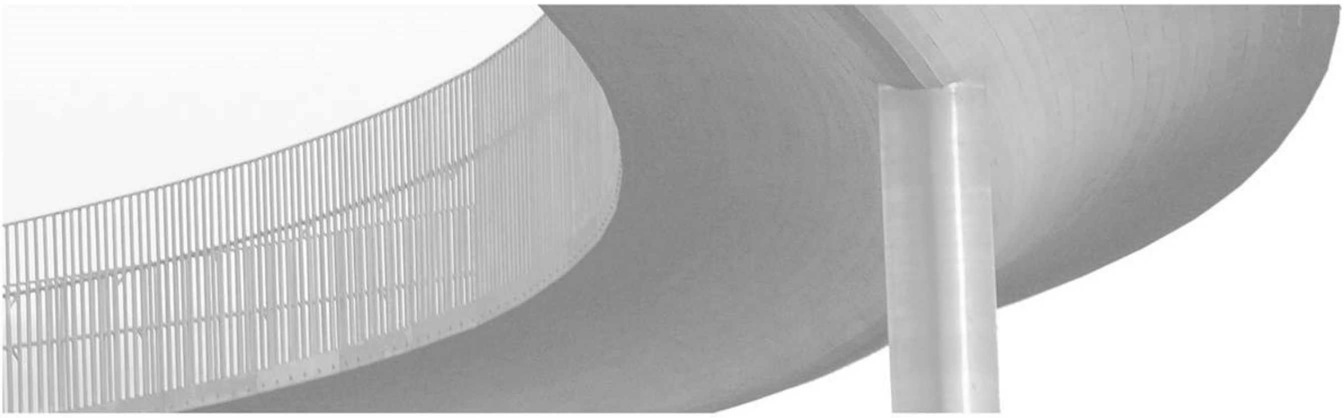
BRIDGES IN A CIRCULAR ECONOMY

Status report 2

08.11.2022



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EXTRACT

This report has provided information on how circular thinking can influence the design of bridges. The principles of circular economy have been outlined, the circular design strategies identified, and circular design actions have been introduced. There is a clear requirement to push circular economy higher up the agenda in the construction industry as the principles (eliminate waste and pollution, re-use and longevity, and protecting nature) go hand-in-hand with the Icelandic national ambitions to cut greenhouse gas emissions by 40% by 2030 under the Paris Agreement.

Methods from the Netherlands, which is a world leader when it comes to the circular economy, have been used to assess the circularity of two footbridge alternatives with respect to the overall goals of material availability and protecting the environment. A steel footbridge performed better in terms of material resource protection but adversely in terms of environmental protection/environmental costs, in comparison to a concrete footbridge at the same location.

This circularity assessment has informed on how circularity can be improved. A ‘Circular Design Framework for Bridges’ has been drawn up. It builds on a Circular Buildings Toolkit by adopting the same circular design strategies. The framework consists of 42 design actions aimed at improving bridge circularity. The actions have been prioritised, and it is the view of the authors that some of the design actions can be implemented immediately. A follow-up to the project will support this implementation, in close dialogue with bridge owners..

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SUMMARY

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1 INTRODUCTION

1.1 Background

The construction industry is estimated to be responsible for 40% of carbon emissions worldwide [1]. This is a large percentage, and it is therefore clear that ambitions like the Icelandic government commitment for a 55% reduction in carbon emissions by 2030 [2] will not be honoured without contributions from the construction sector. Furthermore, the construction sector is responsible for over 35% of the EU´s total waste generation [3].

From the above figures the requirement to reduce the environmental impact from the built environment is clear. The construction industry is subjected to the same requirements as the rest of the world when it comes to for example reduction in carbon emissions and meeting net zero targets.

The simple schematic in the figure below illustrates an encouragement to engineers to follow the hierarchy shown to maximize sustainability improvements in their projects.

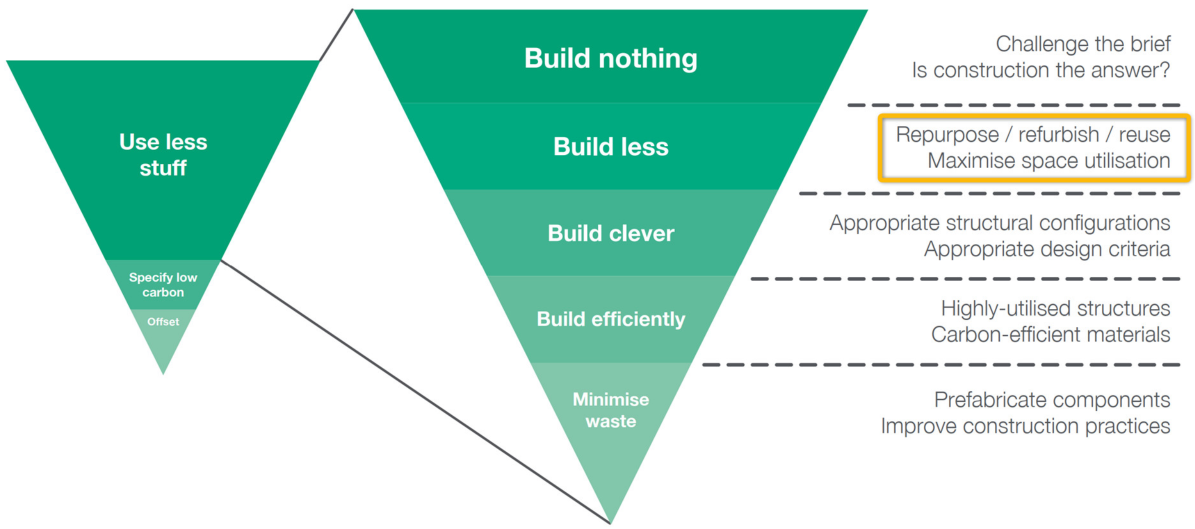


FIGURE 1: Recommended hierarchy for sustainable decision making in the construction industry [4]

It is recognized that re-use of existing structures and structural components is a highly effective approach to improving sustainability, but at the same time strategies that enable such improvements are not in place.

The circular economy is a framework that tackles global challenges like climate change, biodiversity loss, waste production, and environmental pollution. In our current economy, we take materials from the Earth, make products from them, and eventually throw them away as waste – the process is linear.

The circular economy is based on three principles as defined by the Ellen MacArthur foundation [5]:

1. Eliminate waste and pollution

   The first principle of the circular economy is to eliminate waste and pollution. Currently, our economy works in a take-make-waste system. Much of this waste ends up in landfills or incinerators and is lost. This system cannot work in the long term because the resources on our planet are finite.

2. Circulate products and materials (at their highest value)

   The second principle of the circular economy is to circulate products and materials at their highest value. This means keeping materials in use, either as a product or, when that can no longer be used, as components or raw materials. This way, nothing becomes waste and the intrinsic value of products and materials are retained.

3. Regenerate nature

   The third principle of the circular economy is to regenerate nature. By moving from a take-make-waste linear economy to a circular economy, we support natural processes and leave more room for nature to thrive. We employ farming practises that allow nature to rebuild soils and increase biodiversity and return biological materials to the earth. Currently, most of these materials are lost after use and the land used to grow them is depleted of nutrients.

The circular economy is underpinned by a transition to renewable energy and materials. A circular economy decouples economic activity from the consumption of finite resources. It is a resilient system that is good for business, people, and the environment.

Establishing a circular economy calls for a change in existing systems and policies that are set up for the current linear economy. This will affect the construction sector since an adapted approach to manufacturing, procurement, design, and construction would have to be initiated, but it would lead to better utilisation of materials.

1.2 Research context

Building on review work done in the first phase of this project [6], this phase of the project will further outline how the concept of a circular economy can be implemented in bridge projects. The research focus is on two areas:

1. Measuring circularity of bridge alternatives of different materials, using two main goals of a circular economy a) protection of material availability (MCI) and b) protection of environmental boundaries (ECI).
2. Defining "Circular design actions", a list of measures that can be taken by infrastructure owners and designers to improve sustainability of bridge designs. This list references the evaluation done in item 1.

1.2.1 Measuring circularity

Methods for measuring circularity properties have been developed and presented as circularity performance indicators, measuring how well or poorly a structure or a part of a structure fits into a circular economy. The Ellen MacArthur Foundation developed a Material Circularity Indicator (MCI) which has since been used as a model for comparable indicators aimed at estimating the circularity properties of structures [7]. Most of this work focuses on buildings, but there are also examples of these being adapted to bridge design [8] [9].

Today, there is no single agreed indicator for evaluating circularity properties for either buildings or bridges. It is not straightforward to make a numerical assessment of circularity, as many factors must be considered and reaching a consensus on the underlying methodology is challenging. The Netherlands has set very ambitious targets for the transition to a circular economy, covering the construction sector, amongst various other things. In this project an approach that originates in the Netherlands is used as a guidance and for assessing circularity of bridge designs as shown in Chapter 2 below.

1.2.2 Circular design

As well as an adapted framework, circular design is key to improve resource efficiency and reduce waste in the construction industry. It is important to think about circularity from the early stages of design and look to the entire life cycle to the point.

There are many strategies to consider in design to improve the circular performance. For example; to reduce the demand for raw materials, it is more important to reuse than to recycle to keep the value of the product at a maximum for as long as possible. This is reflected in **FIGURE 1**. When it comes to implementing circularity in the design of structures, ten design strategies, based on the work done for the Circular Buildings Toolkit [10], have been outlined:

1. Refuse unnecessary new construction
2. Increase intensity of use
3. Design for Longevity
4. Design for Adaptability
5. Design for Disassembly
6. Refuse unnecessary components
7. Increase material efficiency
8. Reduce the use of virgin materials
9. Reduce the use of carbon intensive materials

10. Design out hazardous/pollutant materials

Within the current research, design actions for bridges that support each of these strategies have been drawn up. These design actions are discussed in Chapter 5.

They build on a similar strategy adopted for buildings, embodied in the Circular Buildings Toolkit (CBT) [10], developed by Arup, in partnership with the Ellen MacArthur Foundation. One of the main obstacles to systematic circularity assessments have been that designers, owners and others involved in civil engineering have not had a basis or methodology to implement circularity in the design of structures. The tool aims to provide a framework with circular strategies, actions and case studies needed to implement circular design principles and thereby futureproofing the design. It includes workshop content that gives design teams the ability to familiarize themselves with the subject in the context of each project at any given time. The Circular Design Strategies and accompanying procedures guide the assessment and shift workshop ideas to actionable project measures and drive real change. In addition, it contains references to various solutions and previous research. For each of the strategies, a performance indicator is set out to be able to quantitatively assess the results of the actions.

FIGURE 2: Circular Buildings Toolkit strategies [10]

This work has so far been aimed at buildings and although there are many similarities between buildings and bridge structures, there is a need to adapt such work specifically to bridges.

1.3 Aims of the research

1.3.1 Overall aim

The Environment Agency of Iceland [11] defines circular economy as "an economy that seeks to prevent resources from becoming waste, with a focus on ensuring that valuable resources can be maintained for as long as possible. The aim is to minimise resource use and thus waste generation". The creation of guidelines and the definition of criteria or performance indicators are an important step in the development of systems that do not exist today and public bodies such as The Icelandic Road and Coastal Administration (IRCA) are responsible for leading by example. In this way, the project fits in with the objectives of the Research Fund for 2022 by acquiring new knowledge and focusing on the sustainability and environmental impact of bridge infrastructure. The project supports the role that IRCA has to provide sustainable transport systems.

1.3.2 Knowledge transfer

A prerequisite for introducing the circularity concept to Icelandic bridge projects is cooperation, knowledge transfer and dissemination of solutions between different actors. Determined efforts are necessary to shift focus in both design and material use. Such cooperation can lead to the identification of existing opportunities and obstacles and can lead to the creation of new knowledge. One of the objectives of the project is knowledge sharing and international cooperation that can influence the design and operation of bridges in Iceland.

1.3.3 Case study circularity assessment

An approach to circularity assessment originating in the Netherlands is applied for comparison of bridge alternatives to i) identify areas where circularity of bridge design can be improved most effectively, ii) for general evaluation of different bridge materials with respect to circularity, iii) highlight an assessment method that can be used as input and guidance for bridge design in Iceland.

2 DUTCH APPROACH TO CIRCULARITY

The Netherlands has set very ambitious targets for the transition to a circular economy. On a nationwide level, the goal is for the Dutch economy to be completely circular by 2050, and by 2030 the consumption of primary raw materials should have been reduced by half from 2016 [12]. These goals are linked to international goals that the Netherlands is committed to, including the 2030 Sustainable Development Goals and the Paris Agreement on climate.

2.1 Rijkswaterstaat directive

Rijkswaterstaat (RWS) is the executive agency of the Ministry of Infrastructure and Water Management, dedicated to promoting safety, mobility and the quality of life in the Netherlands. RWS follows the national target of being circular by 2050 and has added that it wants to work in a circular way by 2030. Working circularly in 2030 is an important intermediate step towards being circular in 2050. The difference between this is internal and external to RWS. RWS itself can influence its processes to become circular in 2030 and thus to work in a circular way. To be circular, it is also necessary for the rest of the chain (including contractors, suppliers and producers) to work in a circular way.

By 2030, RWS will be working in a circular manner in its execution and business operations to achieve three goals:

- Preserving and restoring the environment (including climate (CO_2), pollution and biodiversity).
- Retention and creation of value of objects, components, and materials.
- Protection of material stocks (security of supply)

Circular work is necessary to achieve the objectives of the Paris Climate Agreement and the government-wide programme Netherlands Circular in 2050. By working in a circular way, RWS ensures that objects, parts, and materials remain in the cycle for as long as possible, and last for several life cycles. They do this by:

- Maintaining existing roads, locks, buildings, etc. for as long as possible through optimal management, maintenance, and renovation (circular management and maintenance).

- Grounding renovation, replacement and new construction on circular design principles right from the exploration phase and in the subsequent phases.
- Reuse or recycle objects, components and materials that are recovered to a high value (high-quality re-use and high-quality recycling).

As an example, together with partners from the Netherlands, RWS built the first circular concrete bridge in the Netherlands in 2019, for the Reevesluis project. This bridge is circular in that there is no waste, through reuse no new raw materials are required and used raw materials are put to new use in the most high-value way possible [13]. The experiences gained in building the first circular bridge are used to move the development of circular bridges further, together with the market parties. Rijkswaterstaat does that with the Strategic Business Innovation Research (SBIR) procurement and funding method.

2.2 Platform CB’23

The Netherlands is transitioning to a circular economy as outlined above. This transition also applies to the construction sector. The objectives for this are set out in the Circular Construction Economy Transition Agenda and the associated Implementation Programme [14]. One thing is clear: 'circular' is currently one of the main themes in society, both in the construction sector and elsewhere.

The circular economy is a way to reduce the global consumption of raw materials and reduce waste production. It thus contributes to the integrated sustainability task the world faces: preventing climate change, loss of biodiversity and overburdening the planet. This calls for a change to current systems, which are based on a linear economy. This may have a number of consequences for the construction sector including more and better reuse of construction -materials, -products and -elements and a different approach to the production, procurement, design and implementation of construction projects.

Platform CB’23 (Circular Construction 2023) is committed to drafting some or all of these agreements for the entire Dutch construction sector: both residential and non-residential construction and civil engineering. Multidisciplinary teams consisting of professionals from different parts of the Dutch construction sector, have laid a solid basis for agreements on important circular topics. At this stage, they essentially are working agreements, laid down in guidelines, rather than formal standards.

In working towards a circular construction economy, Platform CB'23 sees the need for unambiguous agreements. The guideline 'Measuring circularity in the construction sector' [15] and 'Passports for the construction sector' [16] have been drawn up for the topics Measuring Circularity and Information and Data. Circular design and Circular procurement are the next topics Platform CB'23 is creating guidelines about.

2.2.1 Goals

The guideline 'Measuring circularity in the construction sector' focuses on the following three goals, which apply to the built environment, including bridges:

A. Protecting material resources.

Protecting material resources means making sure that material resources are not depleted so that they can continue to be used.

B. Protecting the environment.

Protecting the environment means ensuring that the living environment for people and animals remains of a good quality.

C. Protecting existing value.

Protecting existing value means that objects and parts of objects are preserved for as long as possible, remain of the best possible quality and continue to be used in the best possible way. This applies to the first life cycle of an object or part of an object, but also to reuse/recycling in subsequent cycles.

The core measurement method measures the performance with respect to the three goals and thus consists of impact indicators. Impact indicators differ from process indicators, which are sometimes also used to measure circularity. The two types of indicators differ as follows:

- Process indicators measure the extent to which circular strategies are applied and adhered to
- Impact indicators measure the effect of these strategies.

The advantage of impact indicators is that for each specific action the effect on the three key objectives of circularity can be measured.

