Environmental Product Declaration for asphalt mixtures from Lund asphalt plant – Södra Sandby

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): 2021-09-01 Date of revision: 2022-02-18 Date of validity: 2026-08-31 Reg. no. S-P-03641

The verifier and the program operator do not make any claim nor have any responsibility of the legality of the product, its production process or its supply chain. 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.

The asphalt mixtures declared in the EPD are:

- ABT 11 70/100
- ABT 16 70/100
- ABT 8 100/150
- AG 16 70/100
- ABB 22 70/100
- AG 22 100/150
- ABS 11 70/100
- ABS 16 70/100
- ABS 11 70/100 AN7
- ABS 16 70/100 AN7
- ABS 16 70/100 AN7 LTA
- ABS 11 70/100 AN10 LTA
- Roundtop 11 70/100 AN10
- Roundtop 16 70/100 AN10
- ABT 11 70/100 AN 14 LTA
- ABS 16 70/100 AN10 LTA
- TSK 11 70/100
- Viacochip 11 AN 10
- Roundtop 11 70/100 AN7
- Roundtop 16 70/100 AN7
- ABB 11 70/100
- ABB 11 70/100 LTA
- ABT 11 100/150
- ABT 11 100/150 LTA
- ABB 16 70/100
- ABB 16 70/100 LTA
- ABT 16 70/100 LTA

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

1. General product information

The asphalt mixtures declared are manufactured at Södra Sandby asphalt plant in Lund, 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) 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, wax and fibre and they normally constitute less than 0.5 weight-% of the product. In addition, Recycled Asphalt Pavement (RAP) 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 4.

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

Table 1: Temperature class and three different shares of Recycled Asphalt Pavement (RAP) in the asphalt mixtures declared.

#	Asphalt mixture	Temperature class	Share of RAP (no RAP) in weight-%	Share of RAP (actual annual mean) in weight-%	Share of RAP (maximum) in weight-%
1	ABT 11 70/100	HMA	0	29	35
2	ABT 16 70/100	HMA	0	32	35
3	ABT 8 100/150	HMA	0	28	35
4	AG 16 70/100	HMA	0	30	35
5	ABB 22 70/100	HMA	0	31	35
6	AG 22 100/150	HMA	0	31	35
7	ABS 11 70/100	HMA	0	21	22
8	ABS 16 70/100	HMA	0	19	20
9	ABS 11 70/100 AN7	HMA	0	12	15
10	ABS 16 70/100 AN7	HMA	0	14	15
11	ABS 16 70/100 AN7 LTA	WMA	0	0	15
12	ABS 11 70/100 AN10 LTA	WMA	0	0	15
13	Roundtop 11 70/100 AN10	HMA	0	0	15
14	Roundtop 16 70/100 AN10	HMA	0	8	15
15	ABT 11 70/100 AN 14 LTA	WMA	0	29	35
16	ABS 16 70/100 AN10 LTA	WMA	0	0	15
17	TSK 11 70/100	HMA	0	0	15
18	Viacochip 11 AN 10	HMA	0	0	15
19	Roundtop 11 70/100 AN7	HMA	0	0	15
20	Roundtop 16 70/100 AN7	HMA	0	0	15
21	ABB 11 70/100	HMA	0	31	35
22	ABB 11 70/100 LTA	WMA	0	31	35
23	ABT 11 100/150	HMA	0	30	35
24	ABT 11 100/150 LTA	WMA	0	30	35
25	ABB 16 70/100	HMA	0	31	35
26	ABB 16 70/100 LTA	WMA	0	31	35
27	ABT 16 70/100 LTA	HMA	0	32	35

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.

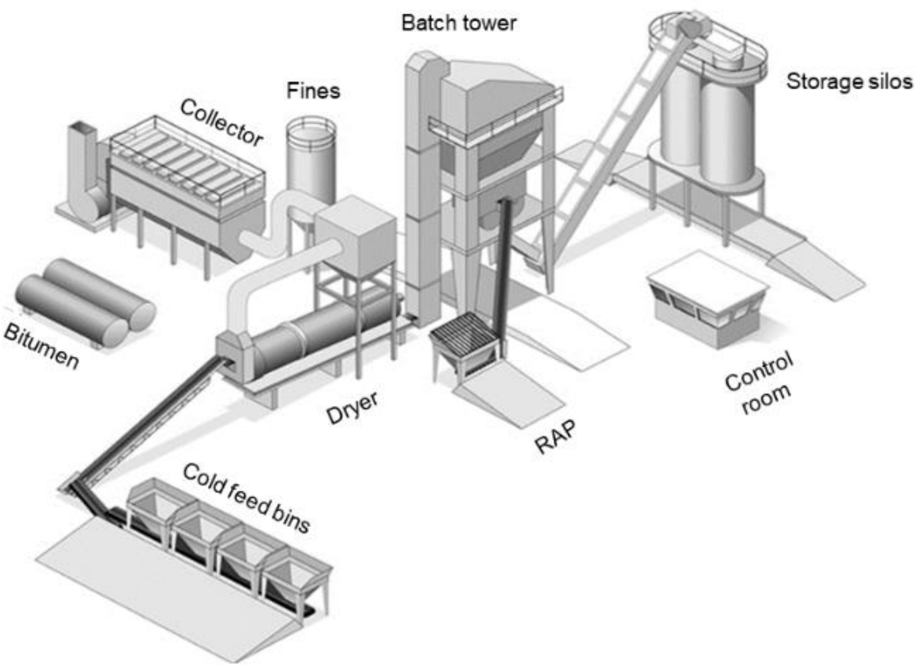

Figure 1: Schematic illustration of an asphalt plant.

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.

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 RAP to an asphalt mixture. Lund asphalt plant uses the method "direct to mixer".

