# Environmental Product Declaration for asphalt mixtures from Östersund asphalt plant – Gräfsåsen


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): 2021-08-17  Date of revision: 2022-02-18  Date of validity: 2026-08-16  Reg. no. S-P-03638

*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:

- ABT11 160/220
- ABT16 160/220
- AG16 160/220
- AG22 160/220
- Viacomat 8 100/150
- Viacogrip11 Bit85

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 |

ECO PLATFORM EPD EN 15804 VERIFIED

EPD®

## 1. General product information

The asphalt mixtures declared are manufactured at the asphalt plant Östersund in Gräfsåsen, 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, hydraulic adhesives 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 | ABT11 160/220 | HMA | 0 | 9 | 30 |
| 2 | ABT16 160/220 | HMA | 0 | 20 | 30 |
| 3 | AG16 160/220 | HMA | 0 | 20 | 30 |
| 4 | AG22 160/220 | HMA | 0 | 14 | 30 |
| 5 | Viacomat 8 100/150 | HMA | 0 | 0 | 10 |
| 6 | Viacogrip11 Bit85 | PMB | 0 | 5 | 10 |

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.

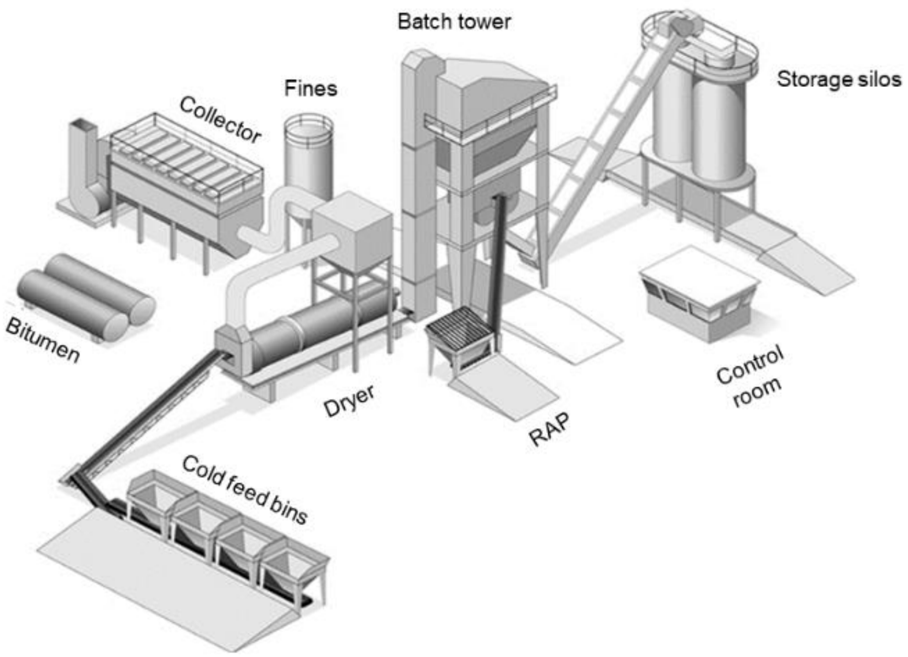


**Figure 1: Schematic illustration of an asphalt plant.**

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 were 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. The Östersund asphalt plant uses the methods "recycling ring" and "direct to mixer".