The impact of circular strategies can only be determined by looking at the entire life cycle. After all, different circular strategies have an impact on the three core objectives at different points in the life cycle. The entire life cycle is therefore a conceptual starting point for the core measurement method. Two examples illustrate how circular strategies can have an impact across the lifecycle. Adaptive Construction (example 1) may require a greater investment of materials in its initial realisation but can thus save additional material use in renovation. In an initiative where a light construction is chosen, material savings are made right at the implementation stage (example 2). Material efficient structures may save precious materials in their initial realisation but will make renovation or reuse in the future very hard. Hence a whole life analyses is necessary to balance the effects in the now with those in the future.

To measure circular impact, it is customary to look at material flows. This is also the starting point for the core measurement method. There are two types of material flows:

- Input streams: These include all the materials used to make, repair, and modify the object within its life cycle. These can be both primary and secondary materials.
- Output streams: This is the material from an object that leaves the object at the end of its life cycle or within it. This may involve material that can be reused or recycled, but also material that is lost.

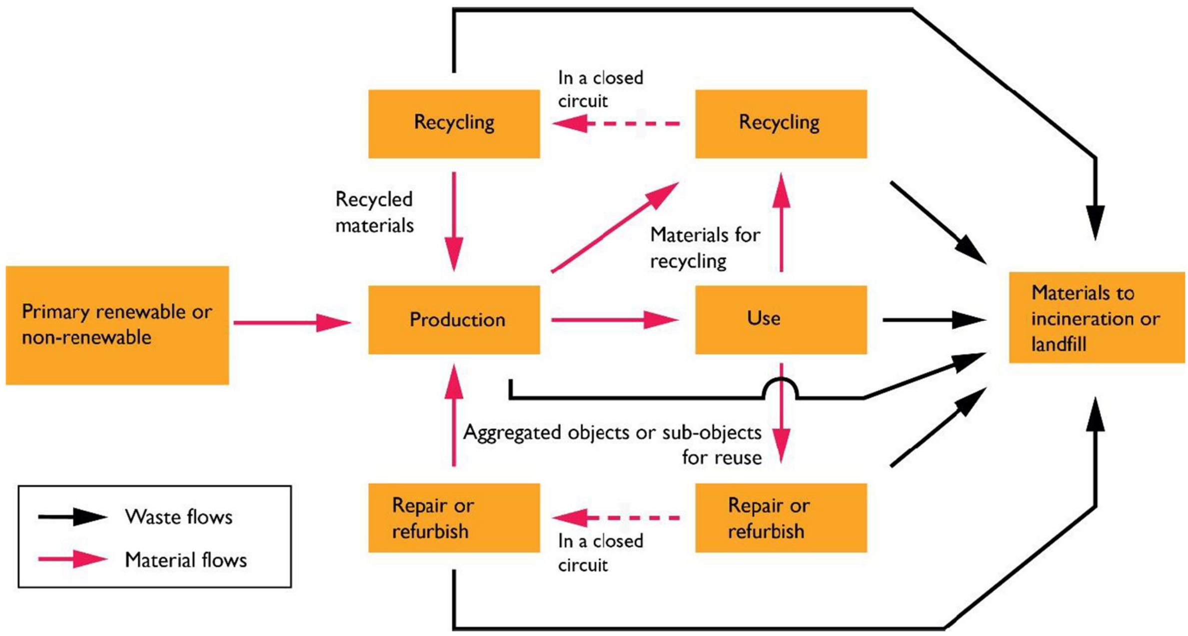


FIGURE 3: Material flow analysis [17]

2.2.2 Measurement of circularity

Referring to the goals outlined in chapter 2.2.1, a measurement strategy has been set. For measuring circularity with respect to the three goals the following performance indicators need to be quantified:

A. Protecting material resources
    1. Quantity of material used (input)
    2. Amount of material available for next cycle (output)
    3. Amount of material lost (output)

B. Protecting the environment
    4. Impact on the environment

C. Protecting existing value
    5. Amount of initial value (input)
    6. Amount of value available for next cycle (output)
    7. Amount of existing value lost (output)

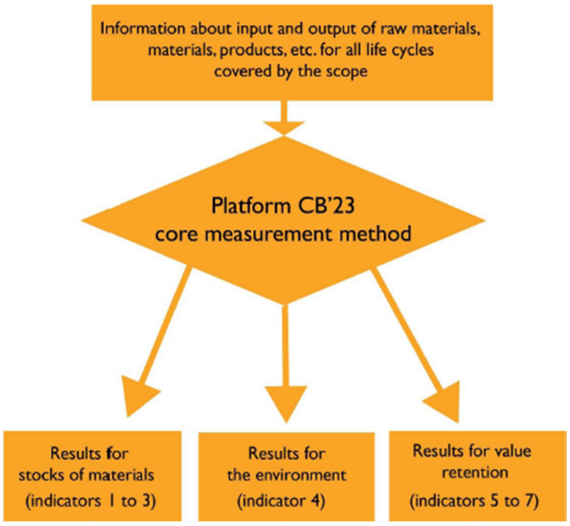


FIGURE 4: Visualisation of circularity measurement [17]

Goal A: Protecting material resources

The core indicators for the protection of environment largely correspond to the material balance from an environmental life cycle analysis (LCA). However, the method of determining the indicators has been adjusted to make the indicators suitable for measuring circularity.

1. The quantity of materials used (input)

1.1 The quantity of primary materials

1.2 The quantity of secondary materials

1.3 The quantity of physically scarce materials

1.4 The quantity of socio-economically scarce and abundant raw materials used

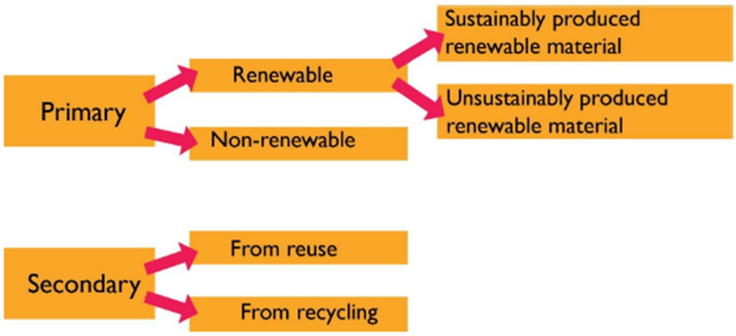


FIGURE 5: Relationships between indicator 1 and sub-indicators 1.1 and 1.2 [17]

2. The quantity of materials available for the next cycle (output)

2.1 The quantity of end-of-life materials available for reuse

2.2 The quantity of end-of-life materials available for recycling

3. The quantity of materials lost (output)

3.1 The quantity of end-of-life materials used for energy production

3.2 The quantity of end-of-life materials sent to landfill

Goal B: Protecting the environment

For the indicators of environmental protection, the environmental impact categories from the Dutch SBK assessment method have been adopted. These categories are based on the European Life Cycle Assessment (LCA) method for construction, EN 15804.

4. Environmental Impact

4.1 Climate change – overall
4.2 Climate change – fossil
4.3 Climate change – biogenic
4.4 Climate change – use of land and changes in use of land
4.5 Ozone depletion
4.6 Acidification
4.7 Eutrophication - freshwater
4.8 Eutrophication - seawater
4.9 Over-fertilisation - soil
4.10 Occurrence of smog
4.11 Depletion of abiotic raw materials - minerals and metals
4.12 Depletion of abiotic raw materials – fossil energy carriers
4.13 Use of water
4.14 Emission of particulate matter
4.15 Ionising radiation
4.16 Ecotoxicity (freshwater)

4.17 Human toxicity, carcinogenic

4.18 Human toxicity, non-carcinogenic

4.19 Impact/Soil quality related to the use of land

For simplification it is an option to exclude some of these 19 categories from the measurements.

Goal C: Protecting of value

For the indicators for the protection of existing value, no existing measurement methods are available. Development of indicators for this goal is underway, and they will be based on subdividing the value assessment to technical-functional value and economic value.

5. The quantity of initial value (input)

5.1 Techno-functional value

5.2 Economic value

6. The quantity of value available for the next cycle (output)

6.1 Techno-functional value

6.2 Economic value

7. The quantity of existing value lost (output)

7.1 Techno-functional value

7.2 Economic value

2.2.3 Report on Adaptability

In addition to the indicators, a report on adaptability is also part of the core measurement method. Adaptability is the degree to which a building or product can meet changing needs. Adaptability reporting helps to calculate input and output flows of materials during the current life cycle (as Adaptability affects maintenance/replacement) and in subsequent life cycles (as Adaptability affects transformation to another function/location).

2.2.4 Data

Data collection is not part of the core measurement method. The user is free to search for the required data in the available sources. To measure the degree of circularity using the core measurement method, all incoming and outgoing material flows (realised and expected) must be inventoried. All these flows are assigned properties: they are given 'labels'. This creates a detailed material balance. In the inventory phase of the core measurement method, the following information is collected:

- Materials used (including in sub-objects) in all life cycle stages, together with the following details for each material;
  - quantity in kilograms;

- scarce/abundant in the list of Critical Raw Materials (CRM, see European Commission, 2017);
- physically scarce/physically abundant determined according to NEN-EN 15804:2012+A2:2019 (abiotic depletion potential, ADP);
- primary/secondary;
  - if secondary: reuse/recycling;
  - if primary: sustainably renewable/non-sustainably renewable;
- most probable end-of-life treatment: available for the next cycle/not available for the next cycle;
  - if available for the next cycle: reuse/recycling;
  - if not available for the next cycle: energy production/landfill.

- Materials which are consumed but do not end up in the object or sub-object and which are not production waste (see paragraph 5.1) for calculating the environmental impacts;
- Emissions into the soil, air and water for calculating the environmental impacts;
- Costs and benefits per life cycle phase, according to Standaard Systematiek voor Kostenramingen (Standard Cost Estimation System - SKK) for civil engineering objects or sub-objects and according to NEN 2699 or NEN-ISO 15686-5 for objects or sub-objects in the buildings sector;
- Information on the adaptability potential of the structure, including information on the detachability of sub-objects;
- Estimated service life of objects or sub-objects (per sub-object). The SBK method (Stichting Bouwkwaliteit) can be used for structures. A substantiated design service life can also be used.

The more is known about the design, the more detailed the data can become. In order to make the type of data used unambiguously transparent, the core measurement method distinguishes four detail levels for data:

- Detail level 1: Material is known (for example: wood).
- Detail level 2: Product is known in outline (for example: beam/leafwood; oak).
- Detail level 3: Product is known in detail (for example: beam/dimensions/ leafwood; oak /fire resistance/recycling info).
- Detail level 4: Product is known, including producer and supplier data (specific data).

2.3 National bridge bank

As an important step to realistically facilitate the reuse use of bridges and bridge components, the cities of Amsterdam and Rotterdam together with Rijkswaterstaat and the Bruggenstichting (Dutch Bridge Foundation) are establishing an independent platform for exchange and future use of bridges.

The initiative is compatible with the above-mentioned goals of the Dutch government of reaching climate neutrality and to establish a circular economy by 2050.

The Dutch Bridge Foundation manages the platform for this initiative [18].

3 CALCULATING CIRCULARITY

The previous chapters have introduced both the Arup and Ellen MacArthur Foundation developed Circular Building Toolkit and Dutch Platform CB'23 strategy, which defines an assessment methodology with respect to overall goals, see 2.2.1. In this project two of the three main goals are considered, i.e. protection of material resources and protection of environmental boundaries[1].

This chapter defines in more detail how these methods combine and are set up for an assessment of circularity.

3.1 CE Dashboard - introduction

Arup has developed a "CE dashboard", which is based on the CB'23 methodology. The primary purpose of the dashboard is to compare alternatives for circular design. The results can be used to recognize the materials and/or components that have the largest impact on the circularity, as well as solving possible conflicts regarding the project.

The input data required for the CE dashboard calculation is categorized into two Excel files. The first file is denoted as the CE database and consists of data for each material used in the project. The data is used to define the performance of materials relating to the main goals mentioned previously. The second sheet is used to capture the bill of quantities of design alternatives up for comparison.

The results from the dashboard are represented graphically, see example below.

[1] As mentioned in chapter 2.2.2, no indicators for the third goal, protection of existing value, are currently in general use although they are under advanced development.

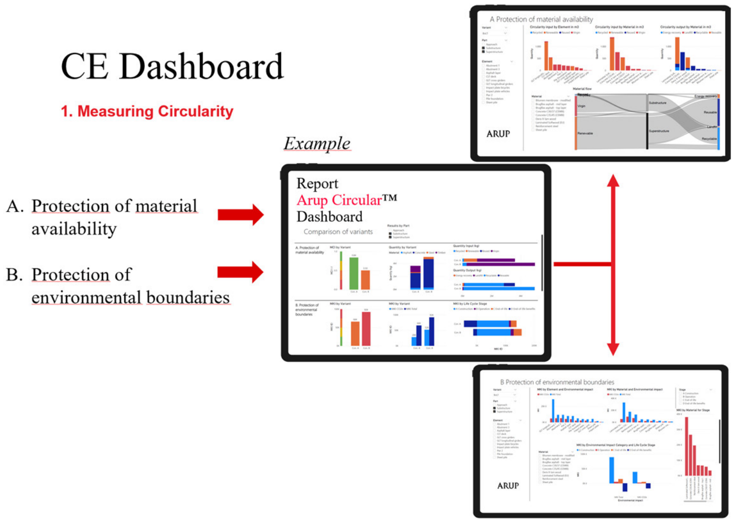
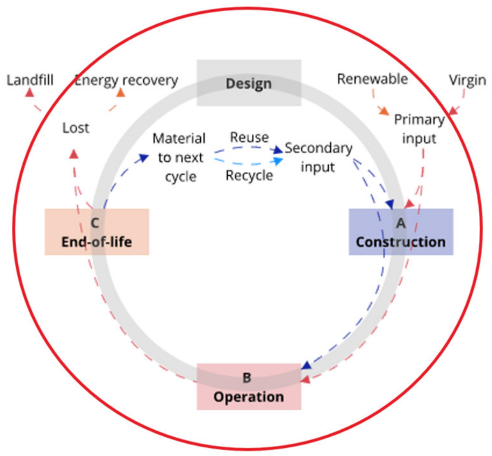


FIGURE 6: An example for graphic representation of results from the Arup CE Dashboard

3.2 Protection of material resources – Material Circularity Indicator (MCI)

The protection of material resources goal is assessed based on the indicators as mentioned in the CB'23 methodology. The MCI (material circularity indicator) value is used to capture the total performance in a single criterion. The MCI value is calculated as a function of the proportion of primary versus secondary material input at the construction stage as well as the proportion of materials that continue to the next cycle versus the material that is lost at the end-of-life phase. An MCI value of 1,0 corresponds to a structure or component life cycle that is 100% circular, i.e., no virgin material is used, and no material goes to waste [7].



Indicator	Description
1. QUANTITY OF USED MATERIAL (INPUT)	
1.1 Quantity of primary material	Use of material produced from primary resources
1.2 Quantity of secondary material	Use of material from previous use or residual from other system

Indicator	Description
2. QUANTITY OF MATERIAL AVAILABLE FOR NEXT CYCLE (OUTPUT)	
2.1 Quantity of material for reuse	Extend to which reuse of material is a realistic next cycle scenario
1.2 Quantity of material for recycling	Extend to which recycling of material is a realistic next cycle scenario
3. QUANTITY OF LOST MATERIAL (OUTPUT)	
3.1 Quantity of material for energy recovery	Extend to which burning of material for energy recovery is the most realistic end-of-life scenario
3.2 Quantity of material going to landfill	Extend to which the loss of material to landfill is the most realistic end-of-life scenario

FIGURE 7: Schematic illustration of quantified components in evaluation of MCI

The gray circle in the image above represents the boundary of a fully circular construction; if a structure requires input from outside the circle, or materials exit the circle during or at the end of the service life, the MCI value will be less than 1,0.

3.3 Protection of environmental boundaries – Environmental Cost Indicator (ECI)

Performance with respect to the protection of environmental boundaries goal is assessed using ECI, Environmental Cost Indicator [19], (in Dutch known as Milieu Kosten Indicator (MKI). This indicator unites relevant environmental impacts into a single environmental cost. The idea behind the indicator originates from EN15804. In the Netherlands it is also used in tender procedures as it monetizes environmental costs based on shadow-prices to a single criterion. By awarding a virtual reduction for offers with a better (lower) ECI, the market is encouraged to develop and offer alternatives of improved circularity [20]. In other cases, ECI values also serve as thresholds, where maximum ECI values are incorporated into contract requirements so that offers with a bad environmental performance automatically get rejected.

Calculation of ECI is interlinked with Life Cycle Assessment, and the same steps are taken in both, i.e.

1. Collection of data on raw materials, semifinished products, processes, and energy used in the product or process analysed.
2. Calculation of emissions these inputs cause – for example, CO_2, PO_4^{3-}, and NOx.
3. Characterisation of the emission data into Impact Categories such as climate change (GWP).

FIGURE 8: The connection between circularity, LCA and Environmental Costs (ECI) [19]

In the calculation of ECI, the emissions are converted to a score for each category, using models that consider the emissions to air, water, and soil, and several substance properties such as biodegradability, volatility, solubility, toxic mechanisms, and more.