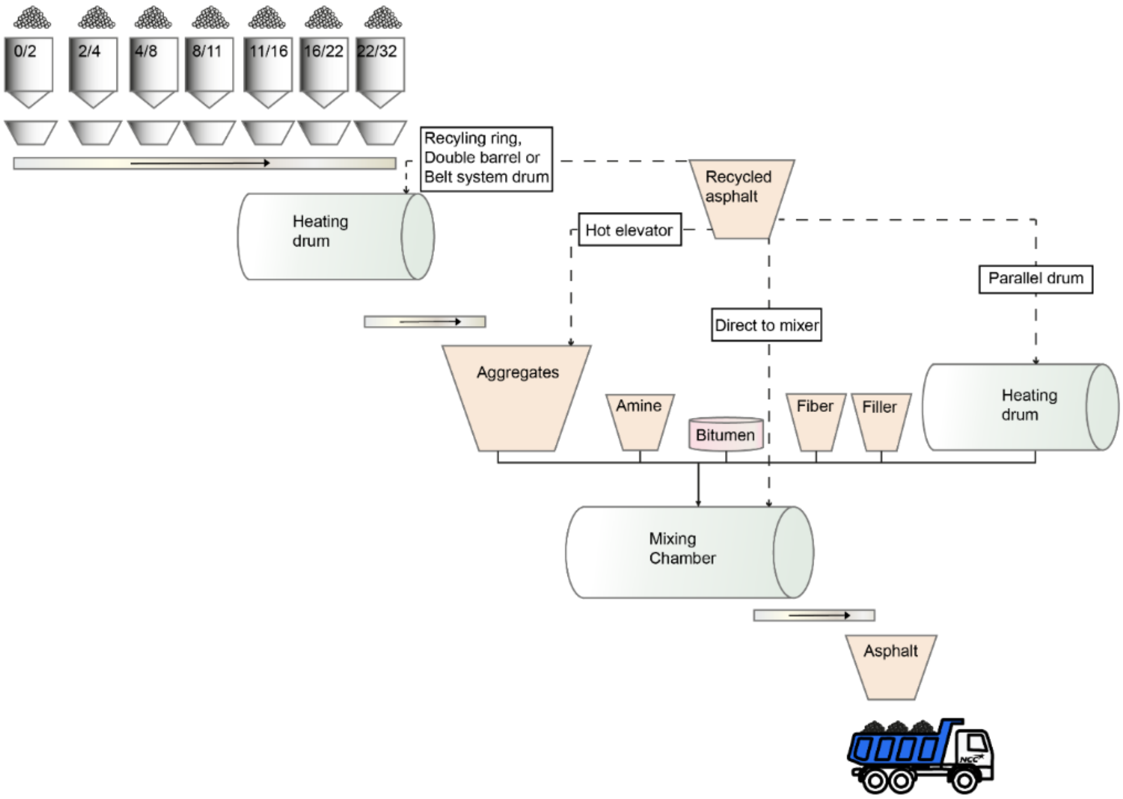

Figure 2: Illustration of the general production process of asphalt.

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 RAP. 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 recycled 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 13108-5 and SS-EN 13108-7.

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

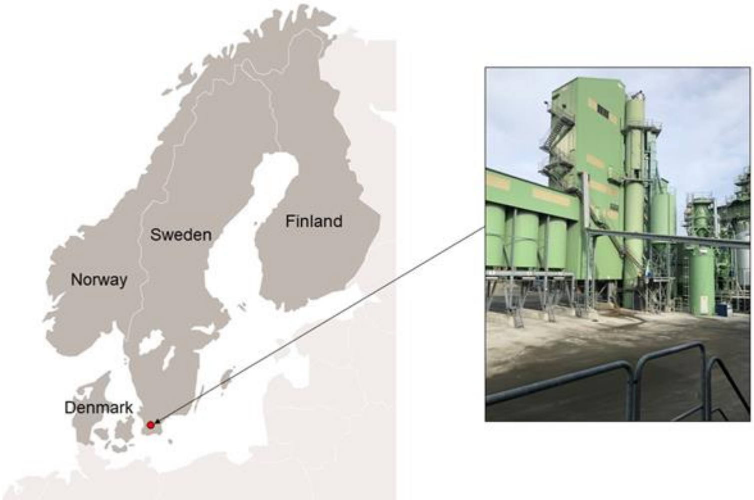

Figure 3: Map and picture showing the geographical location of the declared plant.

2. Declared unit

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

3. 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 Figure 4. The product system under study is presented in Figure 5. Figure 5 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.

	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	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	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			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4: Modules of the life cycle in the EPD, including geography, share of specific data (in GWP-GHG indicator) and data variation.

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 2020. 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.

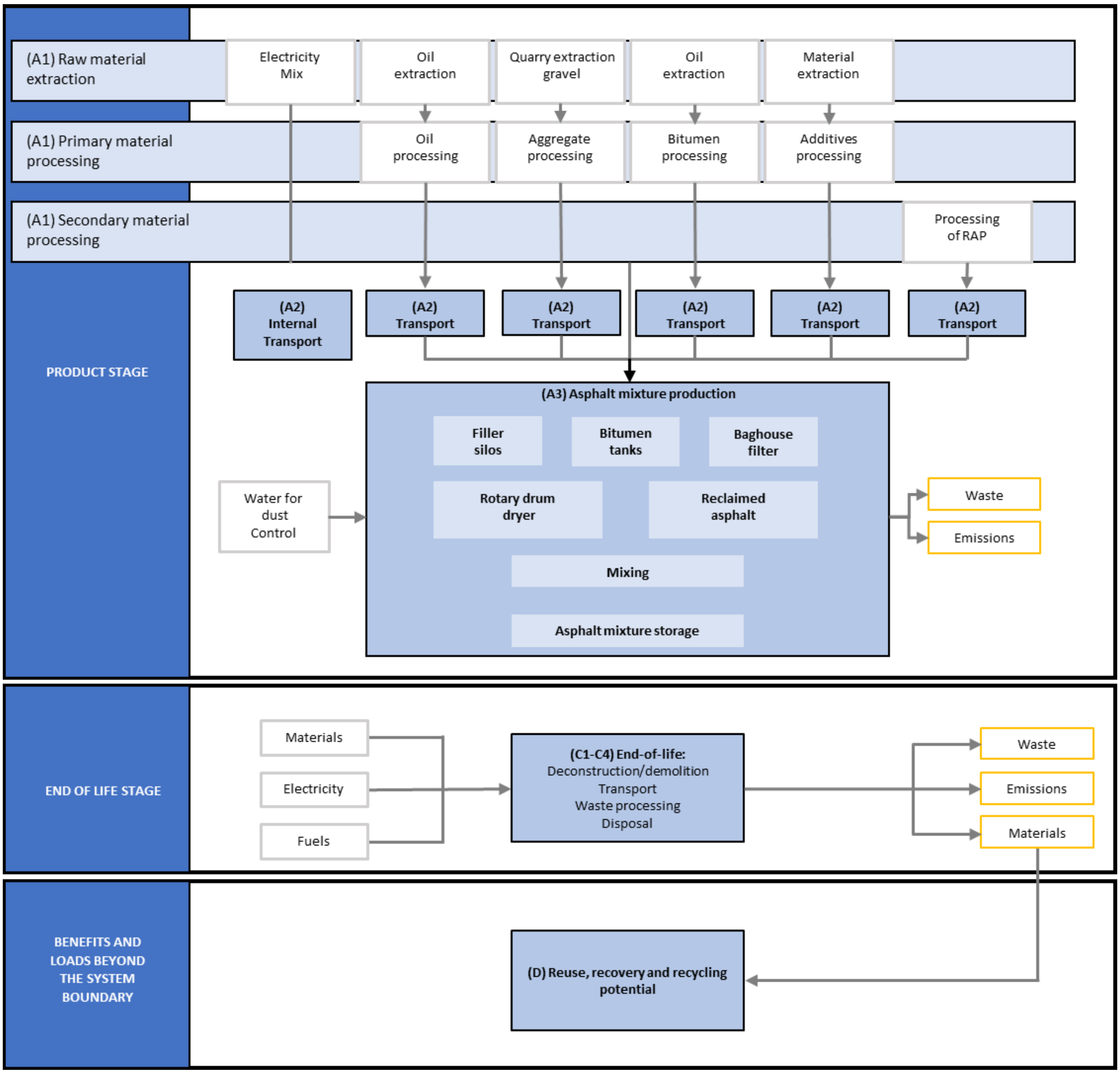

Figure 5: System boundaries for the studied product system.