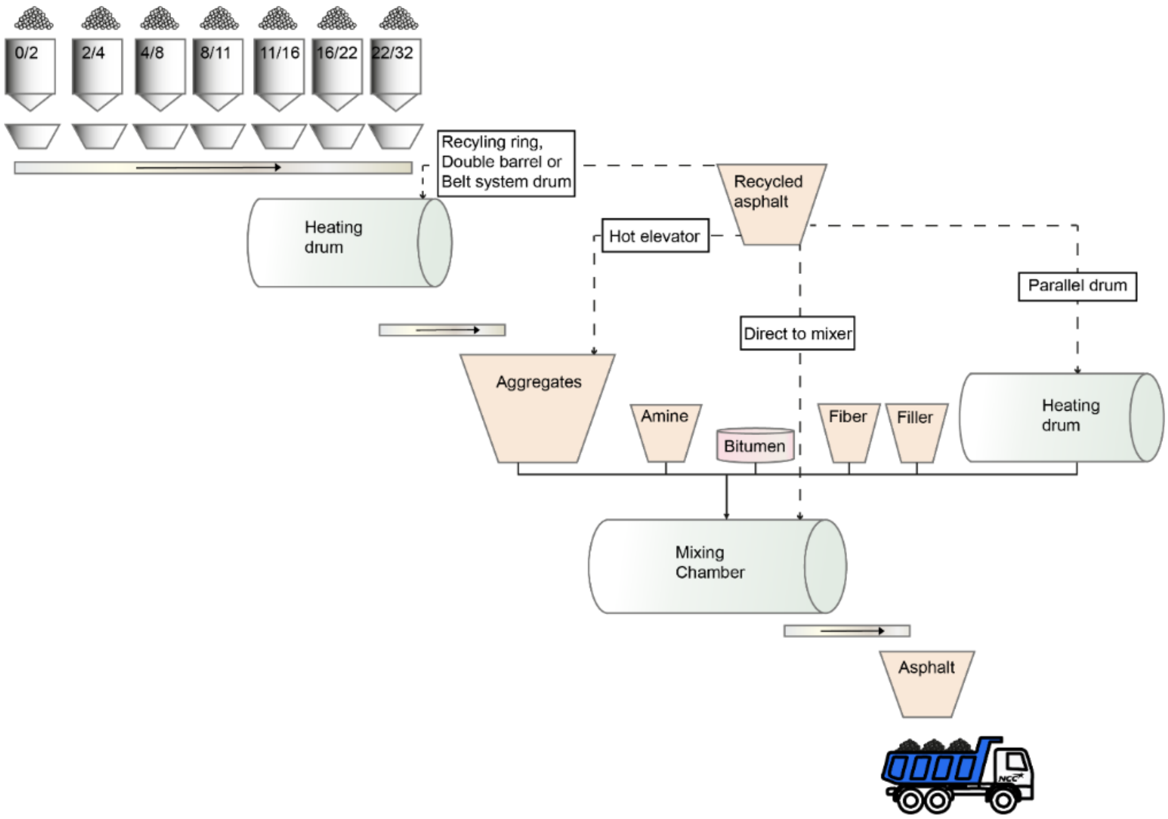


**Figure 2: Illustration of the general production process of asphalt.**

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 13108-3, SS-EN 13108-5 and SS-EN 13108-7.

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

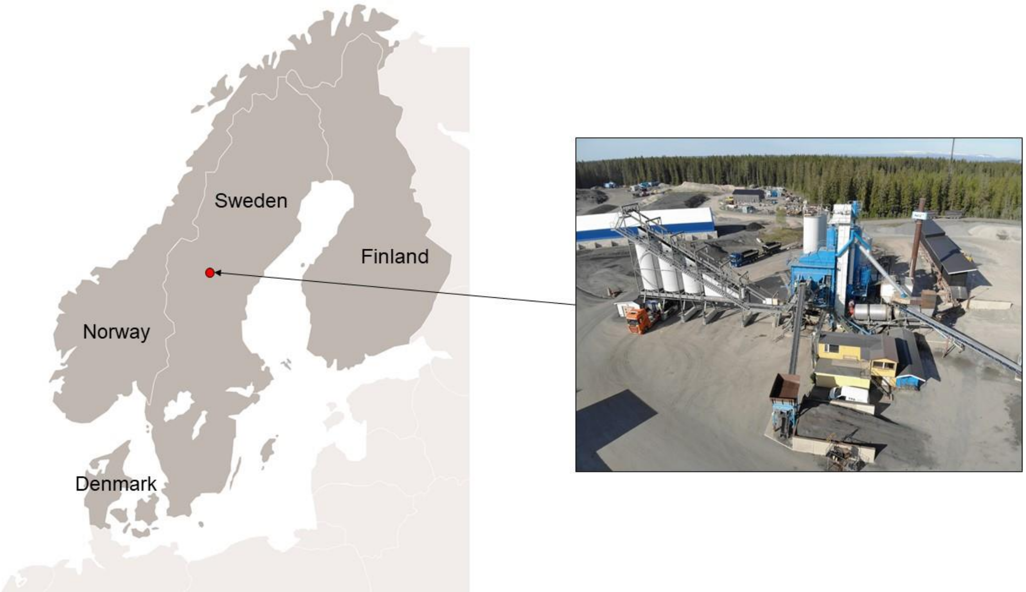


**Figure 3: Map and picture showing the geographical location of the declared plant.**

## 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 is based on an 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.

