1423	-2262	-1307	-1263	-2529
Use of secondary material	kg	0/0	0	NR	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0/0	0	NR	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0/0	0	NR	0	0	0	0	0	0	0	0
Use of net fresh water	m³	0.022/5.4E-04	2.7E-03	NR	0	-0.089	-0.096	-0.065	-0.090	-0.062	-0.061	-0.086

Use of resources		8 ABT 16 70/100	9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Parameter	Unit	D	D	D	D	D	D	D	D
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	-12	-13	-15	-14	-13	-9.2	-9.2	-18
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	0	0
Total use of renewable primary energy	MJ, net calorific value	-12	-13	-15	-14	-13	-9,2	-9,2	-18
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	-101	-102	-135	-104	-79	-152	-152	-121
Use of non-renewable primary energy as raw materials	MJ, net calorific value	-1922	-1934	-2586	-1961	-1482	-2667	-2667	-2286
Total use of non-renewable primary energy	MJ, net calorific value	-2022	-2036	-2721	-2065	-1561	-2819	-2819	-2407
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of net fresh water	m³	-0.082	-0.085	-0.11	-0.088	-0.073	-0.095	-0.095	-0.11

Table 10: Results of the LCA (modules A1- A3) – Waste categories and output flows per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA).

Waste categories & output flows		1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	2.2E-03	5.7E-04
Non-hazardous waste disposed	kg	0.36	0.37	0.36	0.36	0.36	0.36	0.43	0.36
Radioactive waste disposed	kg	6.6E-04	6.7E-04	6.6E-04	6.6E-04	6.5E-04	6.5E-04	1.1E-03	6.6E-04
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	8.9E-03	8.9E-03	8.9E-03	8.9E-03	8.9E-03	8.9E-03	0.043	8.9E-03
Materials for energy recovery	kg	0.030	0.030	0.030	0.030	0.030	0.030	0.041	0.030
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0

Waste categories & output flows		9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	5.7E-04	5.7E-04	5.7E-04	5.7E-04	2.3E-03	2.3E-03	5.7E-04
Non-hazardous waste disposed	kg	0.36	0.45	0.41	0.36	0.47	0.43	0.40
Radioactive waste disposed	kg	6.6E-04	9.3E-04	7.9E-04	6.6E-04	1.1E-03	9.8E-04	7.6E-04
Components for re-use	kg	0	0	0	0	0	0	0
Materials for recycling	kg	8.9E-03	8.9E-03	8.9E-03	8.9E-03	0.046	0.046	8.9E-03
Materials for energy recovery	kg	0.030	0.030	0.030	0.030	0.042	0.042	0.030
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0

Table 11: Results of the LCA (modules C and D) – Waste categories and output flows per declared unit of specific asphalt mixtures. The table presents results for asphalt mixtures containing the actual annual mean share of Reclaimed Asphalt (RA). S1=Scenario 1, S2=Scenario 2.

Waste categories & output flows		1-15 All asphalt mixtures				1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100
Parameter/Indicator	Unit	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D
Hazardous waste disposed	kg	1.4E-09/4.2E-10	2.2E-09	NR	0	-7.8E-07	-8.8E-07	-7.5E-07	-7.6E-07	-7.3E-07	-7.3E-07	-1.6E-03
Non-hazardous waste disposed	kg	9.9E-03/1.2E-03	6.4E-03	NR	0	-0.055	-0.063	-0.053	-0.054	-0.052	-0.052	-0.058
Radioactive waste disposed	kg	3.5E-05/1.0E-05	7.4E-05	NR	0	-7.5E-05	-8.5E-05	-7.2E-05	-7.3E-05	-7.1E-05	-7.1E-05	-1.0E-04
Components for re-use	kg	0/0	0	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0/0	0	1000	0	0	0	0	0	0	0	-0.034
Materials for energy recovery	kg	0/0	0	0	0	0	0	0	0	0	0	-0.012
Exported energy	MJ per energy carrier	0/0	0	0	0	0	0	0	0	0	0	0

Waste categories & output flows		8 ABT 16 70/100	9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Parameter/Indicator	Unit	D	D	D	D	D	D	D	D
Hazardous waste disposed	kg	-7.4E-07	-7.9E-07	-9.5E-07	-9.1E-07	-8.1E-07	-1.8E-03	-1.8E-03	-1.1E-06
Non-hazardous waste disposed	kg	-0.053	-0.057	-0.067	-0.065	-0.058	-0.064	-0.064	-0.079
Radioactive waste disposed	kg	-7.2E-05	-7.7E-05	-9.1E-05	-8.8E-05	-7.9E-05	-1.1E-04	-1.1E-04	-1.1E-04
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	-0.037	-0.037	0
Materials for energy recovery	kg	0	0	0	0	0	-0.013	-0.013	0
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0

Table 12: Additional environmental impact indicators are only declared in the Annex to the General background report.