To create a single, comparable number (the ECI), these scores are then weighted and merged using a 'shadow-price method', where the shadow price is defined as the cost level acceptable for a regulatory authority or national government per unit of emission (prevention costs) [19].

Of all the EN 15804 environmental impact categories listed under Goal B in 2.2.2, only the categories listed in the table below are considered in this project, since the full list is generally not supplied with the Environmental Product Declarations (EPDs) that are used both for the ECI calculations here, and more commonly as input to Life Cycle Assessments. The shadow prices are sourced from [21].

TABLE 1 Weighing factors or shadow-price for ECI calculation

ENVIRONMENTAL IMPACT CATEGORY	UNIT	WEIGHING FACTOR OR SHADOW PRICE [€/KG EQUIVALENT]
Global warming potential	kg CO_2e	0,05
Ozone layer depletion	kg CFC11e	30
Acidification	kg SO_2e	4
Eutrophication	kg PO_4e	9
Photochemical oxidant creation, smog	kg C_2H_4e	2
Depletion of abiotic resources	kg Sbe	0,16

4 CASE STUDY – MJØLAN FOOTBRIDGE, MO I RANA

The EFLA designed Mjølan footbridge in Mo i Rana in Norway has been chosen as the subject of the case study as a pre-design for this bridge considered two alternatives, a steel girder bridge, which was selected for construction, and a post-tensioned concrete girder bridge. Quantities and materials for the two alternatives were therefore available, making it feasible to conduct a comparison between the two in terms of the circularity measurements presented above.

4.1 The Mjølan footbridge

The new footbridge at Mjølan in the town of Mo i Rana, Norway opened in 2019. It improves access to the Arctic Circle High School, next to the Fv810 access road into the town from the north.

FIGURE 9: Location of the Mjølan footbridge

The bridge as-built is a curved steel girder, 106 m long in six spans, see bridge elevation below.

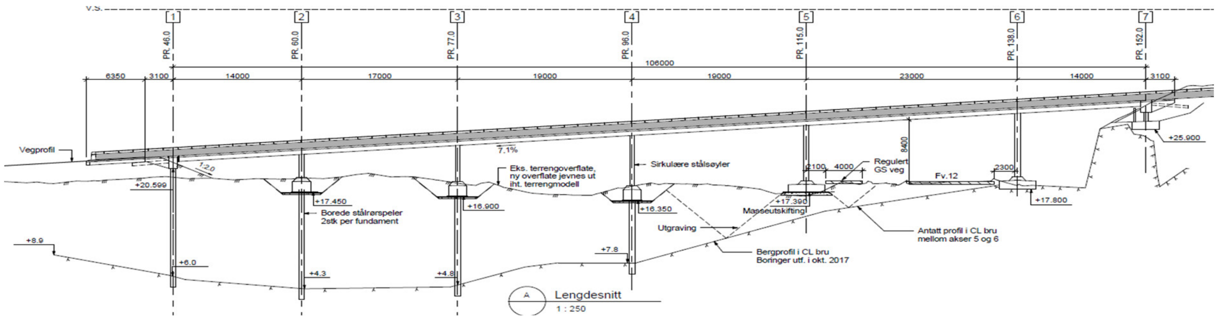


FIGURE 10: Mjølan footbridge elevation

The figures below show the as-built steel girder bridge, and the Breiðholtsbraut footbridge, which was used as a reference in the Mjølan footbridge pre-design for comparison with the steel girder bridge alternative.

FIGURE 11: Mjølan footbridge as built

FIGURE 12: Breiðholtsbraut footbridge, a reference in comparison to a steel girder in the Mjølan footbridge pre-design

In the pre-design, the steel girder was eventually selected based on more favourable HS&E and a shorter period of traffic disruptions associated with that alternative compared to the post-tensioned concrete girder that would have been cast in-situ.

4.2 Quantities – Both bridge alternatives

The tables below show the quantities that were used for circularity measurements of the two bridge alternatives.

TABLE 2 Material quantities for both bridge alternatives

Material	Component	Producer EPD	Quantity steel bridge	Quantity concrete bridge	Unit
Hollow steel section	Piles	Mannesmann	20,5	20,5	tonne
Concrete B45 SV Standard	Piles	Sunnfjord Betong	32	32	m3
Reinforcement steel	Piles	Kamstål AS	6	6	tonne
Lumber formwork	Pile caps	Moelven AS	14	14	m3
Reinforcement steel	Pile caps	Kamstål AS	14	14	tonne
Concrete B45 SV Standard	Pile caps	Sunnfjord Betong	124	124	m3
Hollow steel section	Piers	Mannesmann	9,3	9,3	tonne
Metallic zinc rich Epoxy primer	Piers	International Interzinc	110	110	m2
Polyuerthane topcoat	Piers	International Interthane	60	60	m2
Reinforcement steel	Piers	Kamstål AS		7	tonne
Concrete B45 SV Standard	Piers	Sunnfjord Betong		7	m3
Hot rolled stainless steel plates	Superstructure	Norsk stål	15,5		tonne
Hot rolled mild steel plates	Superstructure	SSAB	48		tonne
Hollow steel section	Superstructure	Mannesmann	31		tonne
Metallic zinc rich Epoxy primer	Superstructure	International Interzinc	900		m2
Polyuerthane topcoat	Superstructure	International Interthane	1100		m2
Reinforcement steel	Superstructure	Kamstål AS		31	tonne
Lumber formwork	Superstructure	Moelven AS		40	m3
Concrete B45 SV Standard	Superstructure	Sunnfjord Betong		153	m3
Permanent Strand Anchor	Superstructure	Dywidag		6	tonne
Hot rolled stainless steel tubes	Superstr. parapet	Outokumpu	4,8	4,8	tonne
Wire mesh (stainless steel)	Superstr. parapet	Outokumpu	0,2	0,2	tonne
Asphalt	Superstr. surfacing	Vandle (NCC)	32	32	tonne
Epoxy-based coating	Superstr. surfacing	Drizoro	320	320	m2

Piles and pile foundations are the same for both. The foundation design is largely dictated by horizontal actions from accidental collisions on the piers and thermal loading.

The circular hollow columns would have been filled with concrete in the concrete alternative.

The steel superstructure is partly made of stainless steel plating as there is a requirement in the Norwegian regulations that edge girders are stainless.

The parapets and the surfacing on the bridge deck are assumed to be the same for both alternatives.

The table also shows which bridge component each material is used for, in many cases the same material is used for more than one bridge component.

The source of the Environmental Product Declarations is also listed in the table.

4.3 MCI calculations – Goal: Protection of material resources

TABLE 3 below shows the input assumptions used in calculation of the Material Circularity Indicator for each construction material, and the calculated MCIs.

Based on the inputs for the material sources (Primary Renewable, Primary Virgin, Secondary Reused and Secondary Recycled) and the assumptions for the end-of-life phase (Reusable, Recyclable, Energy recovery, Landfill) in Norway, the MCI is calculated in a spreadsheet.

As expected, the calculated circularity indicators are lowest for coatings such as metallisation, paint and waterproofing. Concrete for bridge such as this is not particularly circular, but steel can be regarded to be a bit favourable in terms of circularity, main due to the potential for recycling.

TABLE 3 Calculation of MCI based on input data for each material

	A. Protection of material resources								
	Input				Output				MCI
	A Construction				C End-of-life				
	Primary		Secondary		Next cycle		Lost		
Material	Renewable	Virgin	Reused	Recycled	Reusable	Recyclable	Energy recovery	Landfill	
Hollow steel section	0,00	0,80	0,00	0,2	0,05	0,92	0,00	0,03	0,63
Concrete B45 SV Standard	0,00	0,97	0,00	0,03	0,00	0,58	0,00	0,42	0,35
Reinforcement steel	0,00	0,13	0,00	0,87	0,00	0,97	0,00	0,03	0,88
Lumber formwork	1,00	0,00	0,00	0,00	0,00	0,05	0,94	0,01	0,54
Metallic zinc rich Epoxy primer	0,00	1,00	0,00	0,00	0,00	0,00	0,00	1,00	0,12
Polyuerthane topcoat	0,00	1,00	0,00	0,00	0,00	0,00	0,00	1,00	0,14
Hot rolled stainless steel plates	0,00	0,29	0,00	0,71	0,00	0,95	0,00	0,05	0,81
Hot rolled mild steel plates	0,00	0,96	0,00	0,04	0,00	0,98	0,00	0,02	0,53
Permanent Strand Anchor	0,00	0,87	0,00	0,13	0,00	0,97	0,00	0,03	0,60
Hot rolled stainless steel tubes	0,00	0,29	0,00	0,71	0,84	0,11	0,00	0,05	0,83
Wire mesh (stainless steel)	0,00	0,28	0,00	0,725	0,00	0,92	0,00	0,08	0,80
Asphalt	0,00	0,68	0,00	0,32	0,00	1,00	0,00	0,00	0,69
Epoxy-based coating	0,00	1,00	0,00	0,00	0,00	0,00	0,00	1,00	0,29

Using the quantities from **TABLE 2** and the values in **TABLE 3**, the CE dashboard has been used to calculate the overall MCI for both bridge alternatives, as well as the total type of input and output. The results are shown in **FIGURE 13**.

A. Protection of material availability

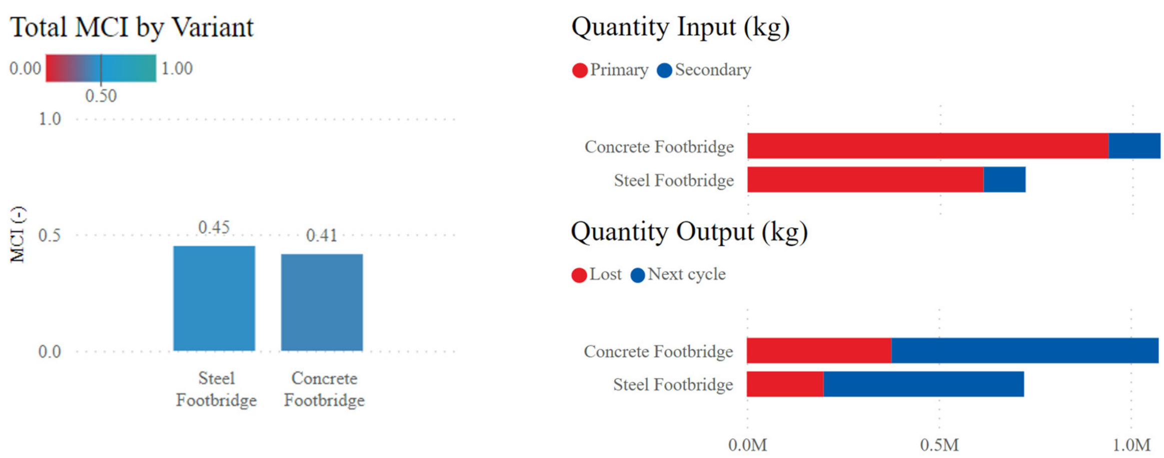


FIGURE 13: Material Circularity Indicator results for the steel and concrete bridge alternatives

In terms of protecting material resources, the MCI results slightly favour the steel bridge alternative because of the recycling potential of a steel deck compared to a concrete deck. The total material quantity used in a steel superstructure compared to concrete result in significantly less primary input of material and less lost material at end of life.

The tables below summarize the total split between primary and secondary materials in the inputs and recycling potential and waste/landfill in the outputs.

TABLE 4 Material flow for the bridge alternatives

Indicator	Description	Steel footbridge	Concrete footbridge
1. QUANTITY OF USED MATERIAL (INPUT)		**700 ton**	**1050 ton**
1.1 Quantity of primary material	Use of material produced from primary resources	85.0%	87.5%
1.2 Quantity of secondary material	Use of material from previous use or residual from other system		
	1.2.1 Quantity of secondary material reused	0.0%	0.0%
	1.2.2 Quantity of secondary material recycled	15.0%	12.5 %
Indicator	**Description**	**Steel footbridge**	**Concrete footbridge**
2. QUANTITY OF MATERIAL AVAILABLE FOR NEXT CYCLE (OUTPUT)		**200 ton**	**350 ton**
2.1 Quantity of material for reuse	Extend to which reuse of material is a realistic next cycle scenario	1.0%	0.5%
1.2 Quantity of material for recycling	Extend to which recycling of material is a realistic next cycle scenario	71.3%	64.4%
3. QUANTITY OF LOST MATERIAL (OUTPUT)		**500 ton**	**700 ton**
3.1 Quantity of material for energy recovery	Extend to which burning of material for energy recovery is the most realistic end-of-life scenario	0.9%	2.4%
3.2 Quantity of material going to landfill	Extend to which the loss of material to landfill is the most realistic end-of-life scenario	26.8%	32.7%

4.4 ECI calculations – Goal: Protection of environmental

The ECI calculations in the CE Dashboard combine the environmental shadow costs for the environmental impact categories in **TABLE 1** based on the unit shadow prices from the Dutch Nationale Mileudatabase [21] and the environmental impact for each bridge material as reported in the Environmental Product Declarations for the different materials.

TABLE 5 shows the calculated ECIs for each material, and each life cycle phase. The benefit costs that would be associated with end-of-life benefits (to a future project) are omitted from the CE Dashboard calculations and therefore greyed out in the table. The table also shows the ECIs for just the Global warming potential impact category, which is 70-95% of the total except for the surface treatment materials, where other categories are accountable for about half of the ECI.

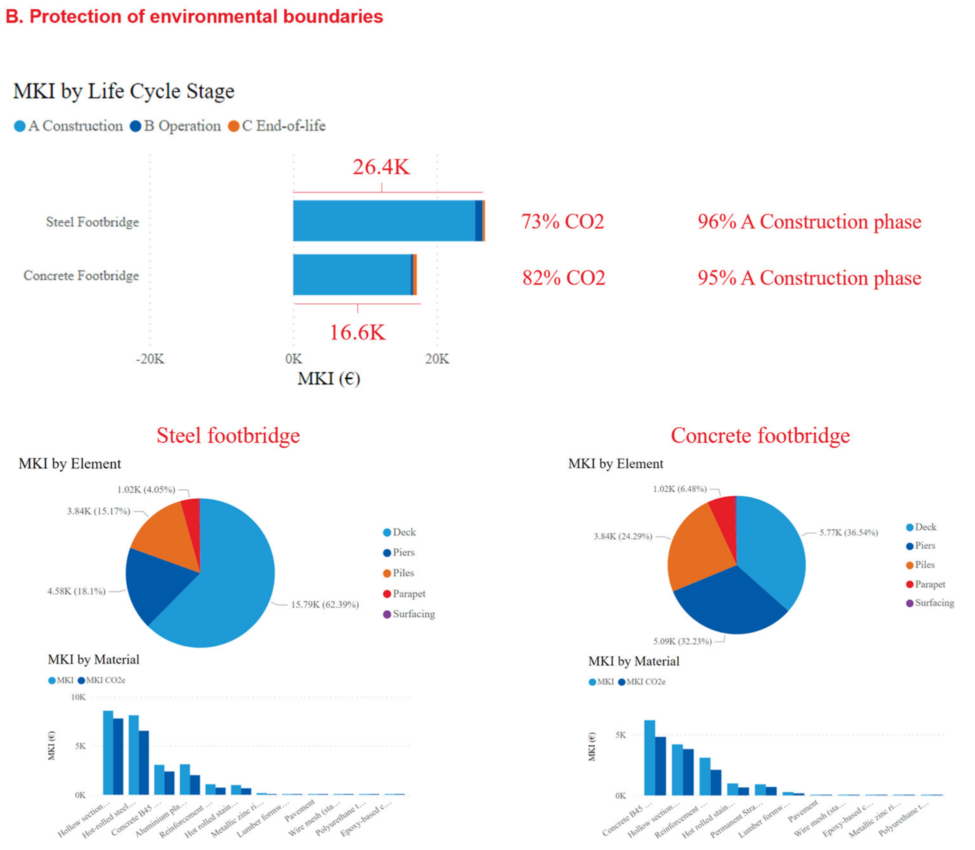
The calculations are done with reference to a 100-year service life for the bridges, since this is the benchmark lifespan of bridge designs both in Norway and in Iceland. Where the service life of components is shorter than 100 years, there is a ECI contribution from the B Operational phase of the life cycle. The values in the operational phase are related to the number of times a material/product needs to be replaced over the 100-yr life span.

For the A phase of the life cycle, the emissions from material extraction, transportation and production is included, since this data is reported producer EPDs. The ECIs from the C phase stem from waste processing of the materials, which is also reported in EPDs. Transportation to construction site, construction emissions and other operational activities are excluded.