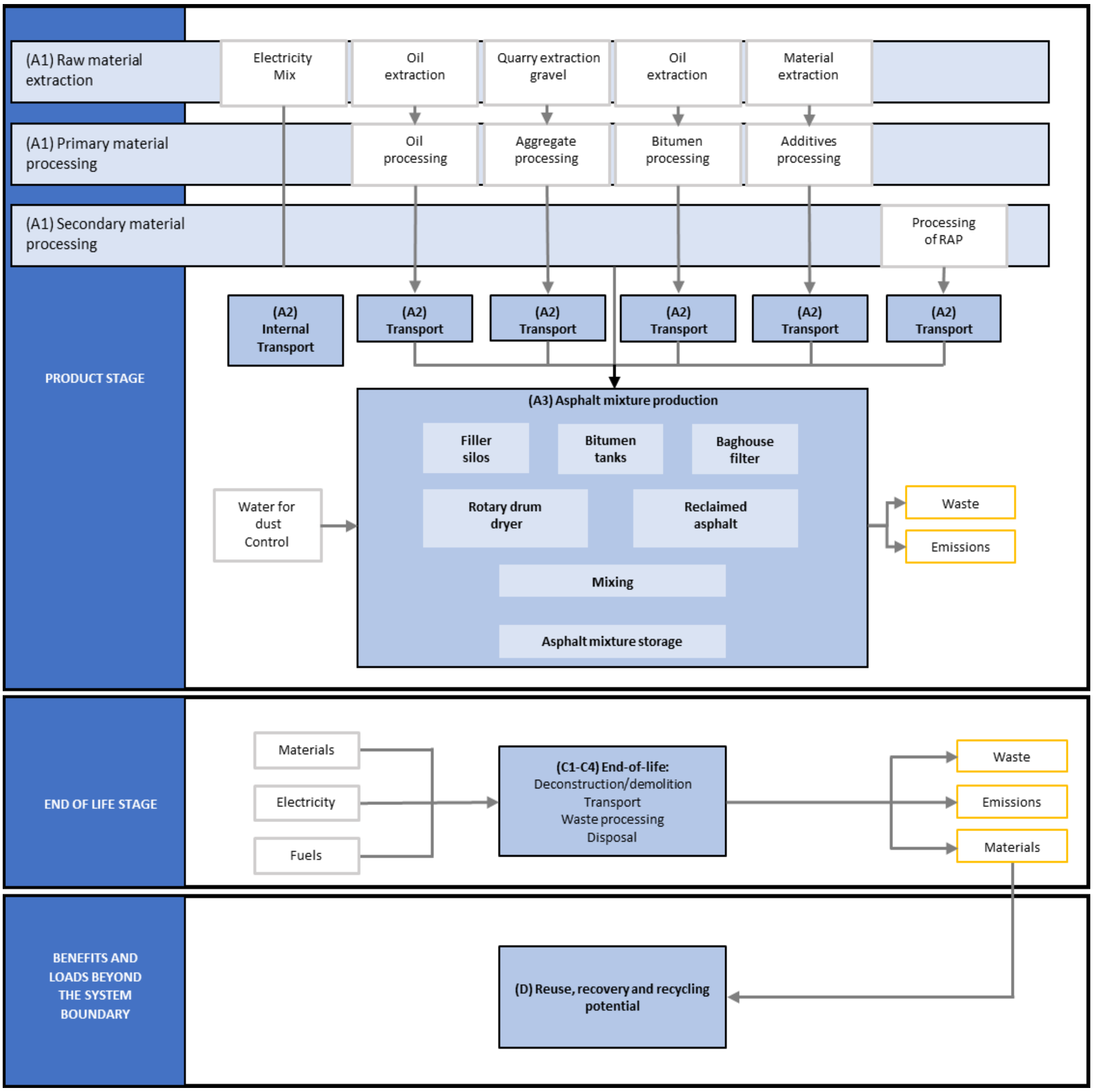


**Figure 5: System boundaries for the studied product system.**

## 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 *Climate change - total*. 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% aggregates and 5% bitumen or 95.4% aggregates and 4.6% 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) | 170 |
| Conventional hot mix asphalt (HMA) | 160 |
| Reduced temperature, warm mix asphalt (WMA) | 130 |
| Soft asphalt (SA) | 100 |