4. Assumptions and approximations

It is possible to vary the share of RAP in the asphalt mixtures. Results are presented for asphalt mixtures containing the mean share. The mean share is the actual annual average RAP share in the asphalt mixtures at the plant. In addition, the result for no RAP content and the maximum possible share of RAP are presented for the impact category *GWP-GHG*. The maximum is the highest possible RAP 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 RAP.

The content of aggregate and bitumen in RAP is assumed to 95.5% aggregates and 4.5% bitumen or 94.9% aggregates and 5.1% bitumen on average, depending on technical preferences of the asphalt mixtures.

The RAP 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 RAP 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.

5. 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 2. The average temperature for each class is based on local experience and requirements in standards. Production temperatures can vary slightly between plants.

Table 2: 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)	145

6. 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.

7. 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.

8. 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 CO_2 eq./kWh. The information is given in Table 3.

Table 3: Electricity in manufacturing (A3).

Energy source	LCA data (g CO2 eq./kWh)
Hydropower	14.3

9. 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.

10. About NCC

NCC is one of the leading construction and property development companies in the Nordic region, with sales of 5.4 billion Euro and approximately 14 500 employees in 2020. 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.

NCC's sustainability work is based on a holistic approach with all three dimensions of sustainability – social, environmental and economical. In NCC's sustainability framework, our focus areas with regards to sustainability are defined; Climate and Energy, Materials & Waste, Social Inclusion, Health & Safety, Compliance and Portfolio Performance. Our sustainability strategy includes the aim of being both a leader and a pioneer in these areas.

NCC reports on its sustainability progress each year and the report has been included in NCC's Annual Report since 2010. NCC applies Global Reporting Initiative (GRI) Standards, the voluntary guidelines of the GRI for the reporting of sustainability information. In addition to GRI, NCC also reports the Group's emission of greenhouse gases to the CDP each year. NCC is a member in BSCI (Business Social Compliance Initiative), which is the broadest business-driven platform for the improvement of social compliance in the global supply chain and has been a member of the UN Global Compact since 2010. The UN Global Compact is a strategic policy initiative for businesses that are committed to aligning their operations and strategies with 10 defined and universally accepted principles in the areas of human rights, labour, environment and anti-corruption.

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

11. EPD owner

NCC Industry Nordic AB, Herrjärva torg 4, 170 80 Solna, Sweden.

Kristine Ek, +46 70 230 11 48,
kristine.ek@ncc.se

The products do not contain any substances of very high concern (SVHC) according to REACH. Table 4 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 RAP. The mass of biogenic carbon in the products is less than 5%. The packaging material is negligible.

Table 4: Content declaration of the asphalt mixtures declared (ranges for declared products).

Product component	Weight, kg	Post-consumer material, weight-%	Renewable material weight-%
Recycled Asphalt Pavement (RAP)	0 – 316 (see Table 1)	0 – 32	0
Aggregates 0/2	0 – 245	*	0
Aggregates 2/4	0 – 138	*	0
Aggregates 4/8	0 – 302	*	0
Aggregates 8/11	0 – 517	*	0
Aggregates 11/16	0 – 529	*	0
Aggregates 16/22	0 – 204	*	0
Aggregates 0/16	0 – 638	*	0
Quality aggregates 4/8	0 – 230	*	0
Quality aggregates 8/11	0 – 517	*	0
Quality aggregates 11/16	0 – 487	*	0
Bitumen, virgin	33 – 71	0	0
Fibre	0 – 5	0	90
Baghouse fines	24 – 99	2.4 – 9.9**	0
Wax	0 – 2	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.

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

The results of the life cycle assessment based on the declared unit for asphalt mixtures containing the actual annual mean share of RAP are presented in Table 5 and 6 (core environmental indicators), Table 7 and 8 (resource use) and Table 9 and 10 (waste categories and output flows).

In addition, the result for *GWP-GHG* is presented for asphalt mixtures containing no RAP and the potential maximum share of RAP. This is presented in Table 13 and 14.

Table 5: 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 Recycled Asphalt Pavement (RAP).

Core environmental indicators			1	2	3	4	5	6	7	8	9
			ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 70/100	ABS 11 70/100 AN7
Impact category		Unit	A1-A3	A1- A3	A1- A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Climate change	Total	kg CO_2 eq.	19	18	19	16	15	14	20	20	29
	Fossil	kg CO_2 eq.	19	18	19	16	15	14	20	20	29
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.061	0.061	0.060	0.060	0.061	0.060	0.061	0.060	0.12
	GWP-GHG**	kg CO_2 eq.	19	18	19	16	15	14	20	20	29
Ozone depletion		kg CFC 11 eq.	1.3E-07	9.1E-04	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Acidification		mol H+ eq.	0.22	9.1E-04	0.22	0.18	0.18	0.17	0.23	0.23	0.26
Eutrophication aquatic freshwater		kg P eq.	9.1E-04	9.1E-04	9.1E-04	9.1E-04	9.1E-04	9.1E-04	9.1E-04	9.1E-04	9.4E-04
Eutrophication aquatic marine		kg N eq.	0.068	0.067	0.068	0.060	0.059	0.057	0.070	0.070	0.081
Eutrophication terrestrial		mol N eq.	0.64	0.63	0.63	0.55	0.54	0.52	0.67	0.67	0.78
Photochemical ozone formation		kg NMVOC eq.	0.17	0.17	0.17	0.14	0.14	0.13	0.18	0.18	0.21
Depletion of abiotic resources - minerals and metals		kg Sb eq.	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.8E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	2460	2310	2420	1830	1700	1570	2630	2630	2890
Water use		m^3 world eq. deprived	5.5	5.3	5.4	4.8	4.7	4.5	5.9	5.9	6.1