TABLE 5 Environmental Cost Indicators for the bridge construction materials for each life cycle phase

		B. Protection of environmental boundaries								
		ECI								
		A Construction		B Operation		C End-of-life		D End-of-life benefits		
Material	Producer EPD	A ECI Total	A ECI CO2e	B ECI Total	B ECI CO2e	C ECI Total	C ECI CO2e	D ECI Total	D ECI CO2e	Service life (years)
Hollow steel section	Mannesmann	141,00	128,00	0,00	0,00	0,00	0,34	-89,00	-81,00	100
Concrete B45 SV Standard	Sunnfjord Betong	19,57	15,24	0,00	0,00	0,64	0,33	-1,80	-1,52	100
Reinforcement steel	Kamstål AS	53,55	36,34	0,00	0,00	0,07	0,04	-2,00	-1,44	100
Lumber formwork	Moelven AS	5,15	3,18	0,00	0,00	3,73	3,20	-21,51	-19,20	100
Metallic zinc rich Epoxy primer	International Interzinc	0,16	0,07	0,66	2,62	0,00	0,00	0,00	0,00	20
Polyurthane topcoat	International Interthane	0,04	0,02	0,15	0,08	0,00	0,00	0,00	0,00	20
Hot rolled stainless steel plates	Norsk stål	201,00	129,00	0,00	0,00	7,00	3,59	-63,00	-37,70	100
Hot rolled mild steel plates	SSAB	169,00	136,00	0,00	0,00	0,00	0,16	-90,00	-74,00	100
Permanent Strand Anchor	Dywidag	152,23	116,06	0,00	0,00	0,26	0,14	-14,32	-10,28	100
Hot rolled stainless steel tubes	Outokumpu	205,61	137,00	0,00	0,00	0,17	0,12	-94,13	-59,50	100
Wire mesh (stainless steel)	Outokumpu	184,30	170,10	184,30	170,10	0,13	0,08	-83,34	-54,90	50
Asphalt	Vandle (NCC)	1,33	1,15	5,30	4,60	1,45	1,30	-3,03	-2,50	20
Epoxy-based coating	Drizoro	0,09	0,09	0,19	0,18	0,00	0,00	0,00	0,00	40

The results from the CE Dashboard are shown in **FIGURE 14**. The calculated environmental costs are higher for the steel bridge. The difference between the two would be reduced if end-of-life benefits are included, because the recycling potential of steel is beneficial in reducing primary steel use in the future.



Indicator	Description	Steel footbridge	Concrete footbridge
4. ENVIRONMENTAL IMPACT			
4. Total	Total of environmental impact on combination of environmental impact categories	26.4K € (A-C) 14.8K € (A-D)	16.6K € (A-C) 11.5K € (A-D)
4.1 Climate change	Extend to which the material contributes to global warming	21.1K € (A-C)	13.0K € (A-C)

FIGURE 14: Environmental Cost Indicator for the steel and concrete bridge alternatives

4.5 Learnings from the case study

The overall Material Circularity Indicator scores of ≈0,4 for the two bridges are not high, i.e. these bridge alternatives as analysed are not a particularly good fit within a circular economy.

Carrying out the assessment has informed on how the scores could be improved. It is notable for the mild steel of the steel bridge that both the plating and the tubular elements are not produced from steels with high recycled content or made from used components. Similarly, the cement that was assumed for use in the concrete alternative did not have a high content of cement clinker replacement with recycled material. Use of reused steel or produced with higher recycled content would improve both the MCI and the ECI indicators.

The curved bridge alignment makes reuse of the primary components in the future challenging, because it would be difficult to find a suitable location with a similar need. Designing more with reuse in mind would also elevate both indicators, thereby improving circularity. This applies to both the steel and concrete bridge alternatives.

Procurement methods can make use of the calculated environmental costs. Normally this would not be with a 1 on 1 comparison between ECI and actual costs. An appropriate method needs to be identified for the Icelandic market.

5 CIRCULAR DESIGN ACTIONS FOR BRIDGES

Working with the Circular Economy Design Strategies outlined in chapter 1.2.2, and building on the definitions and developments that Arup have conducted in collaboration with the Ellen MacArthur Foundation, the authors have through workshops drafted a longlist of circular design actions for bridges, put forward in this report as a 'Circular Design Framework for Bridges'.

The Circular Design Strategies are listed with a reference to the 'Circular Buildings Toolkit' [10] in the table below.

TABLE 6 A recap of the Circular Economy Design Strategies

Key focus point	Circular Economy Design Strategies 1-10
Build Nothing	01. Refuse unnecessary new construction
Efficiently used assets	02. Increase intensity of use
Long-term value	03. Design for Longevity 04. Design for Adaptability 05. Design for Disassembly
Efficient use of materials	06. Refuse unnecessary components 07. Increase material efficiency 08. Reduce the use of virgin materials
The right materials	09. Reduce the use of carbon intensive materials 10. Design out hazardous/pollutant materials

The 'Circular Design Framework for Bridges' is in included as a table in Appendix C. It contains 42 design actions, and these have been classified to 1, 2 and 3:

1. Actions that should be prioritised now in Iceland
2. Actions that decision makers should bring up the agenda in next 5 years, and need to be underpinned now
3. Actions that lie outside the scope of bridge design projects

A suggested follow-up to the design actions is also included in the table. In summary, the following four steps, all classified as '1' in table, can be taken immediately.

- Make Life Cycle Assessments mandatory for bridges, and establish, legislate, and work with carbon emission targets.

- Make Life Cycle Cost Assessment mandatory for bridges, for comparison of bridge alternatives in concept studies and pre-design
- Implementing circular design strategies by using a checklist of circular design actions.
- Include relevant circular economy information in BIM modes that are produced in design and used by owner during the service life

All of these actions require bridge authorities to make the associated design steps mandatory, i.e. it needs to become a requirement to include LCA and LCCA in design, to use a circular checklist at the start of the design process, and to include service life focused parameters in BIM models.

For the follow up to this research project, the authors propose:

- To formulate the circular design actions checklist and the appropriate 'check' criteria for each action in the list. The circularity of bridge designs can undoubtedly be improved by designers applying such a checklist, particularly if it is applied with a workshop at the project start up where a longlist is tailored to a list of items that are most relevant to the individual project.
- To formulate a national methodology to measure circularity in bridge design. A uniform approach would create a fair playing field for all and accelerate change.
- To define in more detail, how the Environmental Costs Indicator can be used in procurement. Procurement is a strong tool for bridge owners to enable swift change.

Through other projects the authors will also support bridge owners in advancing BIM, LCC, LCA and carbon emission target setting.

6 SUMMARY AND DISCUSSION

This report provides information on how bridges can be assessed from a circular economy perspective. The principles of circular economy have been outlined and methods for transferring these principles to design strategies and to bridge design actions have been introduced. There is a clear requirement to push circular economy higher up the agenda in the construction industry as the principles (eliminate waste and pollution, re-use and longevity, and protecting nature) will help enable a climate neutral society and address the risk of scarce material availability.

The Netherlands are world leaders when it comes to the circular economy and have set noteworthy targets for the national economy in terms of circularity and material consumption. Rijkswaterstaat, the executive agency of the Ministry of Infrastructure and Water Management, is working from a clearly defined agenda, using systematic indicators for a climate neutral and circular sector, setting up targets and assessment frameworks. Such assessment is done with a view to improving asset performance with respect to three goals (protecting material resources, protecting the environment, and protecting value) that are aligned with the principles of circular economy.

As a case study, within this research a comparison between steel and concrete footbridge alternatives at a given location in Mo i Rana, Norway, has been conducted. The comparison is done based on the methodology co-created by Rijkswaterstaat in the Netherlands, and the tool that has been applied is aligned with that methodology.

In the circularity assessment of the two bridge alternatives, two key performance indicators are calculated.

- The Material Circularity Indicator (MCI) evaluates performance with respect to the key goal of protecting material resources. It is calculated as a function of the proportion of primary versus secondary material used at the construction stage as well as the proportion of materials that continue to the next cycle versus the material that is lost at end-of-life.
- The Environmental Cost Indicator (ECI). This indicator combines relevant environmental impacts into a single environmental cost and has been developed to encourage the market to develop and offer alternatives of improved environmental performance. The calculated cost is 'shadow cost' that can be used in procurement evaluation or to serve as a threshold in project procurement.

The assessment uses quantities from the steel footbridge as built, and concrete bridge quantities from the pre-design, as bridge type selection was undertaken as part of the pre-design process. Each material used for the bridges was defined in terms its sources (Primary Renewable, Primary Virgin, Secondary Reused and Secondary Recycled), the assumptions for the end-of-life potential (Reusable, Recyclable, Energy recovery, Landfill) and the environmental cost per life stage.

The results for the protection of materials indicate a slightly higher material circularity of the steel bridge, mostly due to the high end of life recycling potential of steel compared to concrete. Due to the lower weight of the steel option, there is a significant reduction in primary material use compared to the concrete alternative.

In terms of Environmental cost, the concrete bridge however performs better than the steel footbridge. Using unit shadow prices for environmental impact categories according to the Dutch National methodology, the total environmental cost for a 100-year service life, excluding end-of-life benefits is €26,400 and €16,600 for the steel and respectively for the concrete footbridge alternative.

The above circularity assessment has informed on how circularity can be improved. Measures include requiring the use of steel with high recycling content or re-used steel and considering more reversible connections to enable the future re-use of components. An appropriate method needs to be identified for the Icelandic market that allows environmental costs to be one of the variables in public procurment.

A 'Circular Design Framework for Bridges' has been drawn up. It builds on the international 'Circular Buildings Toolkit" by adopting the same circular design strategies. The framework consists of 42 design actions aimed at improving bridge circularity. The actions have been prioritised, and it is the view of the authors that the following actions should be implemented immediately:

- Make Life Cycle Assessments mandatory for bridges, and establish, legislate, and work with carbon emission targets.
- Make Life Cycle Cost Assessment mandatory for bridges, for comparison of bridge alternatives in concept studies and pre-design
- Implementing circular design strategies by using a checklist of circular design actions.
- Include relevant circular economy information in BIM modes that are produced in design and used by owner during the service life

To follow-up to this research project, it is proposed that next year's work will be on:

- To formulate the circular design actions checklist and the appropriate 'check' criteria for each action in the list. The circularity of bridge designs can undoubtedly be improved by designers applying such a checklist, particularly if it is applied with a workshop at the project start up where a longlist is tailored to a list of items that are most relevant to the individual project.
- To formulate a national methodology to measure circularity in bridge design. A uniform approach would create a fair playing field for all and accelerate change.
- To define in more detail, how the Environmental Costs Indicator can be used in procurement. Procurement is a strong tool for bridge owners to enable swift change.

Close dialogue with bridge owners is required for the follow up to the research.

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APPENDIX A METHODOLOGY AND ASSUMPTIONS IN DATA COLLECTION FOR THE CE DASHBOARD

Note: For the ECI calculations the environmental impact categories „human toxiological effcts“ and „Ecotoxilogical effects“ were omitted since they are generally not included in the Environmental Product Declarations that were sourced for the used materials.

A.1 Asphalt layer

40mm þykkt asphalt layer (1,0 kN/m^2). Data from Swedish EPD doc that is referenced on the EPD database page of CB’23 for EPD on the European market). Reference unit 1 tonne. EPD considers „product stage“ and „end of life stage“.

Limitations from the EPD doc: Not stated what is the lifetime period, but assumed to be 20 yrs. Unit weight not stated either, assumed 25 kN/m3. For some components environmental impact was stated in other units than the ones that are applied for conversion to environmental costs (table with multiplication factors for EUR/kg). The following conversions were done in order to assess environmental costs in those instances:

- AP (Acidification potential of land and water) given as mol H+ eq so following conversion applies:
$$SO_2 + 0{,}5O_2 + H_2O = H_2SO_4$$
$$SO_2 \rightarrow 32 + 16 * 2 = 64\frac{g}{mol}$$
$$\frac{32g\ SO_2}{mol\ H+}$$
$$(0{,}032kg\ SO_2)/(mol\ H^+)$$
- EP (Eutrophication potential) given as kg P eq so that this conversion applies: $PO_4 \rightarrow 3P$
- POCP (Formation potential of tropospheric ozone photochemical oxidants) given as kg NMVOC eq so that this conversion applies: $1kg\ NMVOC = 0{,}416\ ethylene$

- Reference for those conversions:
  https://pure.iiasa.ac.at/id/eprint/7926/1/XJ-06-011.pdf
  https://www.reddit.com/r/chemhelp/comments/8ipzhd/is_there_a_way_to_convert_kg_so2_equivalent_to/

The project quantities were in m2 so weight is calculated as:

$$\frac{320m^2 * 1{,}0\frac{kN}{m^2}}{9{,}81\frac{m}{s^2}} = 32\ ton$$

A.2 Epoxy-based coating

In documents regarding Mjølan the epoxy protection layer was described as a 12mm thick layer. Data from a EPD file from a Spanish company which was found on the EPD database website was used for the CE database. The declared unit for the EPD is $1m^2$ of surface covered with the synthetic resin (0,45 kg). The file takes the construction stage and end of life stage into the account in the EPD file.

Limitations regarding data from the EPD file: The mass density of the product was not declared in the EPD so it was assumed to have a similar mass density as the asphalt layer. Similarly to the EPD file for the asphalt layer the environmental impact from certain categories was accounted for using different units then the conversion table to environmental cost depends on. Therefore the same conversion was used as described for the asphalt layer.

A.3 Strand Anchors

Data from a Norwegian EPD file was used for the CE database among with data from One Click LCA which depended on the same EPD file. The declared unit for the EPD file was 1 kg strand anchor while the unit used for the LCA was 1 ton.

Limitations regarding data: End of life stage was not accounted for in the EPD file and therefore there is no data for the output at the end of life stage. It is therefore assumed that the percentage of recyclable material at the end of life stage is the same for the cables and the reinforcement steel. The mass density of the product was not declared so it is assumed to be 7900 kg/m^3. Results from the LCA was used for the environmental impact categories. However, the LCA did not include abiotic depletion potential for non-fossil resources (kg Sb-Eq) (this is valid for all LCA done on materials for this project). For that impact category the EPD was used but since it depended on a unit of 1 kg while the LCA was based on 1 ton the values for Sb from the EPD file was multiplied by a factor of 1000 (1 ton = 1000 kg).

In the table of quantities for Mjølan the amount of cables required was measured in MNm but the table of quantities for the CE dashboard measures the amount of steel in tons. Since 170MNm = 1 ton the quantity was converted according to that.

A.4 Formwork

Data from a Norwegian EPD file for sawn wood (Pine) was used for the CE database among with data from One click LCA which depended on the same EPD file. The declared unit for the EPD file and the LCA was 1 m^3.

Limitations regarding data: Data for the MCI coefficient were not sufficient so it was assumed that 100% of the formwork material input was renewable. There was no data for the output at the end of life stage and therefore general statistic for waste from building and construction in Norway was used (https://www.ssb.no/en/natur-og-miljo/avfall/statistikk/avfall-fra-byggeaktivitet). Since this is a raw material there is no determined service life for the product so it is estimated to be 100 years. Data from the LCA was used for all relevant environmental impact categories except for Sb where the data from the EPD file was used.

In the table of quantities for Mjølan the amount of formwork required was measured in m^2 but the table of quantities for the CE dashboard measures the amount of timber in m^3. It was assumed that the formwork used in Mjølan was 75mm thick boards similarly to the formwork used in Breiðholtsbraut. These estimations resulted in the following amount of material:

$$Concrete\ alternative, superstructure: 530m^2 * 75 * 10^{-3}m = 39{,}75m^3$$

$$Foundations, both\ alternatives: 179m^2 * 75 * 10^{-3}m = 13.43m^3$$

A.5 Parapet – Hot rolled stainless steel

Data from EPD for hot rolled stainless steel from Outokumpu was used for the CE database. The declared unit for the EPD is 1 ton. This EPD was used for all stainless steel used for the bridge.

Limitations: Amount of material used for the parapet is accounted for in meters in the table of quantities for Mjølan. However, steel is accounted for in tons in the quantity table for the CE database. Therefore the amount of material required was converted to the desired unit in accordance with drawings K161-163 (see excel sheet that estimates proportion of renewable material).

A.6 Metallic zinc rich epoxy primer

Data from a Swedish EPD file for a metallic zinc rich epoxy primer was used for the CE dashboard among with data from One click LCA which depended on the same EPD file. The declared unit for the EPD file and the LCA was 1 m^2.

Limitations: Service life was not declared for the material so it is assumed to be 20 years.

A.7 Concrete

The concrete used is B45 SV Standard according to drawings.

Data from a Norwegian EPD file for concrete B45 SV Standard was used for the CE dashboard among with data from One click LCA which depended on the same EPD file. The declared unit for the EPD file and the LCA was 1 m^3.

Limitations: There was no data for the output at the end of life stage and therefore general statistic for waste from building and construction in Norway was used (https://www.ssb.no/en/natur-og-miljo/avfall/statistikk/avfall-fra-byggeaktivitet). Service life was not declared for the product so it was assumed to be 100 years.