## 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

## CONTENT DECLARATION INCLUDING PACKAGING

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) | 0–199 (see Table 1) | 0 – 19.9 | 0 |
| Aggregates 0/4 | 167 – 442 | * | 0 |
| Aggregates 4/8 | 0 – 666 | * | 0 |
| Aggregates 8/11 | 0 – 142 | * | 0 |
| Aggregates 11/16 | 0 – 173 | * | 0 |
| Aggregates 16/22 | 0 - 185 | * | 0 |
| Quality aggregates 8/11 | 0 - 619 | * | 0 |
| Bitumen, virgin | 0 – 70 | 0 | 0 |
| Polymer modified bitumen (PMB), virgin | 0 - 55 | 0 | 0 |
| Fibre | 0 - 4 | * | 90 |
| Baghouse fines | 40 – 92 | 4.0 – 9.2** | 0 |
| Liquid adhesion (Amine) | <10 | 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 *Climate change – total* 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 |
|---|---|---|---|---|---|---|---|---|
| | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Impact category | | Unit | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 |
| Climate change | Total | kg $CO_2$ eq. | 22 | 19 | 17 | 17 | 26 | 37 |
| | Fossil*, ** | kg $CO_2$ eq. | 22* | 19* | 17* | 17* | 26* | 37** |
| | Biogenic*** | kg $CO_2$ eq. | 0 | 0 | 0 | 0 | 0 | 0 |
| | Land use and land use change | kg $CO_2$ eq. | 0.064 | 0.063 | 0.062 | 0.061 | 0.069 | 0.12 |
| | GWP-GHG | kg $CO_2$ eq. | 22 | 19 | 17 | 17 | 26 | 37 |
| Ozone depletion | | kg CFC 11 eq. | 1.3E-07 | 1.3E-07 | 1.3E-07 | 1.3E-07 | 1.3E-07 | 1.3E-07 |
| Acidification | | mol H+ eq. | 0.22 | 0.20 | 0.17 | 0.17 | 0.25 | 0.32 |
| Eutrophication aquatic freshwater | | kg P eq. | 8.7E-04 | 8.7E-04 | 8.7E-04 | 8.7E-04 | 8.7E-04 | 0.0068 |
| Eutrophication aquatic marine | | kg N eq. | 0.067 | 0.063 | 0.057 | 0.057 | 0.076 | 0.088 |
| Eutrophication terrestrial | | mol N eq. | 0.64 | 0.59 | 0.53 | 0.53 | 0.73 | 0.85 |
| Photochemical ozone formation | | kg NMVOC eq. | 0.17 | 0.16 | 0.14 | 0.14 | 0.20 | 0.22 |
| 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 | 4.8E-05 |
| Depletion of abiotic resources - fossil fuels | | MJ. net calorific value | 2680 | 2240 | 1780 | 1790 | 3280 | 2830 |
| Water use | | $m^3$ world eq. deprived | 5.6 | 5.1 | 4.6 | 4.7 | 6.5 | 22 |