Core environmental indicators			10	11	12	13	14	15	16	17	18
			ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Impact category		Unit	A1-A3	A1- A3	A1- A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Climate change	Total	kg CO_2 eq.	28	31	31	34	32	19	31	20	28
	Fossil	kg CO_2 eq.	28	31	31	34	31	19	31	20	27
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.12	0.13	0.13	0.13	0.13	0.058	0.13	0.054	0.13
	GWP-GHG**	kg CO_2 eq.	28	31	31	34	32	19	31	20	28
Ozone depletion		kg CFC 11 eq.	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Acidification		mol H+ eq.	0.25	0.27	0.27	0.29	0.27	0.22	0.27	0.22	0.24
Eutrophication aquatic freshwater		kg P eq.	9.4E-04	9.2E-04	9.2E-04	9.4E-04	9.4E-04	8.9E-04	9.2E-04	9.1E-04	9.3E-04
Eutrophication aquatic marine		kg N eq.	0.080	0.083	0.083	0.087	0.082	0.067	0.083	0.067	0.077
Eutrophication terrestrial		mol N eq.	0.78	0.81	0.82	0.86	0.80	0.63	0.81	0.64	0.74
Photochemical ozone formation		kg NMVOC eq.	0.21	0.22	0.22	0.24	0.22	0.17	0.22	0.17	0.20
Depletion of abiotic resources - minerals and metals		kg Sb eq.	4.8E-05	4.8E-05	4.8E-05	4.8E-05	4.8E-05	4.7E-05	4.8E-05	4.7E-05	4.8E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	2800	3120	3160	3490	3040	2450	3120	2630	2650
Water use		m^3 world eq. deprived	6.0	6.3	6.3	6.8	6.2	5.4	6.3	5.8	5.7
Core environmental indicators			19	20	21	22	23	24	25	26	27
			Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Impact category		Unit	A1-A3	A1- A3	A1- A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Climate change	Total	kg CO_2 eq.	26	24	17	17	19	19	17	16	18
	Fossil	kg CO_2 eq.	26	24	17	17	19	19	16	16	18
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.061	0.060	0.064	0.062	0.064	0.062	0.064	0.062	0.062
	GWP-GHG**	kg CO_2 eq.	25	24	17	17	19	18	16	16	18
Ozone depletion		kg CFC 11 eq.	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Acidification		mol H+ eq.	0.27	0.25	0.20	0.19	0.22	0.21	0.19	0.19	0.21
Eutrophication aquatic freshwater		kg P eq.	9.2E-04	9.2E-04	9.1E-04	8.9E-04	9.1E-04	8.9E-04	9.1E-04	8.9E-04	8.9E-04
Eutrophication aquatic marine		kg N eq.	0.079	0.075	0.065	0.064	0.069	0.068	0.064	0.063	0.067
Eutrophication terrestrial		mol N eq.	0.76	0.72	0.60	0.60	0.65	0.65	0.59	0.59	0.63
Photochemical ozone formation		kg NMVOC eq.	0.21	0.20	0.16	0.16	0.17	0.17	0.15	0.15	0.17
Depletion of abiotic resources - minerals and metals		kg Sb eq.	4.8E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05	4.7E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	3300	3029	1979	1978	2349	2348	1892	1890	2227
Water use		m^3 world eq. deprived	6.7	6.3	5.0	4.8	5.4	5.2	4.9	4.8	5.1

* 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).

Table 6: 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 Recycled Asphalt Pavement (RAP).

Core environmental indicators			1-27				1	2	3	4	5	6	7	8
			All asphalt mixtures				ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 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.	2.1 / 0.61	3.0	NR	0	-10	-9.4	-9.9	-7.1	-6.5	-5.9	-11	-11
	Fossil	kg CO_2 eq.	2.0 / 0.61	3.0	NR	0	-10	-9.4	-9.9	-7.1	-6.6	-5.9	-11	-11
	Biogenic*	kg CO_2 eq.	0/0	0	NR	0	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	0.016	0.015	0.016	0.016	0.015	0.015	0.017	0.018
	GWP-GHG	kg CO_2 eq.	2.1/0.61	3.0	NR	0	-10	-9.4	-9.9	-7.1	-6.5	-5.9	-11	-11
Ozone depletion		kg CFC 11 eq.	2.8E-16/8.0E-17	6.0E-16	NR	0	-3.5E-16	-3.4E-16	-3.5E-16	-3.1E-16	-3.6E-16	-3.2E-16	-3.7E-16	-3.9E-16
Acidification		mol H+ eq.	0.022/6.9E-03	0.010	NR	0	-0.099	-0.093	-0.098	-0.069	-0.064	-0.057	-0.11	-0.11
Eutrophication aquatic freshwater		kg P eq.	6.5E-06/1.9E-06	9.1E-06	NR	0	5.4E-06	5.3E-06	5.5E-06	5.5E-06	5.3E-06	5.3E-06	5.8E-06	6.1E-06
Eutrophication aquatic marine		kg N eq.	0.011/3.5E-03	4.7E-03	NR	0	-0.018	-0.016	-0.017	-0.011	-9.9E-03	-8.3E-03	-0.019	-0.019
Eutrophication terrestrial		mol N eq.	0.12/0.038	0.053	NR	0	-0.20	-0.18	-0.19	-0.12	-0.11	-0.094	-0.21	-0.21
Photochemical ozone formation		kg NMVOC eq.	0.033/0.010	9.3E-03	NR	0	-0.072	-0.067	-0.071	-0.046	-0.043	-0.037	-0.077	-0.076
Depletion of abiotic resources - minerals and metals		kg Sb eq.	1.6E-07/4.8E-08	2.7E-07	NR	0	1.0E-07	9.9E-08	1.0E-07	1.1E-07	9.6E-08	1.0E-07	1.1E-07	1.1E-07
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	28/8.4	41	NR	0	-2340	-2200	-2300	-1720	-1590	-1460	-2490	-2490
Water use		m^3 world eq. deprived	0.11/5.5E-03	0.028	NR	0	-2.7	-2.5	-2.7	-2.0	-1.9	-1.7	-2.9	-2.9

Core environmental indicators			9	10	11	12	13	14	15	16	17	18
			ABS 11 70/100 AN7	ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Impact category		Unit	D	D	D	D	D	D	D	D	D	
Climate change	Total	kg CO_2 eq.	-13	-12	-14	-14	-15	-13	-10	-14	-10	-12
	Fossil	kg CO_2 eq.	-13	-12	-14	-14	-15	-13	-10	-14	-10	-12
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	4.1E-03	4.0E-03	4.6E-03	4.6E-03	5.9E-03	3.9E-03	0.016	4.6E-03	0.023	5.4E-03
	GWP-GHG	kg CO_2 eq.	-13	-12	-14	-14	-15	-13	-10	-14	-10	-12
Ozone depletion		kg CFC 11 eq.	-7.7E-16	-7.7E-16	-9.0E-16	-8.8E-16	-8.5E-16	-8.2E-16	-3.5E-16	-9.0E-16	-5.2E-16	-8.9E-16
Acidification		mol H+ eq.	-0.13	-0.12	-0.14	-0.14	-0.15	-0.13	-9.9E-02	-0.14	-0.10	-0.12
Eutrophication aquatic freshwater		kg P eq.	1.0E-06	9.8E-07	1.1E-06	1.1E-06	1.6E-06	9.2E-07	5.4E-06	1.1E-06	7.8E-06	1.4E-06
Eutrophication aquatic marine		kg N eq.	-0.028	-0.027	-0.030	-0.030	-0.032	-0.028	-0.018	-0.030	-0.016	-0.025
Eutrophication terrestrial		mol N eq.	-0.31	-0.30	-0.33	-0.34	-0.36	-0.32	-0.20	-0.33	-0.18	-0.28
Photochemical ozone formation		kg NMVOC eq.	-0.10	-0.10	-0.11	-0.11	-0.12	-0.11	-0.072	-0.11	-0.070	-0.093
Depletion of abiotic resources - minerals and metals		kg Sb eq.	-4.1E-09	-4.8E-09	-6.5E-09	-5.3E-09	5.8E-09	-7.9E-09	1.0E-07	-6.5E-09	1.4E-07	-1.0E-09
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	-2670	-2580	-2890	-2930	-3150	-2710	-2340	-2890	-2510	-2440
Water use		m^3 world eq. deprived	-3.0	-2.9	-3.3	-3.3	-3.6	-3.1	-2.7	-3.3	-3.0	-2.8