A.8 Wire mesh (stainless steel)

According to drawings K161-163 Ø2,0mm wires were used in a 50x87mm mesh for the railing. According to tables in the Carl Stahl X-Tend mesh manual the mesh is 0,77 kg/m^2. The length of the two railings is 248m and the height is approximately 1000m (estimated from drawing K162). Therefore the total amount of net required for the bridge is:

$$0{,}77\frac{kg}{m^2} * 248m^2 = 191kg$$

A.9 Reinforcement steel

Data from a Norwegian EPD file for the product was used for the CE dashboard among with data from One click LCA which depended on the same EPD file. The declared unit for the EPD file 1 kg while the unit used for the LCA was 1 ton.

Limitations: Results from the LCA was used for the environmental impact categories. However, the LCA did not include abiotic depletion potential for non-fossil resources (kg Sb-Eq) (this is valid for all LCA done on materials for this project). For that impact category the EPD was used but since it depended on a unit of 1 kg while the LCA was based on 1 ton the values for Sb from the EPD file was multiplied by a factor of 1000 (1 ton = 1000 kg).

For the End of life stage it was assumed that the proportion of recyclable material was comparable to the reinforcement steel used in Breiðholtsbraut (manufacturer: Pittini). The service life of the product was not declared so it was assumed to be 100 years.

A.10 Steel plates mild steel

Data from EPD for heavy steel plates from SSAB was used for the CE database. The declared unit for the EPD is 1 ton.

A.11 Steel plates stainless steel

Data from EPD for heavy steel plates from Norsk stål was used for the CE database. The declared unit for the EPD is 1 ton.

A.12 Hollow steel section, piles and tubes for superstructure and piers

Data from EPD for heavy steel plates from Mannesmann was used for the CE database. The declared unit for the EPD is 1 ton.

A.13 Polyuerthane topcoat

A polyuretan/polyuretan-akryl topcoat was used for the steel in Mjølan.

Data from a EPD file from AkzoNobel for the product was used for the CE dashboard among with data from One click LCA which depended on the same EPD file. The declared unit for the EPD file and the LCA was 1 m^2.

Limitations: The service life of the product was not declared so it is assumed to be 20 years.

APPENDIX B ENVIRONMENTAL PRODUCT DECLARATIONS

ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Salzgitter AG
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SMM-20210244-IBB1-EN
Issue date	20.06.2022
Valid to	19.06.2027

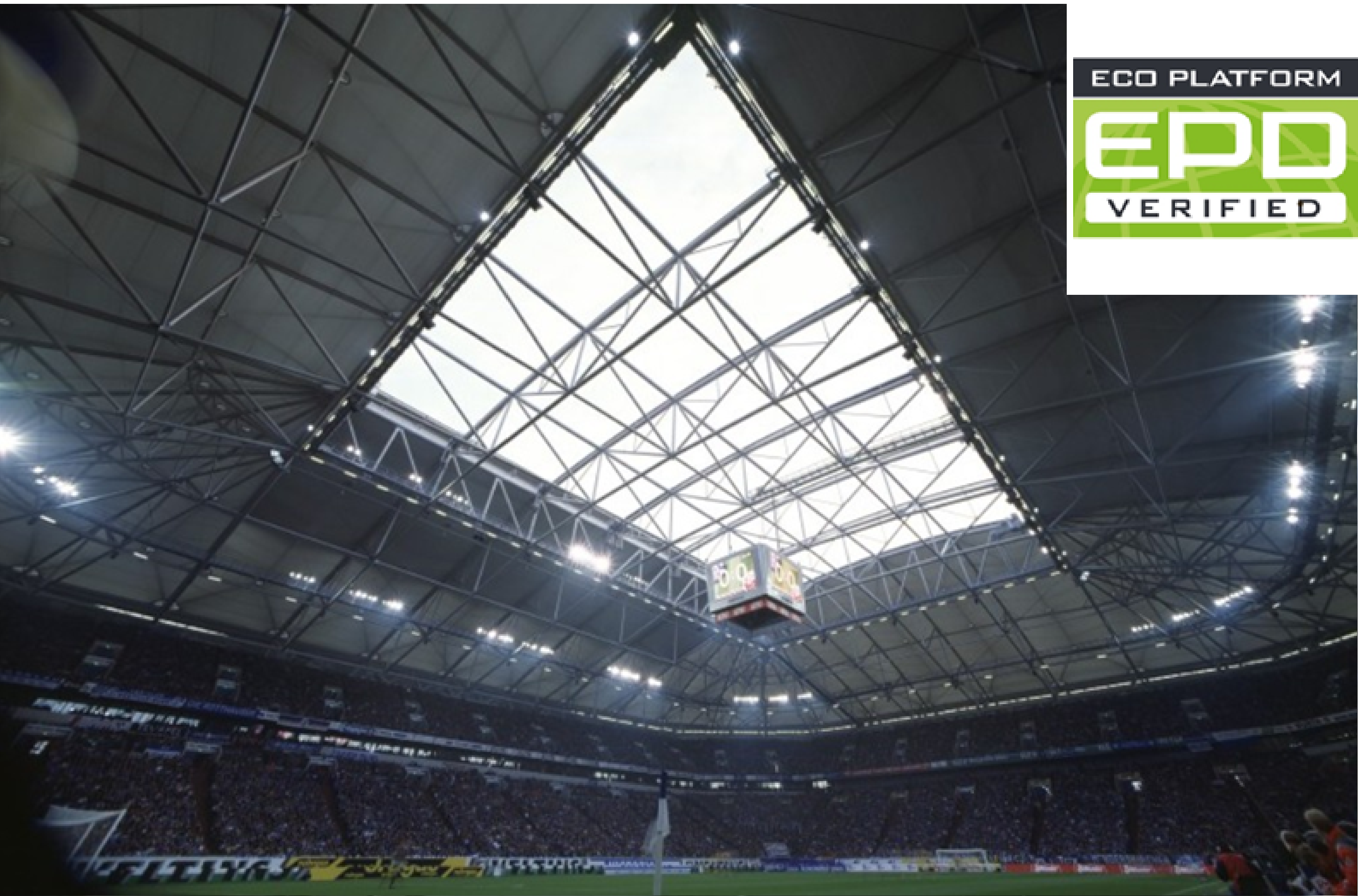
Mannesmann MSH® Sections

Mannesmann Line Pipe GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com | https://epd-online.com

ECO PLATFORM EPD VERIFIED



1. General Information

Salzgitter AG	Mannesmann MSH® Sections
Programme holder IBU – Institut Bauen und Umwelt e.V. Hegelplatz 1 10117 Berlin Germany	**Owner of the declaration** Salzgitter AG Eisenhüttenstraße 99 38239 Salzgitter Germany
Declaration number EPD-SMM-20210244-IBB1-EN	**Declared product / declared unit** The Declaration refers to the production of 1 tonne Mannesmann MSH® sections.
This declaration is based on the product category rules: Structural steels, 11.2017 (PCR checked and approved by the SVR)	**Scope:** This Environmental Product Declaration refers to Cold- and hot-finished Mannesmann MSH® sections with circular, square and rectangular cross-sections from the production facilities of **Mannesmann Line Pipe GmbH** in Hamm and Siegen (Germany).
Issue date 20.06.2022 **Valid to** 19.06.2027	The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences. The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.
	Verification The standard *EN 15804* serves as the core PCR Independent verification of the declaration and data according to *ISO 14025:2011* ☐ internally ☒ externally
Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)	
Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.))	Dr.-Ing. Wolfram Trinius (Independent verifier)

2. Product

2.1 Product description/Product definition

Mannesmann MSH® sections are cold- and hot-finished hollow sections for structural steel which are manufactured from unalloyed structural steels and fine-grain steels, e.g. in accordance with:

EN 10210, Hot-finished structural hollow sections of non-alloy and fine-grain steels

or

EN 10219, Cold-formed welded structural steel hollow sections

Product definition:

(EU) Directive No. 305/2011 (CPR) applies for placing the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a Declaration of Performance taking consideration of the *EN 10210* or *EN 10219* and CE marking.

The respective national regulations apply for usage. Application of the products in Germany is subject to the following guidelines:

1. *DIN 18800* to *DIN 18808*: German application standards for steel construction

2. Eurocode 3: (*EN 1993-1-1* to *EN 1993-1-12*): European application standards for steel construction

3. DASt guidelines: supplementary guidelines, published by the Deutscher Ausschuss für Stahlbau (DASt) technical delivery conditions; German version *EN 10025*

2.2 Application

Mannesmann MSH® sections are used in numerous construction applications. Typical examples include:

- Industrial buildings and halls
- Bridge construction

- Sports facilities
- Airport terminals and hangars
- Offshore constructions

2.3 Technical Data

The mechanical and technological properties of cold- and hot-finished hollow sections are indicated in delivery standards such as Tables A.3 (unalloyed structural steel) and B.3 (fine-grain steel) in *EN 10210* or Table A.3 (unalloyed structural steel) in *EN 10219* and Tables B.4 or B.5 for the treatment conditions of the preliminary material N and M.

The Declaration of Performance shall apply.

Technical construction data

Name	Value	Unit
Density	7850	kg/m³
Modulus of elasticity	210000	N/mm²
Coefficient of thermal expansion	11,5 - 11,9	$10^{-6}K^{-1}$
Thermal conductivity	35 - 47	W/(mK)
Melting point	1538	°C
Electrical conductivity at 20°C	3,8 - 4,0	$\Omega^{-1}m^{-1}$
Minimum yield strength (for sheet steel)	235 - 460	N/mm²
Minimum tensile strength (for sheet steel)	360 - 720	N/mm²

Product according to CPR with hEN:

The product's performance values correspond with the Declaration of Performance in terms of its essential properties in accordance with

- ***EN 10210*:**Hot-finished structural hollow sections of non-alloy and fine-grain steels, Part 1: Technical delivery conditions; Part 2: Tolerances, dimensions and sectional properties
- ***EN 10219:***Cold-formed welded structural steel hollow sections, Part 1: Technical delivery conditions (EN 10219); Part 2: Tolerances, dimensions and sectional properties (EN 10219-2)

2.4 Delivery status

e.g. materials in accordance with *EN 10210* and *EN 10219*

Steel grades:

- S235JRH – S460NLH
- S235JRH – S460MLH

Ultra high-strength grades as TM or QT variants are available on request.

2.5 Base materials/Ancillary materials

The base material for manufacturing hot-rolled coils as a preliminary material for cold- and hot-finished hollow sections is iron (percentage by mass >= 99.5%).

Other components are carbon, silicon and manganese. Chemical composition varies depending on the type of steel. The detailed percentages by mass are indicated in the *EN 10210* and *EN 10219* product standards.

Ancillary materials:
Various lubricants depending on the respective rolling process

The product contains substances from the *ECHA* list of candidates of Substances of Very High Concern (SVHC) (dated 17 January 2022) exceeding 0.1 percentage by mass: **no**

The product contains other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass in at least one partial product: **no**

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the Ordinance on Biocide Products No. (EU) 528/2012): **no**

2.6 Manufacture

Hot-rolled strips of suitable width and sheet thickness, wound as coils, represent the preliminary material for manufacturing longitudinal seam-welded steel pipes at Mannesmann Line Pipe. There are two production facilities with identical manufacturing methods located in Siegen and Hamm.

<u>Pipe production (circular hollow sections):</u>
The process is broken down into three phases: **forming** the infinitely welded strip as open-seam pipes, **welding** and **annealing** the seam for achieving the requisite structure. The heated strip edges are welded together by pressing. The pipes are rounded and aligned followed by non-destructive testing of the HFI seam. The pipe string is then sawn to the desired length for the requisite round hollow section.

<u>Processing (hot-finished round, square and rectangular hollow sections):</u>
The cold-finished circular pipes referred to above are heated to >870 °C solid body for manufacturing hot-finished circular hollow sections and for reforming as square and rectangular sections using four inductors. Production speed ranges from 0.5 to 4.0 m/min.

Both sites are certified to *ISO 9001* for product manufacturing and quality assurance.

2.7 Environment and health during manufacturing

During the entire manufacturing process, no other health protection measures are required extending beyond the legally specified industrial protection measures for commercial enterprises.

Certification of industrial safety and health protection in accordance with *ISO 45001* is in place for both sites.

Via regular analyses of the environmental impacts and permanent improvement measures and action within the framework of TQM (Total Quality Management), the low environmental impacts attributable to the manufacturing process are continuously minimised.

Both production facilities operated by Mannesmann Line Pipe GmbH are certified to *ISO 14001*.

2.8 Product processing/Installation

Processing recommendations:

Hot- and cold-forming:
Hot- and cold-forming are possible without any difficulty. Hot-forming should be carried out in a range of 1050 to 750 °C. Forming with a predominantly upsetting component, e.g. forging, **can** be carried out in the upper temperature range. Forming operations with stretching, on the other hand, **should** be carried out in the lower temperature range. The temperature can decrease to 700 °C for degrees of deformation of less than 5% in the final stage.
This must be followed by cooling down in stationary air. After hot-forming, normalising is necessary if temperatures arose outside the temperature range of 980 to 850 °C during the previous forming process. After stronger cold-forming processes requiring heat treatment in accordance with the respective guidelines (see *AD data sheets*), stress-relief heat treatment is often sufficient unless other acceptance test procedures or other specifications expressly demand normalising.

Welding:
The steels can be welded manually or automatically after each of these procedures. At external temperatures below approx. +5 °C and wall thicknesses exceeding 50 mm (for S 355 and higher exceeding 30 mm), preheating a sufficiently wide zone to 80 to 200 °C is recommended. In any case, the surface should be free of condensation. Stress-relief heat treatment (see heat treatment) is not generally necessary and it should only be carried out if demanded by a building regulation or when welded constructions and/or operating conditions commend depletion of the internal welding stresses. Verifiably suitable welding additives must be used for arc welding while alkaline welding additives are preferable for S 355 and higher.

Industrial safety and health protection measures:
No health protection measures over and beyond the standard industrial safety measures (e.g. protective gloves) are required during processing/installation of the Mannesmann MSH® sections.

Environmental protection measures:
No noteworthy environmental pollution is triggered by processing/assembling the products in question. No special measures need to be taken to protect the environment.

Residual material incurred:
Residual material and packaging incurred on the building site must be collected separately. The specifications of local waste authorities must be maintained during processing.

2.9 Packaging

Mannesmann MSH® sections (angular or circular) are bundled using steel bands and/or shipped on wooden beams, secured with wooden wedges (waste code nos.: 150103 packaging made of wood, 150104 packaging made of metal). All packaging can be reused.

2.10 Condition of use

Contents in condition of use:
The material composition during the use phase is the same as at the time of production. Mannesmann MSH® sections are manufactured from non-alloy structural steels and fine-grain structural steels in accordance with *EN 10210* and *EN 10219*. Contents are listed in Table 2.1 in section 2.

Corrosion protection:
Detailed information on corrosion protection is available in the technical information sheet entitled "Protecting hollow sections from corrosion" on *Mannesmann Line Pipe*.

2.11 Environment and health during use

General health and environmental aspects
There are no health risks for users of Mannesmann MSH® sections or for persons manufacturing or processing Mannesmann MSH® sections. From an environmental perspective, there are no restrictions governing the use of Mannesmann MSH® sections.

2.12 Reference service life

Building product life cycles are dependent on the respective building design, use and maintenance. The use phase for structural hollow sections is not depicted as they involve maintenance-free and generally durable products.

2.13 Extraordinary effects

Fire
Mannesmann MSH® sections comply with the requirements of construction product class A1 "non-flammable" in accordance with *DIN 4102-1* and *EN 13501*. No smoke gas develops.

Fire Protection

Name	Value
Building material class	A1

Water
The effects of flooding on Mannesmann MSH® sections do not lead to any changes in the product or any other negative environmental impact.

Mechanical destruction
In the event of extraordinary mechanical impact, steel structures display very good characteristics thanks to the high degree of ductility (malleability) of the material. As a general rule, no chips, breaking edges or similar are incurred.

2.14 Re-use phase

Mannesmann MSH® sections are 100% recyclable. The Mannesmann MSH® sections used in a structure are only partially reused after demolition; the largest share is primarily directed to electro-steel plants as scrap.

2.15 Disposal

As steel is 100% recyclable, this material does not require disposal. Waste code in accordance with the European List of Wastes (EWC), as per the European List of Wastes Ordinance *AVV*: 17 04 05 Iron and steel.

2.16 Further information

Further information on Mannesmann MSH® sections is available on *Mannesmann Line Pipe*.

3. LCA: Calculation rules

3.1 Declared Unit

As a representative of the group of cold- and hot-finished Mannesmann MSH® sections, 1 tonne hot-finished Mannesmann MSH® section serves as the declared unit.

Declared Unit

Name	Value	Unit
Declared unit	1	t
Thickness (max. wall thickness)	25,4	mm
Density	7850	kg/m^3
Conversion factor to 1 kg	0.001	-

3.2 System boundary

Type of EPD: cradle to gate with Modules C1 - C4 and Module D.