* 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.
*** 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 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 | | | 1-6 | | | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | All asphalt mixtures | | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Impact category | | Unit | C1 (S1/S2) | C2 | C3 | C4 | D | D | D | D | D | D |
| Climate change | Total | kg $CO_2$ eq. | 2.1 /0.62 | 3.0 | NR | 0 | -13 | -11 | -8.5 | -8.6 | -15 | -13 |
| | Fossil | kg $CO_2$ eq. | 2.0/0.61 | 3.0 | NR | 0 | -13 | -11 | -8.5 | -8.6 | -16 | -13 |
| | Biogenic* | kg $CO_2$ eq. | 0/0 | 0 | NR | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Land use and land use change | kg $CO_2$ eq. | 0.017/0.0052 | 0.025 | NR | 0 | 0.011 | 0.010 | 0.010 | 0.011 | 0.012 | -0.0041 |
| | GWP-GHG | kg $CO_2$ eq. | 2.1/0.62 | 3.0 | NR | 0 | -13 | -11 | -8 | -9 | -15 | -13 |
| Ozone depletion | | kg CFC 11 eq. | 2.8E-16/8.1E-17 | 6.0E-16 | NR | 0 | -2.7E-11 | -2.4E-11 | -2.5E-11 | -2.6E-11 | -2.8E-11 | -6.3E-12 |
| Acidification | | mol H+ eq. | 0.022/6.9E-03 | 0.010 | NR | 0 | -0.12 | -0.10 | -0.082 | -0.082 | -0.15 | -0.13 |
| Eutrophication aquatic freshwater | | kg P eq. | 6.5E-06/1.9E-06 | 9.1E-06 | NR | 0 | 3.5E-06 | 3.1E-06 | 3.1E-06 | 3.3E-06 | 3.8E-06 | -2.1E-06 |
| Eutrophication aquatic marine | | kg N eq. | 0.011/0.0035 | 0.0047 | NR | 0 | -0.027 | -0.023 | -0.018 | -0.018 | -0.033 | -0.032 |
| Eutrophication terrestrial | | mol N eq. | 0.13/0.038 | 0.053 | NR | 0 | -0.30 | -0.25 | -0.20 | -0.20 | -0.37 | -0.36 |
| Photochemical ozone formation | | kg NMVOC eq. | 0.033/0.010 | 0.0093 | NR | 0 | -0.10 | -0.084 | -0.066 | -0.067 | -0.12 | -0.11 |
| Depletion of abiotic resources - minerals and metals | | kg Sb eq. | 1.6E-07/4.8E-08 | 2.7E-07 | NR | 0 | -1.3E-07 | -1.2E-07 | -1.3E-07 | -1.3E-07 | -1.4E-07 | -1.4E-07 |
| Depletion of abiotic resources - fossil fuels | | MJ, net calorific value | 28/8.4 | 41 | NR | 0 | -2560 | -2120 | -1670 | -1680 | -3130 | -2460 |
| Water use | | $m^3$ world eq. deprived | 0.11/0.0055 | 0.028 | NR | 0 | -3.0 | -2.5 | -2.0 | -2.0 | -3.6 | -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 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 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Parameter | Unit | 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 | 322 | 321 | 321 | 321 | 379 | 351 |
| Use of renewable primary energy as raw materials | MJ, net calorific value | 0 | 0 | 0 | 0 | 64 | 19 |
| Total use of renewable primary energy | MJ, net calorific value | 322 | 321 | 321 | 321 | 443 | 370 |
| Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials | MJ, net calorific value | 244 | 219 | 195 | 196 | 286 | 523 |
| Use of non-renewable primary energy as raw materials | MJ, net calorific value | 2430 | 2020 | 1590 | 1600 | 3000 | 2310 |
| Total use of non-renewable primary energy | MJ, net calorific value | 2680 | 2240 | 1780 | 1790 | 3280 | 2830 |
| Use of secondary material | kg | 154 | 245 | 239 | 189 | 92 | 140 |
| Use of renewable secondary fuels | MJ, net calorific value | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of non-renewable secondary fuels | MJ, net calorific value | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of net fresh water | $m^3$ | 0.28 | 0.26 | 0.25 | 0.25 | 0.30 | 0.66 |

**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 | | 1-6 | | | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | All asphalt mixtures | | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Parameter | Unit | C1 (S1/S2) | C2 | C3 | C4 | 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 | -12 | -11 | -11 | -12 | -13 | -9.1 |
| Use of renewable primary energy as raw materials | MJ, net calorific value | 0/0 | 0 | NR | 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 | -12 | -11 | -11 | -12 | -13 | -9.1 |
| 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 | -125 | -104 | -83 | -83 | -152 | -133 |
| Use of non-renewable primary energy as raw materials | MJ, net calorific value | 0/0 | 0 | NR | 0 | -2430 | -2020 | -1590 | -1600 | -2980 | -2330 |
| Total use of non-renewable primary energy | MJ, net calorific value | 28/8.4 | 41 | NR | 0 | -2560 | -2120 | -1670 | -1680 | -3130 | -2460 |
| Use of secondary material | kg | 0/0 | 0 | NR | 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 |
| Use of non-renewable secondary fuels | MJ, net calorific value | 0/0 | 0 | NR | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of net fresh water | $m^3$ | 0.022/5.4 | 0.0027 | NR | 0 | -0.10 | -0.086 | -0.075 | -0.078 | -0.12 | -0.085 |

**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 |
|---|---|---|---|---|---|---|---|
| | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Parameter/Indicator | Unit | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 |
| Hazardous waste disposed | kg | 0.013 | 0.012 | 0.013 | 0.013 | 0.013 | 0.0088 |
| Non-hazardous waste disposed | kg | 0.31 | 0.31 | 0.31 | 0.31 | 0.38 | 0.34 |
| Radioactive waste disposed | kg | 5.6E-04 | 5.5E-04 | 5.5E-04 | 5.5E-04 | 8.3E-04 | 7.7E-04 |
| Components for re-use | kg | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for recycling | kg | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for energy recovery | kg | 0.030 | 0.029 | 0.029 | 0.029 | 0.030 | 0.024 |
| Exported energy | MJ per energy carrier | 0.13 | 0.11 | 0.12 | 0.12 | 0.13 | 0.030 |