Core environmental indicators			19	20	21	22	23	24	25	26	27
			Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Impact category		Unit	D	D	D	D	D	D	D	D	D
Climate change	Total	kg CO_2 eq.	-13	-12	-7.8	-7.8	-9.5	-9.5	-7.4	-7.4	18
	Fossil	kg CO_2 eq.	-13	-12	-7.8	-7.8	-9.6	-9.6	-7.4	-7.4	18
	Biogenic*	kg CO_2 eq.	0	0	0	0	0	0	0	0	0
	Land use and land use change	kg CO_2 eq.	0.022	0.021	0.016	0.016	0.015	0.015	0.016	0.016	0.062
	GWP-GHG	kg CO_2 eq.	-13	-12	-7.7	-7.7	-9.4	-9.4	-7.3	-7.3	18
Ozone depletion		kg CFC 11 eq.	-4.8E-16	-4.8E-16	-3.6E-16	-3.6E-16	-3.5E-16	-3.5E-16	-3.6E-16	-3.6E-16	1.3E-07
Acidification		mol H+ eq.	-0.13	-0.12	-0.076	-0.076	-0.094	-0.094	-0.072	-0.072	0.21
Eutrophication aquatic freshwater		kg P eq.	7.4E-06	7.3E-06	5.4E-06	5.4E-06	5.4E-06	5.4E-06	5.4E-06	5.4E-06	8.9E-04
Eutrophication aquatic marine		kg N eq.	-0.023	-0.020	-0.013	-0.013	-0.017	-0.017	-0.012	-0.012	0.067
Eutrophication terrestrial		mol N eq.	-0.25	-0.22	-0.14	-0.14	-0.19	-0.19	-0.13	-0.13	0.63
Photochemical ozone formation		kg NMVOC eq.	-0.092	-0.082	-0.053	-0.053	-0.068	-0.068	-0.050	-0.050	0.17
Depletion of abiotic resources - minerals and metals		kg Sb eq.	1.4E-07	1.4E-07	9.9E-08	9.9E-08	9.9E-08	9.9E-08	1.0E-07	1.0E-07	4.7E-05
Depletion of abiotic resources - fossil fuels		MJ, net calorific value	-3046	-2779	-1860	-1860	-2229	-2229	-1773	-1773	2227
Water use		m^3 world eq. deprived	-3.5	-3.2	-2.2	-2.2	-2.6	-2.6	-2.1	-2.1	5.1

* 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 7: 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 Recycled Asphalt Pavement (RAP).

Use of resources		1 ABT 11 70/100	2 ABT 16 70/100	3 ABT 8 100/150	4 AG 16 70/100	5 ABB 22 70/100	6 AG 22 100/150	7 ABS 11 70/100	8 ABS 16 70/100	9 ABS 11 70/100 AN7
Parameter	Unit	A1-A3	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	334	334	334	333	334	333	391	391	394
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	64	64	64
Total use of renewable primary energy	MJ, net calorific value	334	334	334	333	334	333	455	455	458
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	212	205	210	180	174	167	226	226	332
Use of non-renewable primary energy as raw materials	MJ, net calorific value	2240	2110	2210	1650	1520	1400	2400	2410	2560
Total use of non-renewable primary energy	MJ, net calorific value	2460	2310	2420	1830	1700	1570	2630	2630	2890
Use of secondary material	kg	331	346	330	323	350	349	288	253	200
Use of renewable secondary fuels	MJ, net calorific value	0	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	0
Use of net fresh water	m^3	0.24	0.23	0.24	0.22	0.22	0.21	0.25	0.25	0.25
Use of resources		10 ABS 16 70/100 AN7	11 ABS 16 70/100 AN7 LTA	12 ABS 11 70/100 AN10 LTA	13 Roundtop 11 70/100 AN10	14 Roundtop 16 70/100 AN10	15 ABT 11 70/100 AN 14 LTA	16 ABS 16 70/100 AN10 LTA	17 TSK 11 70/100	18 Viacochip 11 AN 10
Parameter	Unit	A1-A3	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	394	383	382	411	396	321	383	352	354
Use of renewable primary energy as raw materials	MJ, net calorific value	64	64	64	80	64	0	64	16	16
Total use of renewable primary energy	MJ, net calorific value	458	447	446	491	460	321	447	368	370
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	327	355	354	467	444	210	355	216	323
Use of non-renewable primary energy as raw materials	MJ, net calorific value	2470	2770	2810	3030	2600	2240	2770	2420	2330
Total use of non-renewable primary energy	MJ, net calorific value	2800	3120	3170	3490	3040	2450	3120	2630	2650
Use of secondary material	kg	211	79	94	84	170	331	79	38	79
Use of renewable secondary fuels	MJ, net calorific value	0	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	0
Use of net fresh water	m^3	0.24	0.25	0.25	0.27	0.25	0.24	0.25	0.26	0.24

Use of resources		19 Roundtop 11 70/100 AN7	20 Roundtop 16 70/100 AN7	21 ABB 11 70/100	22 ABB 11 70/100 LTA	23 ABT 11 100/150	24 ABT 11 100/150 LTA	25 ABB 16 70/100	26 ABB 16 70/100 LTA	27 ABT 16 70/100 LTA
Parameter	Unit	A1-A3	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	409	395	335	321	335	321	335	321	321
Use of renewable primary energy as raw materials	MJ, net calorific value	80	64	0	0	0	0	0	0	0
Total use of renewable primary energy	MJ, net calorific value	489	459	335	321	335	321	335	321	321
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	362	346	194	192	212	210	189	188	205
Use of non-renewable primary energy as raw materials	MJ, net calorific value	2940	2684	1786	1786	2138	2138	1703	1703	2023
Total use of non-renewable primary energy	MJ, net calorific value	3300	3029	1979	1978	2350	2348	1892	1890	2227
Use of secondary material	kg	84	99	334	334	342	342	330	330	346
Use of renewable secondary fuels	MJ, net calorific value	0	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	0
Use of net fresh water	m^3	0.27	0.27	0.23	0.22	0.24	0.23	0.22	0.22	0.23

Table 8: 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 Recycled Asphalt Pavement (RAP).