The EPD comprises the following life cycle phases:

- Product stage (Modules A1 - A3)
- End-of-Life stage (Modules C1 - C4)
- Benefits and loads beyond the system boundary (Module D)

Modules A1 - A3 cover both the upstream chain of production and provision of raw materials, auxiliary materials and energy sources, the production of hot strip on the basis of iron ore, as well as its transport to the plants of Mannesmann Line Pipe GmbH, and the energy and material costs there. Waste water treatment is also considered.

For Module C2 (Transport), it is assumed that the steel scrap is transported 100 km by truck for further processing. No other expenses are incurred in Module C, or are already included in the other modules (e.g. recycling in the electric arc furnace and in the converter).

Module D takes consideration of the reuse and recycling potential. Recycling credits are allocated in line with the "theoretically 100% primary furnace route" approach, in accordance with *Worldsteel 2017*.

3.3 Estimates and assumptions

Estimates and assumptions were documented in detail and are based on real production data from hot strip and steel pipe production.

3.4 Cut-off criteria

The end-of-life scenario involves product losses of 3.1%. Landfilling is not considered. Likewise, the manufacture and utilisation of packaging material (steel bands, wooden beams) are not considered. Nor is the use of lubricants taken into consideration.

In their entirety, these unconsidered flows significantly comply with the cut-off criterion of max. 5% of energy and mass expenditure while also adhering to the criterion of 1% in relation to individual processes, *PCR, Part A + A2*.

3.5 Background data

The LCA results of the declared product are based on modelling in the *GaBi ts* software environment.

Modelling is based on primary production data for the production of hot strip and the energy and media consumption values for an entire year.

This has been supplemented by secondary data from the GaBi database. The respective documentation can be viewed online.

3.6 Data quality

All primary data on steel/hot strip production and pipe production refers to the financial year 2018. The annual volumes have been examined for representativity in relation to previous financial years.

The current GaBi database (GaBi version 10.5.1.124, database 2021.2) was used for background data sets.

The assessment model of the "Product Environmental Footprint (PEF)" approach (see *PEF*) of the EC Joint Research Centre 2012 was used to assess the quality of the primary and secondary data in this EPD. Accordingly, the overall data quality can be rated as "very good".

3.7 Period under review

The period under review is fiscal 2018. The volumes of hot-finished Mannesmann MSH® sections produced in 2018 serve as averages for the Declaration.

3.8 Allocation

The methodology used for the co-products in the "coking plant" and "power plant" processes of primary steel production was physical allocation based on calorific value. For the other co-products, a partitioning approach based on the product energy content was used according to the recommendation of *Worldsteel 2014*.

The use of steel scrap for the production of hot strip in Module A1 is considered unencumbered. However, a large percentage of scrap requirements is already covered by the cutting losses incurred during pipe production.

The remaining residual quantity is fed into Module A1 before the End-of-Life scenario is considered and deducted from the "scrap for recycling" material flow. The difference is the net scrap quantity that is transferred to the recycling process; please refer to *Helmus*. Recycling credits are allocated in line with the "theoretically 100% primary furnace route" approach, *Worldsteel 2014*.

If reused, this material flow is credited to pipe production (Modules A1-A3).

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

The background database used involves the *GaBi* data base, version 2021.2.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon

End of life (C1 - C4)

Name	Value	Unit
Collected separately	969	kg
Reuse	53	kg
Recycling (net flow steel scrap)	914	kg

Reuse, recovery and recycling potential (D), relevant scenario information

Name	Value	Unit
Collection Rate	96,9	%
Recycling	91,6	%
Reuse	5,3	%
Loss	3,1	%

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 tonne Mannesmann MSH® sections

Core Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Global warming potential - total	[kg CO_2-Eq.]	2.55E+3	0.00E+0	6.77E+0	0.00E+0	0.00E+0	-1.62E+3
Global warming potential - fossil fuels	[kg CO_2-Eq.]	2.55E+3	0.00E+0	6.72E+0	0.00E+0	0.00E+0	-1.62E+3
Global warming potential - biogenic	[kg CO_2-Eq.]	4.00E+0	0.00E+0	-8.08E-3	0.00E+0	0.00E+0	1.94E+0
GWP from land use and land use change	[kg CO_2-Eq.]	1.56E+0	0.00E+0	5.54E-2	0.00E+0	0.00E+0	-2.77E-1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	3.74E-8	0.00E+0	1.34E-15	0.00E+0	0.00E+0	-2.82E-8
Acidification potential, accumulated exceedance	[mol H^+-Eq.]	7.05E+0	0.00E+0	4.02E-2	0.00E+0	0.00E+0	-4.71E+0
Eutrophication, fraction of nutrients reaching freshwater end compartment	[kg P-Eq.]	2.69E-3	0.00E+0	2.01E-5	0.00E+0	0.00E+0	-5.12E-4
Eutrophication, fraction of nutrients reaching marine end compartment	[kg N-Eq.]	1.55E+0	0.00E+0	1.97E-2	0.00E+0	0.00E+0	-9.08E-1
Eutrophication, accumulated exceedance	[mol N-Eq.]	1.68E+1	0.00E+0	2.18E-1	0.00E+0	0.00E+0	-9.86E+0
Formation potential of tropospheric ozone photochemical oxidants	[kg NMVOC-Eq.]	4.42E+0	0.00E+0	3.79E-2	0.00E+0	0.00E+0	-2.43E+0
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	5.17E-4	0.00E+0	6.01E-7	0.00E+0	0.00E+0	-2.67E-4
Abiotic depletion potential for fossil resources	[MJ]	2.44E+4	0.00E+0	9.03E+1	0.00E+0	0.00E+0	-1.33E+4
Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	[m^3 world-Eq deprived]	4.79E+0	0.00E+0	6.29E-2	0.00E+0	0.00E+0	-5.66E-1

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 tonne Mannesmann MSH® sections

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier	[MJ]	2.20E+3	0.00E+0	5.20E+0	0.00E+0	0.00E+0	1.55E+3
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	2.20E+3	0.00E+0	5.20E+0	0.00E+0	0.00E+0	1.55E+3
Non-renewable primary energy as energy carrier	[MJ]	2.45E+4	0.00E+0	9.06E+1	0.00E+0	0.00E+0	-1.34E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	2.45E+4	0.00E+0	9.06E+1	0.00E+0	0.00E+0	-1.34E+4
Use of secondary material	[kg]	1.88E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	9.14E+2
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	4.79E+0	0.00E+0	5.95E-3	0.00E+0	0.00E+0	-5.66E-1

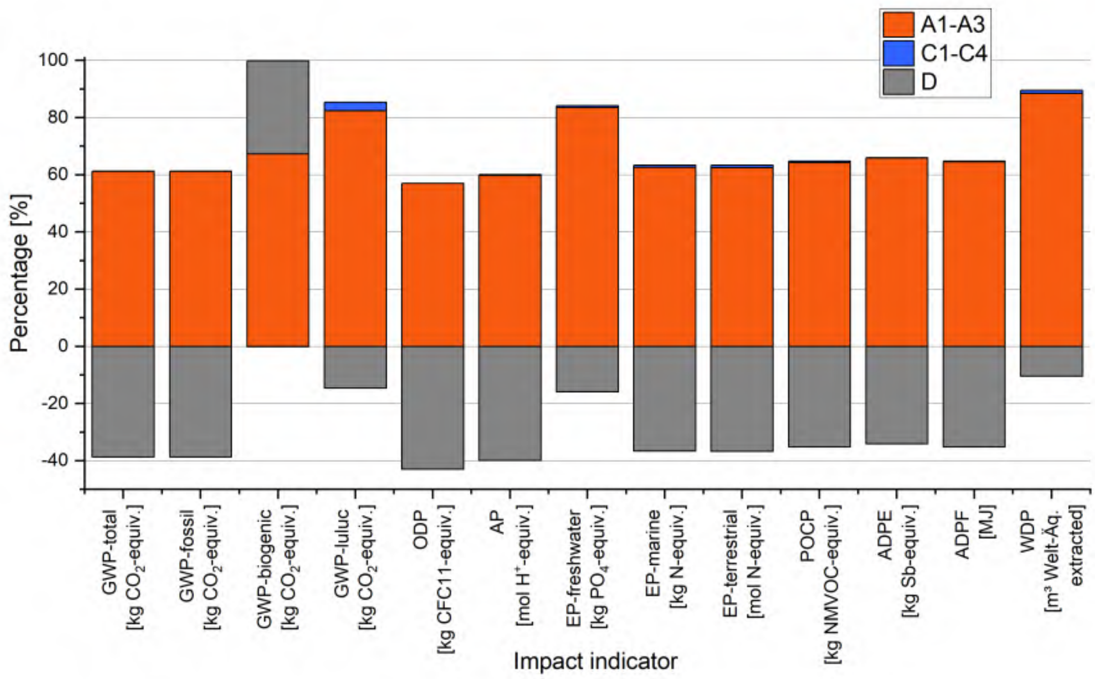
RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 tonne Mannesmann MSH® sections

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	[kg]	2.34E+0	0.00E+0	4.78E-9	0.00E+0	0.00E+0	-1.25E-1
Non-hazardous waste disposed	[kg]	2.89E+1	0.00E+0	1.42E-2	0.00E+0	0.00E+0	-2.42E+1
Radioactive waste disposed	[kg]	2.67E-1	0.00E+0	1.64E-4	0.00E+0	0.00E+0	1.84E-1
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	5.30E+1	0.00E+0	0.00E+0
Materials for recycling	[kg]	1.89E+2	0.00E+0	0.00E+0	9.16E+2	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 tonne Mannesmann MSH® sections

Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Potential incidence of disease due to PM emissions	[Disease Incidence]	ND	ND	ND	ND	ND	ND
Potential Human exposure efficiency relative to U235	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for ecosystems	[CTUe]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for humans - cancerogenic	[CTUh]	ND	ND	ND	ND	ND	ND
Potential comparative toxic unit for humans - not cancerogenic	[CTUh]	ND	ND	ND	ND	ND	ND
Potential soil quality index	[-]	ND	ND	ND	ND	ND	ND

6. LCA: Interpretation



The results of the environmental impact show that practically the “entire greenhouse gas emissions (**GWP total**)” of Modules A1 - A3 come from fossil sources (cf. indicator **GWP fossil**).
As expected, the more detailed analysis shows that hot strip production (Module A1) has the greatest influence on GWP total or GWP fossil, accounting for almost 94%. Here, the fossil carbon input in the blast furnace process is particularly noteworthy, leading to direct, process-related CO_2 emissions and to further indirect emissions in the power plant process. Within Module A1, approx. 70% of greenhouse gas emissions come from the direct plant emissions and the remainder from the emissions of the preliminary processes for the production and provision of the raw materials such as the coal, iron ore carriers and lime. In Module A3 (“Pipe production”), the majority of greenhouse gas emissions are accounted for by upstream emissions in the production of electricity.

In contrast, the absolute shares of the “greenhouse potentials from biogenic sources (**GWP biogenic**)” and from “landscape use and landscape use change (**GWP luluc**)” have only a negligible share of the total greenhouse potential. As expected, the contributions in Modules A1 and A3 come exclusively from the upstream processes, and here primarily from the electricity mix used or the raw material supplies.

For the "Water depletion potential (user) (**WEP**)", the chains of electricity generation to cover the electricity demand in Module A3 are decisive.

The other core indicators of environmental impacts are predominantly determined by steel and hot strip production in Module A1. The “Potential for stratospheric ozone depletion (**ODP**)” should be emphasised. The ODP is almost exclusively caused by the use of methanol in wastewater treatment in Module A1, as halogenated hydrocarbons are emitted during the production of methanol.

For the remaining impact indicators, the provision of raw materials for steel production (Module A1) also has the greatest influence on the absolute size of the environmental indicators. As expected, the largest contributions are made by the provision of iron ore carriers, coal and lime, i.e. those input materials that are used in the largest quantities (see Table 7). In addition, the impact indicators describing the acidification potential (**AP**), the eutrophication potential (**EP freshwater**, **EP marine**, **EP terrestrial**) and the ozone creation potential (**POCP**) are increased by the direct NO_x and SO_2 emissions of the sintering plant and the power plant.

The credits from the reuse and recycling of steel scrap in Module D result from the selected recycling approach of avoided primary steel production and the associated avoidance of emissions from this process route. The positive share of the impact indicator **GWP biogenic** of Module D comes from the biogenic shares of the German electricity mixes used.

In contrast to fossil-based primary steel production recycling by means of the electric arc process is mainly based on electricity. This is largely made up of renewable energies. For this reason, “Module D” leads to an increase rather than a decrease in the use of renewable energy, while at the same time reducing the use of fossil energy, as can be seen from the indicators **PERE** and **PENRE**.

In summary, almost every LCA indicator is determined by the steel production process in Module A1. Only electricity generation and its upstream chains have a significant overall impact on the pipe manufacturing process (Module A3). For Mannesmann Line Pipe, material efficiency is therefore the biggest lever in this and most categories.

7. Requisite evidence

This EPD concerns semi-finished products made from structural steel. Further processing depends on the respective application. Accordingly, further documentation is not of relevance here.

7.1 Weathering

Components manufactured from Mannesmann MSH® sections are not generally exposed to weathering without protection. Corrosion protection systems are selected in accordance with the respective application and site.

8. References

Standards

DIN 4102
DIN 4102-1:1998-05, Fire behaviour of building materials and building components – Part 1: Building materials, terms, requirements and tests

DIN 18800
DIN 18800-1:2008-11, Steel structures – Part 1: Rating and construction

DIN 18808
DIN 18808:1984-10, Steel structures; Supporting structures made of hollow sections under predominantly static loads

EN 1993-1-1
Eurocode 3: Rating and construction of steel structures – Part 1-1: General rules and rules for buildings; German version EN 1993-1-1:2005 + AC:2009
DIN EN 1993-1-1:2010-12

EN 1993-1-12
DIN EN 1993-1-12:2010-12, Eurocode 3: Rating and construction of steel structures – Part 1-12: Additional rules for the extension of EN 1993 to steel grades up to S700; German version EN 1993-1-12:2007 + AC:2009

EN 10025
DIN EN 10025-1:2005-02, Hot-rolled products of structural steels – Part 1: General technical delivery conditions; German version EN 10025-1:2004

EN 10210
DIN EN 10210-1:2006-07, Hot-finished structural hollow sections of non-alloy and fine-grain steels – Part 1: General technical delivery conditions; German version EN 10210-1:2006

EN 10219
DIN EN 10219-1:2006-07, Cold-finished welded hollow sections for steel construction using unalloyed structural steels and fine-grain steels – Part 1: General technical delivery conditions; German version EN 10219-1:2006

EN 10219-2
DIN EN 10219-1:2006-07, Cold-finished welded hollow sections for steel construction – Part 2: Tolerances, dimensions and sectional properties

EN 13501
DIN EN 13501-1:2019-05, Classification of construction products and methods by reaction to fire – Part 1: Classification with the results of tests on reaction to fire of construction products

EN 15804
DIN EN 15804 + A2:2020-03, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

ISO 9001
DIN EN ISO 9001:2015-11, Quality management systems – Requirements

ISO 14001
DIN EN ISO 14001:2015-11, Environmental management systems – Requirements with guidance for use (ISO 14001:2015)

ISO 14025
DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III environmental declarations – Principles and procedures (ISO 14025:2006); German and English versions EN ISO 14025:2011

ISO 45001
ISO 45001:2018-03, Occupational health and safety management systems – Requirements with guidance for use (ISO 45001:2018)

AVV
Ordinance on the list of wastes (Directive governing the European Waste Index): 10 December 2001 (Federal Law Gazette No. I S. 337s9), last amended: 4

July 2020

PCR, Part A
Product category guidelines for building-related products and services Part A: Calculation rules for the Life Cycle Assessment and requirements on the Project Report, in accordance with EN 15804+A2:2019, version 1.8, Berlin: Institut Bauen und Umwelt e.V. (pub.), 01.07.2020

PCR, Part B
Steel pipes for pressure applications; Product category guidelines for building-related products and services Part B: Requirements on the EPD for steel pipes for pressure applications, version 1.0, Berlin: Institut Bauen und Umwelt e.V. (pub.), www.ibu-epd.com, 2016-05

PEF
EC Joint Research Centre, Product Environmental Footprint (PEF) Guide, consolidated version, Ispra, Italy, 2012

(**EU) Directive No. 305/2011/**
(EU) Directive No. 305/2011 of the European Parliament and Council of 9 March 2011 establishing harmonised conditions for marketing construction products and replacing Council Guideline 89/106/EEC

Other literature

ECHA
https://echa.europa.eu/de/candidate-list-table

GaBi ts
GaBi version 10.5.1.124; database used: 2021.2 GaBi ts data set documentation for the software system and databases, LBP, University of Stuttgart and thinkstep, Leinfelden-Echterdingen, 2021 (http://documentation.gabi-software.com/)

Helmus
Manfred Helmus, Anne Christine Randel, Raban Siebers, Carla Pütz, 2019: Entwicklung und Validierung einer Methode zur Erfassung der Sammelraten von Bauprodukten aus Metall (Development and validation of a method for recording the collection rates of metal building products); Final report; Deutsche Bundesstiftung Umwelt