**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 | | 1-6 | | | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | All asphalt mixtures | | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Parameter/Indicator | Unit | C1 (S1/S2) | C2 | C3 | C4 | D | D | D | D | D | D |
| Hazardous waste disposed | kg | 1.4E-09/4.2E-10 | 2.2E-09 | NR | 0 | -0.0055 | -0.0050 | -0.0051 | -0.0054 | -0.0059 | -0.0050 |
| Non-hazardous waste disposed | kg | 0.0099/0.0013 | 0.0064 | NR | 0 | -0.013 | -0.011 | -0.012 | -0.012 | -0.013 | -0.020 |
| Radioactive waste disposed | kg | 3.5E-05/1.0E-05 | 7.4E-05 | NR | 0 | -8.8E-05 | -7.9E-05 | -8.1E-05 | -8.7E-05 | -9.3E-05 | -1.2E-04 |
| Components for re-use | kg | 0/0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for recycling* | kg | 0/0 | 0 | ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for energy recovery | kg | 0/0 | 0 | 0 | 0 | -0.0071 | -0.0064 | -0.0065 | -0.0070 | -0.0075 | -0.0017 |
| Exported energy | MJ per energy carrier | 0/0 | 0 | 0 | 0 | -0.13 | -0.11 | -0.12 | -0.12 | -0.13 | -0.030 |

*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.

** ABT11 160/220: 847, ABT16 160/220: 755, AG16 160/220: 761, AG22 160/220: 811, Viacomat 8 100/150: 908, Viacogrip11 Bit85: 860.

**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 only present the result for the impact category Climate change – total, 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) – Climate change – total 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 |
|---|---|---|---|---|---|---|---|---|
| | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Impact category | Unit | RAP content | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 | A1-A3 |
| Climate change – Total | kg $CO_2$ eq. | No RAP | 23 | 22 | 20 | 19 | 26 | 38 |
| | | Mean RAP | 22 | 19 | 17 | 17 | 26 | 37 |
| | | Max RAP | 19 | 18 | 16 | 15 | 25 | 36 |

**Table 14: Results of the LCA (modules C and D) – Core environmental indicators per declared unit of specific asphalt mixtures. Climate change – total 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 | | | 1-6 | | | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | All asphalt mixtures | | | | ABT11 160/220 | ABT16 160/220 | AG16 160/220 | AG22 160/220 | Viacomat 8 100/150 | Viacogrip11 Bit85 |
| Impact category | Unit | RAP content | C1 (S1/S2) | C2 | C3 | C4 | D | D | D | D | D | D |
| Climate change – Total | kg $CO_2$ eq. | No RAP | 2.1 /0.62 | 3.0 | NR | 0 | -14 | -13 | -11 | -10 | -15 | -14 |
| | | Mean RAP | 2.1 /0.62 | 3.0 | NR | 0 | -13 | -11 | -8.5 | -8.6 | -15 | -13 |
| | | Max RAP | 2.1 /0.62 | 3.0 | NR | 0 | -10 | -9.4 | -7.4 | -6.7 | -14 | -12 |

## 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 | ABT11 160/220 | 847 |
| 2 | ABT16 160/220 | 755 |
| 3 | AG16 160/220 | 761 |
| 4 | AG22 160/220 | 811 |
| 5 | Viacomat 8 100/150 | 908 |
| 6 | Viacogrip11 Bit85 | 860 |

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)<br>☐ EPD verification (External) |
| Certification body: | Bureau Veritas |
| Accredited: | SWEDAC |
| Procedure for follow-up of data during EPD validity involves third party verifier: | ☒ Yes<br>☐ 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 Östersund asphalt plant – Gräfsåsen, 2020. Version 2021-08-17.

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, 1992-2021.

General background report – Environmental Product Declarations for asphalt mixtures. Version 2021-03-01.

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

NCC (2019). Environmental Product Declaration for aggregates from Uddevalla quarry – Glimmingen, published at EPD International.

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 13108-3:2016 Bituminous mixtures – Material specifications – Part 3: Soft Asphalt

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 |
|---|---|
| 2021-08-17 | Original version |
| 2022-02-18 | Editorial changes |