Use of resources		1-27 All asphalt mixtures				1 ABT 11 70/100	2 ABT 16 70/100	3 ABT 8 100/150	4 AG 16 70/100	5 ABB 22 70/100	6 AG 22 100/150	7 ABS 11 70/100	8 ABS 16 70/100
Parameter	Unit	C1 (S1/S2)	C2	C3	C4	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	1.6/0.47	2.3	NR	0	-8.4	-8.2	-8.4	-6.4	-8.4	-6.8	-8.9	-9.4
Use of renewable primary energy as raw materials	MJ, net calorific value	0/0	0	NR	0	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	-8.4	-8.2	-8.4	-6.4	-8.4	-6.8	-8.9	-9.4
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	-97	-90	-95	-66	-61	-54	-103	-102
Use of non-renewable primary energy as raw materials	MJ, net calorific value	0/0	0	NR	0	-2240	-2110	-2210	-1650	-1520	-1400	-2390	-2390
Total use of non-renewable primary energy	MJ, net calorific value	28/8.4	41	NR	0	-2340	-2200	-2300	-1720	-1590	-1460	-2490	-2490
Use of secondary material	kg	0/0	0	NR	0	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	0
Use of non-renewable secondary fuels	MJ, net calorific value	0/0	0	NR	0	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.022/5.4E-04	2.7E-03	NR	0	-0.090	-0.086	-0.089	-0.070	-0.071	-0.064	-0.096	-0.098

Use of resources		9	10	11	12	13	14	15	16	17	18
		ABS 11 70/100 AN7	ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Parameter	Unit	D	D	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	-7.3	-7.2	-8.5	-8.3	-8.6	-7.6	-8.4	-8.5	-12	-8.8
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	0	0	0	0
Total use of renewable primary energy	MJ, net calorific value	-7.3	-7.2	-8.5	-8.3	-8.6	-7.6	-8.4	-8.5	-12	-8.8
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	-127	-123	-138	-140	-149	-130	-97	-138	-98	-116
Use of non-renewable primary energy as raw materials	MJ, net calorific value	-2540	-2460	-2750	-2790	-3010	-2580	-2240	-2750	-2410	-2330
Total use of non-renewable primary energy	MJ, net calorific value	-2670	-2580	-2890	-2930	-3150	-2710	-2340	-2890	-2510	-2440
Use of secondary material	kg	0	0	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	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0	0	0
Use of net fresh water	m³	-0.088	-0.086	-0.097	-0.098	-0.11	-0.090	-0.090	-0.097	-0.11	-0.088

Use of resources		19	20	21	22	23	24	25	26	27
		Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Parameter	D	D	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	-11	-11	-8,5	-8,5	-8,2	-8,2	-8,6	-8,6	-8,2
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	0	0	0
Total use of renewable primary energy	MJ, net calorific value	-11	-11	-8,5	-8,5	-8,2	-8,2	-8,6	-8,6	-8,2
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	-125	-112	-74	-74	-92	-92	-70	-70	-86
Use of non-renewable primary energy as raw materials	MJ, net calorific value	-2921	-2667	-1786	-1786	-2138	-2138	-1703	-1703	-2023
Total use of non-renewable primary energy	MJ, net calorific value	-3045	-2779	-1860	-1860	-2229	-2229	-1773	-1773	-2108
Use of secondary material	kg	0	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	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0	0
Use of net fresh water	m³	-0,12	-0,11	-0,078	-0,078	-0,087	-0,087	-0,077	-0,077	-0,084

Table 9: 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 Recycled Asphalt Pavement (RAP).

Waste categories & output flows		1	2	3	4	5	6	7	8	9
		ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 70/100	ABS 11 70/100 AN7
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	8.0E-03	7.9E-03	8.0E-03	8.3E-03	8.0E-03	8.0E-03	8.5E-03	8.9E-03	1.9E-03
Non-hazardous waste disposed	kg	0.39	0.39	0.39	0.39	0.39	0.39	0.45	0.46	0.44
Radioactive waste disposed	kg	5.4E-04	5.4E-04	5.4E-04	5.4E-04	5.4E-04	5.4E-04	8.0E-04	8.0E-04	9.6E-04
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0.027	0.027	0.027	0.028	0.027	0.027	0.028	0.028	0.021
Materials for energy recovery	kg	0.052	0.052	0.052	0.053	0.052	0.052	0.053	0.054	0.039
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0	0
Waste categories & output flows		10	11	12	13	14	15	16	17	18
		ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	1.9E-03	2.2E-03	2.2E-03	2.8E-03	1.8E-03	8.0E-03	2.2E-03	0.012	2.7E-03
Non-hazardous waste disposed	kg	0.44	0.43	0.43	0.48	0.46	0.37	0.43	0.42	0.40
Radioactive waste disposed	kg	9.6E-04	9.7E-04	9.7E-04	1.5E-03	1.4E-03	5.2E-04	9.7E-04	6.2E-04	7.9E-04
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0.021	0.021	0.021	0.022	0.021	0.027	0.021	0.031	0.022
Materials for energy recovery	kg	0.039	0.039	0.039	0.041	0.039	0.052	0.039	0.061	0.041
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0	0
Waste categories & output flows		19	20	21	22	23	24	25	26	27
		Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	0.011	0.011	8.1E-03	8.1E-03	7.9E-03	7.9E-03	8.2E-03	8.2E-03	7.9E-03
Non-hazardous waste disposed	kg	0.49	0.48	0.39	0.38	0.39	0.37	0.39	0.38	0.37
Radioactive waste disposed	kg	1.3E-03	1.2E-03	5.5E-04	5.3E-04	5.5E-04	5.3E-04	5.5E-04	5.3E-04	5.3E-04
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0.030	0.030	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Materials for energy recovery	kg	0.059	0.059	0.053	0.053	0.052	0.052	0.053	0.053	0.052
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0	0

Table 10: 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 Recycled Asphalt Pavement (RAP).