Impact category	Unit	Module A1-D
Particulate matter emissions	Disease incidence	Not declared in EPD, see Background Annex Report
Ionizing radiation, human health	kBq U235 eq.	Not declared in EPD, see Background Annex Report
Eco-toxicity (freshwater)	CTUe	Not declared in EPD, see Background Annex Report
Human toxicity, cancer effects	CTUh	Not declared in EPD, see Background Annex Report
Human toxicity, non-cancer effects	CTUh	Not declared in EPD, see Background Annex Report
Land use related impacts/Soil quality	dimensionless	Not declared in EPD, see Background Annex Report

Table 13: Classification of disclaimers to the declaration of core and additional environmental impact indicators.

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

Note that Table 14 and 15 are additional results and do only present the result for the impact category GWP-GHG, for no RA, the annual actual mean share of RA (as presented in Table 6 and 7) and the maximum possible share of RA.

Table 14: Results of the LCA (modules A1-A3) – GWP-GHG for three different RA content, (1) no RA content, (2) the actual annual mean share of RA and (3) the maximum possible share of RA in the various asphalt mixtures.

Core environmental indicators			1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Impact category	Unit	RA content	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP-GHG	kg CO_2 eq.	No RA	25	25	22	25	21	21	38	25
		Mean RA	22	23	19	23	18	17	36	21
		Max RA	20	21	17	20	16	16	36	19

Core environmental indicators			9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Impact category	Unit	RA content	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP-GHG	kg CO_2 eq.	No RA	24	39	34	22	51	32	24
		Mean RA	21	37	31	19	51	32	24
		Max RA	19	37	31	16	47	31	18

Table 15: Results of the LCA (modules C and D) – GWP-GHG for three different RA content, (1) no RA content, (2) the actual annual mean share of RA and (3) the maximum possible share of RA in the various asphalt mixtures.

Core environmental indicators			1-15 All asphalt mixtures				1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100
Impact category	Unit	RA content	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D
GWP-GHG	kg CO_2 eq.	No RA	2.2/0.65	3.0	NR	0	-13	-13	-10	-13	-9.8	-9.6	-14
		Mean RA	2.2/0.65	3.0	NR	0	-10	-11	-6.8	-11	-6.3	-6.1	-13
		Max RA	2.2/0.65	3.0	NR	0	-8.0	-9.6	-5.1	-8.4	-4.7	-4.5	-13

Core environmental indicators			8 ABT 16 70/100	9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Impact category	Unit	RA content	D	D	D	D	D	D	D	D
GWP-GHG	kg CO_2 eq.	No RA	-13	-12	-14	-11	-10	-14	-14	-11
		Mean RA	-9.6	-9.6	-13	-9.8	-7.5	-14	-14	-11
		Max RA	-7.6	-7.2	-13	-9.7	-5.1	-13	-13	-6.4

Additional Environmental Information

General information

Components in asphalt, such as aggregates and bitumen, are finite resources. Bitumen is a fossil resource. To extract aggregates or oil will affect the environment.

The production of asphalt mixtures requires equipment and vehicles running on fossil and renewable energy. The operations, including transports, cause mainly emissions and dust to air and disturbances such as noise.

Asphalt production is, depending on size, country and activities, regulated through specific legislation or site-specific decisions from authorities.

NCC's stationary plants in Denmark, Finland and Sweden are certified according to ISO 14001. The Business Management System in NCC Industry, including Norway, contains routines corresponding to this standard.

In the Nordic countries (Iceland excluded) approximately 1 tonne of asphalt mixtures per capita and year are produced and paved at our roads (EAPA, 2017). No asphalt is disposed during manufacture, application, maintenance or in the end-of life.