Mannesmann Line Pipe
www.mannesmann-linepipe.com

SZFG
Overview of the current SZFG certificates at: https://www.salzgitter-flachstahl.de/de/informationsmaterial/zertifikate.html

World steel 2014
World Steel Association, A methodology to determine the LCI of steel industry co-products, Brussels, Belgium, 2014

World steel 2015
World Steel Association, Steel in the circular economy: a life cycle perspective, Brussels, Belgium, 2015

World steel 2017
World Steel Association, Life Cycle Inventory Methodology Report, Brussels, Belgium, 2017, ISBN 978-2-930069-89-0

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epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Eier av deklarasjonen:	Sunnfjord Betong AS
Programoperatør:	Næringslivets Stiftelse for Miljødeklarasjoner
Utgiver:	Næringslivets Stiftelse for Miljødeklarasjoner
Deklarasjonsnummer:	NEPD-2035-906-NO
Publiseringsnummer:	NEPD-2035-906-NO
ECO Platform registreringsnummer:	-
Godkjent dato:	04.02.2020
Gyldig til:	04.02.2025

B45 SV Standard, D-max 22 mm,Synk 200

Sunnfjord Betong AS

Sunnfjord Betong As

www.epd-norge.no

Generell informasjon

Produkt:

B45 SV Standard, D-max 22 mm,Synk 200

Eier av deklarasjonen:

Sunnfjord Betong AS
Kontaktperson: Mindor Sunde
Telefon: +47 95 84 04 99
e-post: mindor@sunnfjordbetong.no

Programoperatør:

Næringslivets stiftelse for Miljødeklarasjoner
Pb. 5250 Majorstuen, 0303 Oslo
Phone: +47 97722020
e-post: post@epd-norge.no

Produsent:

Sunnfjord Betong AS

Deklarasjonsnummer:

NEPD-2035-906-NO

Produksjonssted:

Sunnfjord Betong AS
Indre Hornnesvika 13
6809 Førde
Web: www.sunnfjordbetong.no

ECO Platform registreringsnummer:

Kvalitet/Miljøsystem:

Sunnfjord Betong AS sitt kvalitetsystem er bygd opp etter NS-EN 206

Deklarasjonen er basert på PCR:

EN 15804:2012+A1:2013 tjener som kjerne-PCR
NPCR 020:2018 Part B for Concrete and concrete elements

Org. no.:

954992373

Erklæring om ansvar:

Eieren av deklarasjonen skal være ansvarlig for den underliggende informasjon og bevis. EPD Norge skal ikke være ansvarlig med hensyn til produsent informasjon, livsløpsvurdering data og bevis.

Godkjent dato: 04.02.2020

Gyldig til: 04.02.2025

Deklarert enhet:

1 m3 B45 SV Standard, D-max 22 mm,Synk 200

Årstall for studien:

2019

Deklarert enhet med opsjon:

A1,A2,A3,A4

Sammenlignbarhet:

EPD av byggevarer er nødvendigvis ikke sammenlignbare hvis de ikke samsvarer med NS-EN 15804 og ses i en bygningskontekst.

Funksjonell enhet:

Miljødeklarasjonen er utarbeidet av:

Deklarasjonen er utviklet ved bruk av eEPD v3.0 fra LCA.no
Godkjenning:
Bedriftsspesifikke data er

Samlet og registrert av: Mindor Sunde

Kontrollert av: Bjarte Færestrand

Verifikasjon:

Uavhengig verifikasjon av data, annen miljøinformasjon og EPD er foretatt etter ISO 14025:2010, kapittel 8.1.3 og 8.1.4

Ekstern

Tredjeparts verifikator:

Sign

Anne Rønning

Seniorforsker Anne Rønning

(Uavhengig verifikator godkjent av EPD Norge)

Godkjent:

Sign

Håkon Hauan

Håkon Hauan
Daglig leder av EPD-Norge

Produkt

Produktbeskrivelse:

Resept til Vegvesenbetong

Produktspesifikasjon:

Fabrikkblandet betong i henhold til NS-EN 206

Material	%
Cement	16,93
Aggregate	74,98
Water	6,92
Chemicals	0,28
SCM	0,89

Tekniske data:

B45 SV Standard, cl 0,10, X0,XC1,XC2,XC3,XC4,XF1,XD1,XS1,XA1,XA2,XA4,XF2,XF3,XS4,XD2,XD

Markedsområde:

Nordfjord, Sunnfjord og Sogn

Levetid, produkt:

Som for bygninger

Levetid, bygg:

Som for bygninger

LCA: Beregningsregler

Deklarert enhet:

1 m3 B45 SV Standard, D-max 22 mm,Synk 200

Cut-off kriterier:

Alle viktige råmaterialer og all viktig energibruk er inkludert. Produksjonsprosessen for råmaterialene og energistrømmer som inngår med veldig små mengder (mindre enn 1%) er ikke inkludert. Disse cut-off kriteriene gjelder ikke for farlige materialer og stoffer.

Allokering:

Allokering er gjort iht. bestemmelser i EN 15804. Inngående energi og vann, samt produksjon av avfall i egen produksjon er allokert likt mellom alle produktene gjennom masseallokering. Miljøpåvirkning og ressursforbruk for primærproduksjonen av resirkulerte materialer er allokert til det opprinnelige produktsystemet. Bearbeidingsprosessen og transport av materialet til produksjonssted er allokert til analysen i denne EPDen.

Datakvalitet:

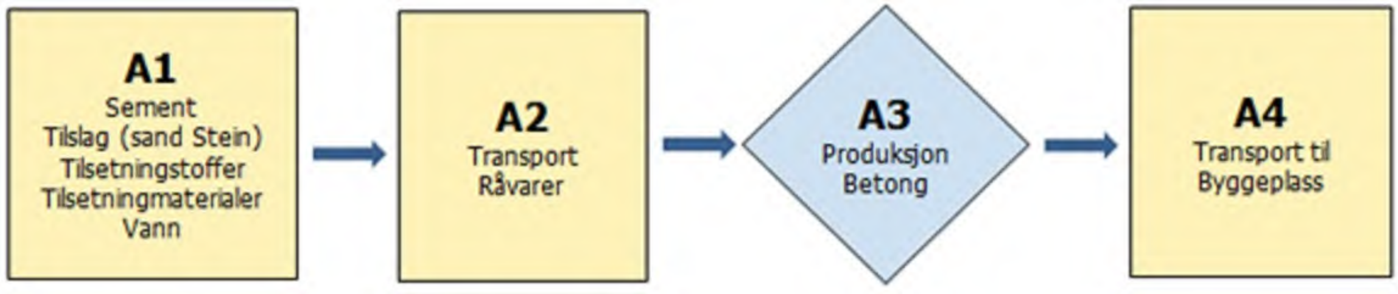
Spesifikke data for produktsammensetningen er fremskaffet av produsenten. De representerer produksjonen av det deklarerte produktet og ble samlet inn for EPD- utvikling i det oppgitte året for studien. Bakgrunnsdata er basert på registrerte EPDer i henhold til EN 15804, Østfoldforskning sine databaser, ecoinvent og andre LCA databaser. Datakvaliteten for råmaterialene i A1 er presentert i tabellen nedenfor.

Materials	Source	Data quality	Year
Aggregate	EcoInvent 3	Database	0
SCM	0	Waste	0
Aggregate	Modified EcoInvent	Database	2012
Chemicals	EPD-EFC-20150086-IAG1-EN	EPD	2015
Chemicals	EPD-EFC-20150088-IAG1-EN	EPD	2015
Chemicals	EPD-EFC-20150091-IAG1-EN	EPD	2015
Cement	NEPD 211, 15	EPD	2016
Water	ecoinvent 3.4	Database	2017

Systemgrenser:

Modulene A1 - A4 er inkludert i analysen.
Det inkluderer uttak og produksjon av råmaterialer, transport til fabrikk,selve produksjonsprosessen og transport ut til kunde.

Flytskjemaet nedenfor illustrerer systemgrensene for analysen:



Teknisk tilleggsinformasjon

LCA: Scenarier og annen teknisk informasjon

Følgende informasjonen beskriver scenariene for modulene i EPDen.

Transport fra produksjonssted til bruker (A4)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	Brennstoff/Energi forbruk	Enhet	Verdi (l/t)
Bil	38,8 %	Lastebil, EURO 6	35	0,043626	l/tkm	1,53
Jernbane					l/tkm	
Båt					l/tkm	
Annet					l/tkm	

Scenarier etter A1-A4 er ikke inkludert

Byggefase A5

.	Enhet	Verdi
Hjelpematerialer	kg	
Vannforbruk	m^3	
Elektrisitetsforbruk	kWh	
Andre energikilder	MJ	
Materialta[illegible]	kg	
Materiale[illegible]llsbehandling	kg	
Støv i lu[illegible]	kg	
VOC utslipp	kg	

Monterte produkter i bruk (B1)

.	Unit	Value

Vedlikehold (B2)/Repar[illegible]

.	Enhet	Verdi
Vedlikeholdsfrekvens*	.	
Hjelpematerialer	[illegible]	
Andre ressurser	[illegible]	
Vannforbruk	[illegible]	
Elektrisitetsforbruk	kWh	
Andre energikilder	MJ	
Materialtap	kg	
VOC utslipp	kg	

Utskifting (B4)/Renovering (B5)

.	Enhet	Verdi
Utskiftingsfrekvens*	stk	
Elektrisitetsforbruk	kWh	
Utskifting av slitte deler	0	

* Tall eller referanselevetid

Driftsenergi (B6) og vannbruk (B7)

.	Enhet	Verdi
Vannforbruk	m^3	
Elektrisitetsforbruk	kWh	
Andre energikilder	MJ	
Utstyrets varmeeffekt	kW	

Sluttfase [illegible]

.	Enhet	Verdi
Farlig avfall	kg	
Blandet avfall	kg	
Gjenbruk	kg	
Resirkulering	kg	
Energigjenvinning	[illegible]	
Til deponi	[illegible]	

Transport avfallsbehandling (C2)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	Brennstoff/Energi forbruk	Enhet	Verdi (l/t)
Bil					l/tkm	
Jernbane					l/tkm	
Båt					l/tkm	
Annet					l/tkm	

LCA: Resultater

Systemgrenser (X=inkludert, MND=modul ikke deklarert, MNR=modul ikke relevant)

Product stage				Construction installation stage	User stage							End of life stage				.	Beyond the system bondaries
Råmaterialer	Transport	Tilvirkning	Transport	Konstruksjons/ installasjonsfase	Bruk	Vedlikehold	Reparasjon	Utskiftinger	Renovering	Operasjonell energibruk	Operasjonell vannbruk	Demontering	Transport	Avfallsbehandling	Avfall til sluttbehandling		Gjenbruk/gjenvinning/ resirkulering-potensiale
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	.	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	.	MND

Miljøpåvirkning (Environmental impact)

Parameter	Unit	A1	A2	A3	A4
GWP	kg CO_2 -eq	2,66E+02	1,56E+01	1,75E+00	1,28E+01
ODP	kg CFC11 -eq	2,81E-06	2,74E-06	2,96E-07	2,41E-06
POCP	kg C_2H_4-eq	3,86E-02	2,79E-03	2,59E-04	1,94E-03
AP	kg SO_2 -eq	6,76E-01	1,02E-01	5,03E-03	3,01E-02
EP	kg PO_4^{3-} -eq	7,48E-02	2,10E-02	6,98E-04	3,95E-03
ADPM	kg Sb -eq	1,46E-04	1,24E-05	3,89E-06	3,98E-05
ADPE	MJ	1,40E+03	2,21E+02	2,35E+01	1,93E+02

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Ressursbruk (Resource use)

Parameter	Unit	A1	A2	A3	A4
RPEE	MJ	2,69E+02	3,05E+00	2,79E+01	2,85E+00
RPEM	MJ	2,23E+01	0,00E+00	0,00E+00	0,00E+00
TPE	MJ	2,91E+02	3,05E+00	2,79E+01	2,85E+00
NRPE	MJ	1,43E+03	2,26E+02	2,57E+01	1,98E+02
NRPM	MJ	1,87E+01	0,00E+00	0,00E+00	0,00E+00
TRPE	MJ	1,45E+03	2,26E+02	2,57E+01	1,98E+02
SM	kg	7,33E+01	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	3,09E+01	0,00E+00	4,79E-03	0,00E+00
NRSF	MJ	2,65E+02	0,00E+00	0,00E+00	0,00E+00
W	m^3	1,82E+00	3,89E-02	2,64E-01	3,74E-02

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Avfall (End of life - Waste)

Parameter	Unit	A1	A2	A3	A4
HW	kg	3,73E-04	1,29E-04	1,40E-05	1,17E-04
NHW	kg	4,69E+01	6,05E+00	3,70E-01	1,06E+01
RW	kg	INA*	INA*	INA*	INA*

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Utgangsfaktorer (End of life - Output flow)

Parameter	Unit	A1	A2	A3	A4
CR	kg	0,00E+00	0,00E+00	1,25E+02	0,00E+00
MR	kg	4,59E-01	0,00E+00	0,00E+00	0,00E+00
MER	kg	1,04E-01	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	INA*	INA*	INA*	INA*
ETE	MJ	INA*	INA*	INA*	INA*

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Norske tilleggskrav

Klimagassutslipp fra bruk av elektrisitet i produksjonsfasen

Nasjonal produksjonsmiks fra import, lavspenning (inkludert produksjon av overføringslinjer, i tillegg til direkte utslipp og tap i nett) er brukt for anvendt elektrisitet i produksjonsprosessen (A3). Bakgrunnsdata er presentert i tabellen under. Karakteriseringsfaktorer fra EN15804:2012+A1:2013 er benyttet.

Elektrisitetsmiks	Datakilde	Mengde	Enhet
El-mix, Norway (kWh)	ecoinvent 3.4	31,04	g CO2-ekv/kWh

Farlige stoffer

Produktet er ikke tilført stoffer fra REACH Kandidatliste eller den norske prioritetslisten.

Inneklima

Produktet har ingen påvirkning på inneklima

Bibliografi

NS-EN ISO 14025:2010 Miljømerker og deklarasjoner - Miljødeklarasjoner type III - Prinsipper og prosedyrer.
NS-EN ISO 14044:2006 Miljøstyring - Livsløpsvurderinger - Krav og retningslinjer
NS-EN 15804:2012+A1:2013 Bærekraftig byggverk - Miljødeklarasjoner - Grunnleggende produktkategoriregler for byggevarer
ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products.
ecoinvent v3, Allocation, cut-off by classification, Swiss Centre of Life Cycle Inventories.
Iversen et al., (2018) eEPD v3.0 - Background information for EPD generator system. LCA.no rapportnummer 04.18
Vold, M. og Edvardsen, T. (2014) EPD-generator for betongindustrien, bakgrunnsinformasjon for verifisering, OR 04.14, Østfoldforskning, Fredrikstad.
NPCR Part A: Construction products and services. Ver. 1.0. April 2017, EPD-Norge.
NPCR 020 Part B for Concrete and concrete elements. Ver. 2.0 October 2018, EPD-Norge

epd-norge.no The Norwegian EPD Foundation	**Programoperatør og utgiver** Næringslivets Stiftelse for Miljødeklarasjoner Pb. 5250 Majorstuen 0303 Oslo Norway	Telefon: e-post: web:	+47 97722020 post@epd-norge.no www.epd-norge.no
Sunnfjord Betong As	**Eier av deklarasjon** Sunnfjord Betong AS Indre Hornnesvika 13 6809 Førde	Telefon: Fax: e-post: web:	+47 95 84 04 99 +47 57 82 25 00 mindor@sunnfjordbetong.no www.sunnfjordbetong.no
Østfoldforskning	**Forfatter av livsløpsrapporten** Østfoldforskning AS Stadion 4 1671 Kråkerøy	Telefon: Fax: e-post: web:	+47 69 35 11 00 +47 69 34 24 94 www.ostfoldforskning.no
LCA.no	**Utvikler av EPD-generator** LCA.no AS Dokka 1C 1671 Kråkerøy	Telefon: e-post: web:	+47 916 50 916 post@lca.no www.lca.no

epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Eier av deklarasjonen:	Kamstål AS
Programoperatør:	Næringslivets Stiftelse for Miljødeklarasjoner
Utgiver:	Næringslivets Stiftelse for Miljødeklarasjoner
Deklarasjonsnummer:	NEPD-2201-1007-NO
Publiseringsnummer:	NEPD-2201-1007-NO
ECO Platform registreringsnummer:	-
Godkjent dato:	18.05.2020
Gyldig til:	18.05.2025