Waste categories & output flows		1-27				1	2	3	4	5	6	7	8
		All asphalt mixtures				ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 70/100
Parameter/Indicator	Unit	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D	D
Hazardous waste disposed	kg	1.4E-09/4.2E-10	2.2E-09	NR	0	-8.0E-03	-7.9E-03	-8.0E-03	-8.3E-03	-8.0E-03	-8.0E-03	-8.5E-03	-9.0E-03
Non-hazardous waste disposed	kg	9.9E-03/1.3E-03	6.4E-03	NR	0	-0.030	-0.029	-0.030	-0.030	-0.030	-0.030	-0.032	-0.033
Radioactive waste disposed	kg	3.5E-05/1.0E-05	7.4E-05	NR	0	-2.6E-05	-2.6E-05	-2.6E-05	-2.8E-05	-2.7E-05	-2.8E-05	-2.8E-05	-2.9E-05
Components for re-use	kg	0/0	0	0	0	0	0	0	0	0	0	0	0
Materials for recycling*	kg	0/0	0	**	0	-8.6E-03	-8.5E-03	-8.7E-03	-8.9E-03	-8.6E-03	-8.7E-03	-9.2E-03	-9.7E-03
Materials for energy recovery	kg	0/0	0	0	0	-0.018	-0.018	-0.018	-0.019	-0.018	-0.018	-0.019	-0.020
Exported energy	MJ per energy carrier	0/0	0	0	0	0	0	0	0	0	0	0	0

Waste categories & output flows		9	10	11	12	13	14	15	16	17	18
		ABS 11 70/100 AN7	ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Parameter/Indicator	Unit	D	D	D	D	D	D	D	D	D	D
Hazardous waste disposed	kg	-5.5E-03	-5.4E-03	-6.3E-03	-6.2E-03	-6.6E-03	-5.6E-03	-8.0E-03	-6.3E-03	-0.012	-6.7E-03
Non-hazardous waste disposed	kg	-0.022	-0.022	-0.025	-0.025	-0.026	-0.023	-0.030	-0.025	-0.044	-0.027
Radioactive waste disposed	kg	-7.6E-05	-7.6E-05	-8.9E-05	-8.7E-05	-8.3E-05	-8.1E-05	-2.6E-05	-8.9E-05	-4.0E-05	-8.7E-05
Components for re-use	kg	0	0	0	0	0	0	0	0	0	0
Materials for recycling*	kg	-2.1E-03	-2.0E-03	-2.4E-03	-2.4E-03	-3.0E-03	-2.0E-03	-8.6E-03	-2.4E-03	-0.013	-3.0E-03
Materials for energy recovery	kg	-4.3E-03	-4.2E-03	-4.9E-03	-4.9E-03	-6.3E-03	-4.0E-03	-0.018	-4.9E-03	-0.026	-6.1E-03
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0	0	0

Waste categories & output flows		19	20	21	22	23	24	25	26	27
		Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Parameter/Indicator	Unit	D	D	D	D	D	D	D	D	D
Hazardous waste disposed	kg	-0.011	-0.011	-8.1E-03	-8.1E-03	-7.9E-03	-7.9E-03	-8.2E-03	-8.2E-03	-7.9E-03
Non-hazardous waste disposed	kg	-0.041	-0.041	-0.030	-0.030	-0.029	-0.029	-0.031	-0.031	-0.029
Radioactive waste disposed	kg	-3.6E-05	-3.6E-05	-2.7E-05	-2.7E-05	-2.6E-05	-2.6E-05	-2.8E-05	-2.8E-05	-2.6E-05
Components for re-use	kg	0	0	0	0	0	0	0	0	0
Materials for recycling*	kg	-0.012	-0.012	-8.7E-03	-8.7E-03	-8.5E-03	-8.5E-03	-8.8E-03	-8.8E-03	-8.5E-03
Materials for energy recovery	kg	-0.025	-0.024	-0.018	-0.018	-0.018	-0.018	-0.018	-0.018	-0.018
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0	0

*100% of the all asphalt mixtures are assumed to be material recycled in the next life cycle. However, this figure presents the net flow going to module D.

** ABT 11 70/100: 669, ABT 16 70/100: 654, ABT 8 100/150: 670, AG 16 70/100: 677, ABB 22 70/100: 650, AG 22 100/150: 651, ABS 11 70/100: 712, ABS 16 70/100: 747, ABS 11 70/100 AN7: 800, ABS 16 70/100 AN7: 789, ABS 16 70/100 AN7 LTA: 921, ABS 11 70/100 AN10 LTA: 906, Roundtop 11 70/100 AN10: 916, Roundtop 16 70/100 AN10: 831, ABT 11 70/100 AN 14 LTA: 669, ABS 16 70/100 AN10 LTA: 921, TSK 11 70/100: 962, Viacochip 11 AN 10: 921, Roundtop 11 70/100 AN7: 916, Roundtop 16 70/100 AN7: 901, ABB 11 70/100: 666, ABB 11 70/100 LTA: 666, ABT 11 100/150: 658, ABT 11 100/150 LTA: 658, ABB 16 70/100: 670, ABB 16 70/100 LTA: 670, ABT 16 70/100 LTA: 654.

Table 11: Additional environmental impact indicators are only declared in the Annex to the General background report.

Additional environmental impact indicators		
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 12: 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 13 and 14 are additional results and do only present the result for the impact category *GWP-GHG*, for no RAP, the annual actual mean share of RAP (as presented in Table 5 and 6) and the maximum possible share of RAP.

Table 13: Results of the LCA (modules A1-A3) – GWP-GHG for three different RAP content, (1) no RAP content, (2) the actual annual mean share of RAP and (3) the maximum possible share of RAP in the various asphalt mixtures.

Core environmental indicators			1	2	3	4	5	6	7	8	9
			ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 70/100	ABS 11 70/100 AN7
Impact category	Unit	RAP content	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP-GHG	kg CO_2 eq.	No RAP	21	21	21	18	18	17	22	22	31
		Mean RAP	19	18	19	16	15	14	20	20	29
		Max RAP	18	18	18	15	15	14	20	20	28
Core environmental indicators			10	11	12	13	14	15	16	17	18
			ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Impact category	Unit	RAP content	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP-GHG	kg CO_2 eq.	No RAP	31	31	31	34	33	21	31	20	28
		Mean RAP	28	31	31	34	32	19	31	20	28
		Max RAP	28	28	28	31	30	18	28	18	25
Core environmental indicators			19	20	21	22	23	24	25	26	27
			Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Impact category	Unit	RAP content	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP-GHG	kg CO_2 eq.	No RAP	25	24	19	19	21	21	19	19	20
		Mean RAP	25	24	17	17	19	18	16	16	18
		Max RAP	24	22	16	16	18	18	16	16	18

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

Core environmental indicators			1-27				1	2	3	4	5	6	7	8
			All asphalt mixtures				ABT 11 70/100	ABT 16 70/100	ABT 8 100/150	AG 16 70/100	ABB 22 70/100	AG 22 100/150	ABS 11 70/100	ABS 16 70/100
Impact category	Unit	RAP content	C1 (S1/S2)	C2	C3	C4	D	D	D	D	D	D	D	D
GWP-GHG	kg CO_2 eq.	No RAP	2.1 / 0.61	3.0	NR	0	-12	-12	-12	-9.3	-9.0	-8.3	-12	-12
		Mean RAP	2.1 / 0.61	3.0	NR	0	-10	-9.4	-9.9	-7.1	-6.5	-5.9	-11	-11
		Max RAP	2.1 / 0.61	3.0	NR	0	-9.6	-9.1	-9.4	-6.5	-6.2	-5.5	-11	-11