Since asphalt is a valuable resource, it is recycled into new asphalt mixtures. In NCC, Division Asphalt, 26% - as an average – of the produced asphalt mixtures originated from Reclaimed Asphalt (RA) in 2021.

Explanatory material is given in the background report to this EPD.

To read more about NCCs general sustainability work, please refer to our webpage: https://www.ncc.com/sustainability

Release of dangerous substances to indoor air, soil and water during the use stage

According to EN 15804, the EPD does not need to give this information if the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised test methods according to the provisions of the respective technical committees for European product standards are not available. This criterion is fulfilled for asphalt material.

Scenario information

For modules other than A1-A3, scenario-based information shall be declared for the products.

Module C
Scenario 1:
Pavement milling of asphalt is carried out in this scenario. It is further transported to the waste processing where it is crushed and sieved. It is assumed that all asphalt mixtures are recyclable, why no asphalt is sent for disposal. Crushing of RA is accounted for in the next life cycle, to avoid double counting.

Scenario 2:
Asphalt excavation resulting in asphalt slabs is carried out in this scenario. It is further transported to the waste processing where it is crushed and sieved. It is assumed that all asphalt mixtures are recyclable, why no asphalt is sent for disposal. Crushing of RA is accounted for in the next life cycle, to avoid double counting.

Table 16: Scenario-based information for end of life.

Scenario information	Unit (per declared unit)	Scenario 1 and 2
	kg collected separately	1000
	kg collected with mixed construction waste	0
	kg for re-use	0
	kg for recycling	1000
	kg for energy recovery	0
	kg product or material for final disposal	0
Assumptions for scenario development, e.g. transportation	units as appropriate	Further scenario-based information is presented in the Annex of the Background Report

Module D
Information in module D aims at transparency of the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system e.g. as secondary materials or fuels.

Loads are assigned to module D for materials and fuels (that have left the system from any of the modules A4-C4) where further processing occur after the end-of-waste state is reached. This, in order to replace primary material or fuel input in another product system.

Benefits are assigned to module D for materials and fuels (that have left the system in any of the modules A4-C4) that can substitute primary material of fuels that do not need to be produced. A functional equivalence must be reached.

The substitution effect is only calculating the resulting net output flow. The net output flow for the asphalt mixtures declared can be found in Table 17.

Table 17: Net output flow for module D per declared unit.

#	Asphalt mixture	Mass (kg)
1	ABT 11 160/220	684
2	ABT 11 (H) 160/220	768
3	ABb 22 70/100	640
4	ABT 11 70/100	670
5	AG 22 70/100	627
6	AG 22 160/220	627
7	ABS 16 An<6 70/100	826
8	ABT 16 70/100	650
9	ABT 16 160/220	694
10	ABS 16 40/100-75	837
11	Viacogrip 16 65/105-50	792
12	AG 16 160/220	694
13	ABS 16 An<6 45/80-55	911
14	ABS 16 An<7 70/100	911
15	ABb 16 70/100	963

Loads accounted for are crushing of the RA (the same in both scenarios).

Benefits accounted for are aggregates and bitumen material which are replaced by RA (the same in both scenarios).

The specific calculation procedure is described in the Annex of the Background Report.

Programme information

This EPD is developed by NCC Industry Nordic AB. It is a result from an EPD certification process verified by Bureau Veritas. The EPD is valid for five years (after which it can be revised and reissued). NCC Industry Nordic AB is the declaration owner and has the liability and responsibility for the EPD.

EPDs of construction products may not be comparable if they do not comply with EN 15804.

EPDs within the same product category but from different programmes may not be comparable.

The aim of this EPD is that it shall provide objective and reliable information on the environmental impact of the production of the declared product.

The intended use of the EPD is for business-to-business communication.

Table 18: Verification details.

CEN standard EN 15804 serves as the core Product Category Rules (PCR)	
Product Category Rules (PCR):	PCR 2019:14 Construction products, version 1.11
PCR review was conducted by:	The Technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☒ EPD process certification (Internal) ☐ EPD verification (External)
Certification body:	Bureau Veritas
Accredited:	SWEDAC
Procedure for follow-up of data during EPD validity involves third party verifier:	☒ Yes ☐ No

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Differences versus previous versions

Table 19: Versions of this EPD.

Date of revision	Description of difference versus previous versions
2021-10-15	Original version
2022-02-18	Editorial changes
2022-07-11	Result changes based on updated production year. EPD template updated.