Core environmental indicators			9	10	11	12	13	14	15	16	17	18
			ABS 11 70/100 AN7	ABS 16 70/100 AN7	ABS 16 70/100 AN7 LTA	ABS 11 70/100 AN10 LTA	Roundtop 11 70/100 AN10	Roundtop 16 70/100 AN10	ABT 11 70/100 AN 14 LTA	ABS 16 70/100 AN10 LTA	TSK 11 70/100	Viacochip 11 AN 10
Impact category	Unit	RAP content	D	D	D	D	D	D	D	D	D	D
GWP-GHG	kg CO_2 eq.	No RAP	-14	-14	-14	-14	-15	-14	-12	-14	-10	-12
		Mean RAP	-13	-12	-14	-14	-15	-13	-10	-14	-10	-12
		Max RAP	-12	-12	-12	-12	-13	-12	-9.6	-12	-9.2	-9.9

Core environmental indicators			19	20	21	22	23	24	25	26	27
			Roundtop 11 70/100 AN7	Roundtop 16 70/100 AN7	ABB 11 70/100	ABB 11 70/100 LTA	ABT 11 100/150	ABT 11 100/150 LTA	ABB 16 70/100	ABB 16 70/100 LTA	ABT 16 70/100 LTA
Impact category	Unit	RAP content	D	D	D	D	D	D	D	D	D
GWP-GHG	kg CO_2 eq.	No RAP	-13	-12	-10	-10	-12	-12	-9.6	-9.6	-11
		Mean RAP	-13	-12	-7.7	-7.7	-9.4	-9.4	-7.3	-7.3	-8.8
		Max RAP	-11	-10	-7.3	-7.3	-9.0	-9.0	-6.9	-6.9	-8.6

1. 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 recycled asphalt pavements (RAP) in 2020.

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

2. 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.

3. 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 RAP 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 RAP is accounted for in the next life cycle, to avoid double counting.

Table 15: Scenario-based information for end of life.

Scenario information	Unit (per declared unit)	Scenario 1 and 2
Collection process specified by type	kg collected separately	1000
	kg collected with mixed construction waste	0
Recovery system specified by type	kg for re-use	0
	kg for recycling	1000
	kg for energy recovery	0
Disposal specified by type	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 16.

Table 16: Net output flow for module D per declared unit.

#	Asphalt mixture	Mass (kg)
1	ABT 11 70/100	669
2	ABT 16 70/100	654
3	ABT 8 100/150	670
4	AG 16 70/100	677
5	ABB 22 70/100	650
6	AG 22 100/150	651
7	ABS 11 70/100	712
8	ABS 16 70/100	747
9	ABS 11 70/100 AN7	800
10	ABS 16 70/100 AN7	789
11	ABS 16 70/100 AN7 LTA	921
12	ABS 11 70/100 AN10 LTA	906
13	Roundtop 11 70/100 AN10	916
14	Roundtop 16 70/100 AN10	831
15	ABT 11 70/100 AN 14 LTA	669
16	ABS 16 70/100 AN10 LTA	921
17	TSK 11 70/100	962
18	Viacochip 11 AN 10	921
19	Roundtop 11 70/100 AN7	916
20	Roundtop 16 70/100 AN7	901
21	ABB 11 70/100	666
22	ABB 11 70/100 LTA	666
23	ABT 11 100/150	658
24	ABT 11 100/150 LTA	658
25	ABB 16 70/100	670
26	ABB 16 70/100 LTA	670
27	ABT 16 70/100 LTA	654

Loads accounted for are crushing of the RAP (the same in both scenarios).
Benefits accounted for are aggregates and bitumen material which are replaced by RAP (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.

Table 17: Verification details.

CEN standard EN 15804 served 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

Address of programme operator: EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden, E-mail: info@environdec.com

REFERENCES

Annex to General Background Report, Asphalt mixtures, Plant specific information for asphalt mixtures from Lund asphalt plant – Södra Sandby, 2020. Version 2022-01-13.

EAPA (2017). Asphalt in Figures 2017. European Asphalt Pavement Association.

Ekblad, J. and Lundström, R. (2013). NCC Green Asphalt: energibehov och utsläpp av CO2. NCC Rapport 2013-01. NCC Roads, Upplands Väsby.

EN 15804:2012+A2:2019/AC:2021: Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products

EPD International (2019) General Programme Instructions for the International EPD® System, version 3.01, dated 2019-09-18. www.environdec.com

EPD process – general description (2021) NCC Industry, Division Asphalt

Eurobitume (2012) Life Cycle Inventory: Bitumen.

Eurobitume (2019) The Eurobitume Life-cycle inventory for bitumen.

GaBi Professional: Documentation of GaBi: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Leinfelden-Echterdingen, 1992-2022.

General background report – Environmental Product Declarations for asphalt mixtures. Version 2021-11-11.

NCC (2017). Environmental Product Declaration for aggregates from the mobile crushing plant in Bjurholm, published at EPD International.

NCC (2021). Environmental Product Declaration for aggregates from Lund quarry – Södra Sandby, published at EPD International. Version 2021-06-03.

Product Category Rules PCR 2018:04 Asphalt Mixtures, version 1.03 of 2019-09-06

Product Category Rules PCR 2019:14 Construction products, version 1.11 of 2021-02-05

Rubio M C, Martínez G, Baena L & Moreno F. Warm mix asphalt: an overview. Journal of Cleaner Production, 24 (2012) 76-84.

SS-EN 13108-1:2016 Bituminous mixtures – Material specifications – Part 1: Asphalt Concrete

SS-EN 13108-5:2016 Bituminous mixtures – Material specifications – Part 5: Stone Mastic Asphalt

SS-EN 13108-7:2016 Bituminous mixtures – Material specifications – Part 7: Porous Asphalt

SS-EN ISO 14025:2010 Environmental labels and declarations - Type III environmental declarations - Principles and procedures (ISO 14025:2006)

SS-EN ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework (ISO 14040:2006)

SS-EN ISO 14044:2006/A1:2018 Environmental management - Life cycle assessment - Requirements and guidelines – Amendment 1 (ISO 14044:2006 / Amd 1:2018)

The German BITUMEN Forum (2016). Progress report 2006.

The International EPD® System, EPD International AB, Stockholm, Sweden, http://www.environdec.com/

Trafikverket (2021). Klimatkalkyl version 7.0 – emissionsfaktorer. https://klimatkalkyl-pub.ea.trafikverket.se/Klimatkalkyl/modell.

United Nations Statistics Division (2015). Central Product Classification, version 2.1. https://unstats.un.org/unsd/classifications/unsdclassifications/cpcv21.pdf.

Table 18: Versions of this EPD.

Date of revision	Description of difference versus previous versions
2021-09-01	Original version
2022-01-13	A few asphalt mixtures added.
2022-02-18	Editorial changes