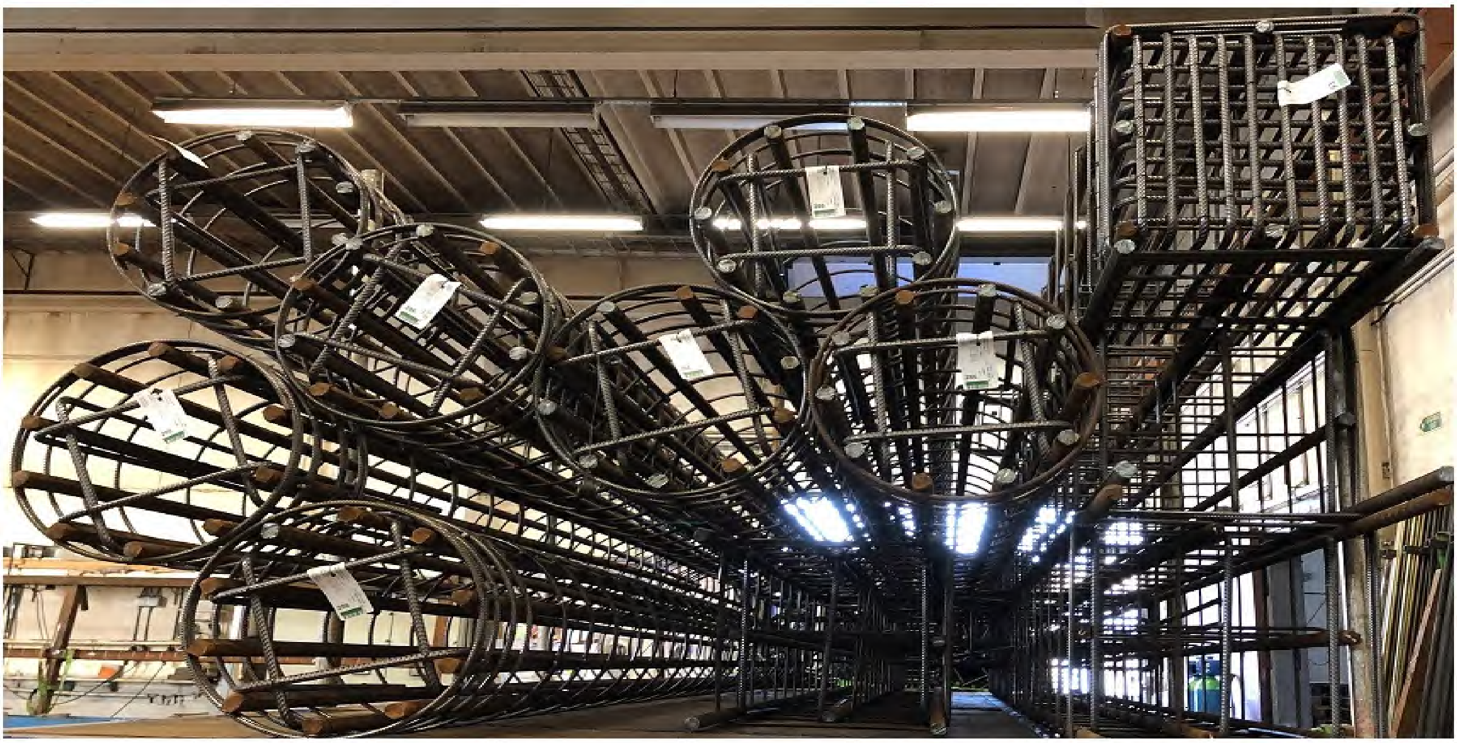
Armeringsløsninger fra Kamstål AS

Kamstål AS

Kamstål AS
Vi gir jernet en ny dimensjon

www.epd-norge.no

Kamstål AS
Vi gir jernet en ny dimensjon
www.kamstal.no



Generell informasjon

Produkt:

Armeringsløsninger fra Kamstål AS

Eier av deklarasjonen:

Kamstål AS
Kontaktperson: Magnus A Krokstad
Telefon: 48219948
e-post: magnus@kamstal.no

Programoperatør:

Næringslivets stiftelse for Miljødeklarasjoner
Pb. 5250 Majorstuen, 0303 Oslo
Phone: +47 23 08 80 00
e-post: post@epd-norge.no

Produsent:

Kamstål AS

Deklarasjonsnummer:

NEPD-2201-1007-NO

Produksjonssted:

Vestre Svanholmen 3,
4313 Sandnes,
Norge

ECO Platform registreringsnummer:

Kvalitet/Miljøsystem:

Deklarasjonen er basert på PCR:

EN 15804:2012+A1:2013 tjener som kjerne-PCR
NPCR 013:2019 Part B for Steel and aluminium construction products

Org. no.:

916 725 280

Erklæring om ansvar:

Eieren av deklarasjonen skal være ansvarlig for den underliggende informasjon og bevis. EPD Norge skal ikke være ansvarlig med hensyn til produsent informasjon, livsløpsvurdering data og bevis.

Godkjent dato: 18.05.2020

Gyldig til: 18.05.2025

Deklarert enhet:

1 kg Armeringsløsninger fra Kamstål AS

Årstall for studien:

2020

Deklarert enhet med opsjon:

A1,A2,A3,A4,C1,C2,C3,C4,D

Sammenlignbarhet:

EPD av byggevarer er nødvendigvis ikke sammenlignbare hvis de ikke samsvarer med NS-EN 15804 og ses i en bygningskontekst.

Funksjonell enhet:

Miljødeklarasjonen er utarbeidet av:

Deklarasjonen er utviklet ved bruk av eEPD v4.0 fra LCA.no
Godkjenning:
Bedriftsspesifikke data er

Samlet og registrert av: Magnus A Krokstad

Kontrollert av: Einar A Mortensen

Verifikasjon:

Uavhengig verifikasjon av data, annen miljøinformasjon og EPD er foretatt etter ISO 14025:2010, kapittel 8.1.3 og 8.1.4

Ekstern

Tredjeparts verifikator:

Sign

Fredrik Moltu Johnsen

(Uavhengig verifikator godkjent av EPD Norge)

Godkjent:

Sign

Håkon Hauan
Daglig leder av EPD-Norge

Produkt

Produktbeskrivelse:

Armeringsprodukter, kappet, bøyd og sveist

Produktspesifikasjon:

Armeringsstål, også kjent som Kamstål, er definert som et lavlegert stål med karboninnhold opp til 0.24%. Det benyttes til å stive av, og styrke, betongkonstruksjoner.

Kamstål blir levert i mange former, men definisjonen er uansett gjeldende om det leveres som rette stenger, bøyde produkter, sveiste korger eller nett.

Material	%
Reinforcement	9,00
Steel	91,00

Tekniske data:

Kamståls leverandører er i all hovedsak BMZ, Serfas, BSW, Pittini. Ytterligere leverandører vil bli definert som standard "Reinforcing Steel" fra generell database.

Alt stål er levert etter NS-EN 10080 og NS 3576-serien.

Markedsområde:

Kamstål AS leverer til Bygg & anlegg, Industri og Vindkraft i hele Norge, men har vår hovedkundebase på Sør- og Vestlandet.

Levetid, produkt:

Ikke relevant

Levetid, bygg:

Ikke relevant

LCA: Beregningsregler

Deklarert enhet:

1 kg Armeringsløsninger fra Kamstål AS

Cut-off kriterier:

Alle viktige råmaterialer og all viktig energibruk er inkludert. Produksjonsprosessen for råmaterialene og energistrømmer som inngår med veldig små mengder (mindre enn 1%) er ikke inkludert. Disse cut-off kriteriene gjelder ikke for farlige materialer og stoffer.

Allokering:

Allokering er gjort iht. bestemmelser i EN 15804. Inngående energi og vann, samt produksjon av avfall i egen produksjon er allokert likt mellom alle produktene gjennom masseallokering. Miljøpåvirkning og ressursforbruk for primærproduksjonen av resirkulerte materialer er allokert til det opprinnelige produktsystemet. Bearbeidingsprosessen og transport av materialet til produksjonssted er allokert til analysen i denne EPDen.

Datakvalitet:

Spesifikke data for produktsammensetningen er fremskaffet av produsenten. De representerer produksjonen av det deklarerte produktet og ble samlet inn for EPD-utvikling i det oppgitte året for studien. Bakgrunnsdata er basert på registrerte EPDer i henhold til EN 15804, Østfoldforskning sine databaser, ecoinvent og andre LCA databaser. Datakvaliteten for råmaterialene i A1 er presentert i tabellen nedenfor.

Materials	Source	Data quality	Year
Reinforcement	NEPD-458-296-EN	EPD	2016
Steel	EPD-BS-GB-10.2	EPD	2017
Reinforcement	ecoinvent 3.5	Database	2018
Steel	BREG EN EPD NO.: 000265	EPD	2019
Steel	EPDITALY0090	EPD	2019

Systemgrenser:

Produksjonen av stålet, samt leveransen til vår nærmeste kai (eller direkte til våre produksjonslokaler) er i stor grad definert som A1 med enkelte unntak. A2 er definert som transport fra kai til våre produksjonslokaler.

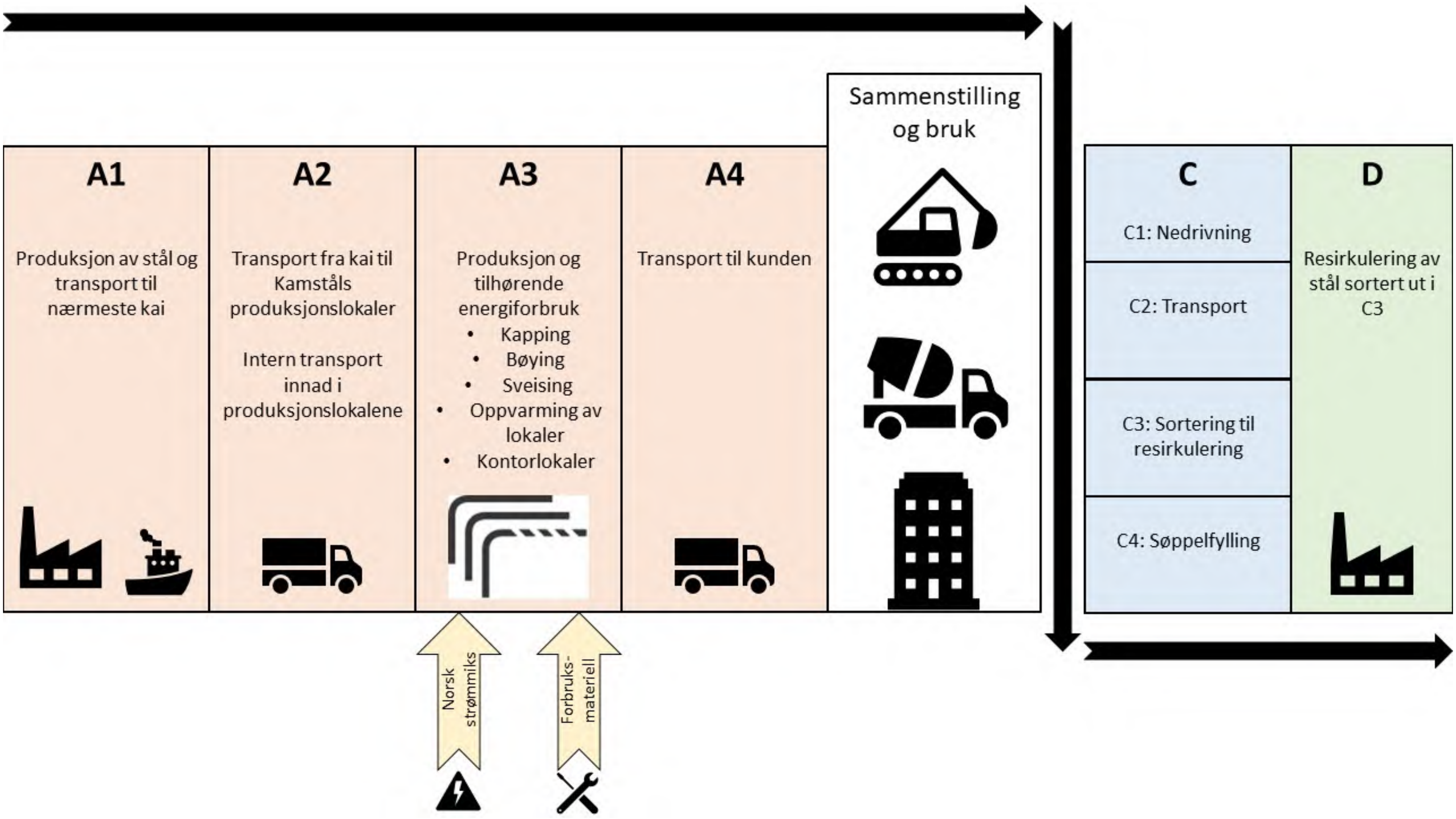
A3 inkluderer all energiforbruk hos Kamstål AS, inkludert oppvarming og belysning i våre produksjons- og kontorlokaler.

Transport fra våre produksjonslokaler og til byggeplass er definert som A4, i denne generelle EPD-en er dette oppgitt som en gjennomsnittlig avstand for våre kunder.

C1 til C4 er nedrivning av konstruksjonen, transport til avfallshåndtering, utsortering til resirkulering og deponering av det stålet som ikke blir solgt som skrapmetall til produksjon av nytt stål respektivt. For C2 og D er det brukt verste scenario funnet med kun 67% resirkulering av armeringen etter bygningen er revet.

Flytskjemaet under illustrerer systemgrensene for analysen.

Flytskjemaet nedenfor illustrerer systemgrensene for analysen:



Teknisk tilleggsinformasjon

Hvis produktet som inneholder armeringen også skal deklarere modulene C og D må disse ekskluderes fra denne EPD for å unngå dobbel bokføring av miljøutslippene.

LCA: Scenarier og annen teknisk informasjon

Følgende informasjonen beskriver scenariene for modulene i EPDen.

Transport fra produksjonssted til bruker (A4)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	Brennstoff/Energi forbruk	Enhet	Verdi (l/t)
Bil	38,8 %	Truck, lorry 16-32 tonnes, EURO 6	30	0,043626	l/tkm	1,31
Jernbane					l/tkm	
Båt					l/tkm	
Annet					l/tkm	

Sluttfase (C1,C3,C4)

.	Enhet	Verdi
Farlig avfall	kg	
Blandet avfall	kg	
Gjenbruk	kg	
Resirkulering	kg	4,0200
Energigjenvinning	kg	
Til deponi	kg	0,3300

Transport avfallsbehandling (C2)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	FBrennstoff/Energi forbruk	Enhet	Verdi (l/t)
Truck	38,8 %	Truck, lorry 16-32 tonnes, EURO 6	50	0,043626	l/tkm	2,18
Jernbane					l/tkm	
Båt					l/tkm	
Annen transport					l/tkm	

..

Gevinst og belastninger etter endt levetid (D)

.	Enhet	Verdi
Substitusjon av primært armeringsstål, med netto sekundært stål (kg)	kg/DU	0,06

LCA: Resultater

Systemgrenser (X=inkludert, MND=modul ikke deklarert, MNR=modul ikke relevant)

Product stage			Construction installation stage		User stage							End of life stage				.	Beyond the system bondaries
Råmaterialer	Transport	Tilvirkning	Transport	Konstruksjons/ installasjonsfase	Bruk	Vedlikehold	Reparasjon	Utskiftinger	Renovering	Operasjonell energibruk	Operasjonell vannbruk	Demontering	Transport	Avfallsbehandling	Avfall til sluttbehandling		Gjenbruk/gjenvinning/ resirkulering-potensiale
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	.	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	.	X

Miljøpåvirkning (Environmental impact)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP	kg CO_2 -eq	7,24E-01	4,78E-03	5,67E-02	7,97E-03	1,34E-04	1,71E-03	-9,85E-02
ODP	kg CFC11 -eq	4,68E-08	9,00E-10	9,82E-09	1,50E-09	1,60E-11	5,68E-10	-4,06E-09
POCP	kg C_2H_4-eq	1,96E-04	7,24E-07	9,50E-06	1,21E-06	3,67E-08	5,22E-07	-6,88E-05
AP	kg SO_2 -eq	2,69E-03	1,12E-05	4,30E-04	1,87E-05	8,36E-07	1,25E-05	-4,40E-04
EP	kg PO_4^{3-} -eq	6,53E-04	1,47E-06	9,36E-05	2,46E-06	1,28E-07	2,20E-06	-1,47E-04
ADPM	kg Sb -eq	9,66E-07	1,49E-08	2,45E-10	2,48E-08	1,00E-11	3,30E-11	-1,90E-06
ADPE	MJ	9,09E+00	7,22E-02	7,84E-01	1,20E-01	1,25E-03	4,81E-02	-9,26E-01

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Ressursbruk (Resource use)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
RPEE	MJ	1,34E+00	1,07E-03	4,27E-03	1,78E-03	1,04E-02	3,93E-04	-8,35E-02
RPEM	MJ	2,19E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TPE	MJ	1,35E+00	1,07E-03	4,27E-03	1,78E-03	1,04E-02	3,93E-04	-8,35E-02
NRPE	MJ	1,07E+01	7,39E-02	7,91E-01	1,23E-01	1,68E-03	4,88E-02	-8,79E-01
NRPM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TRPE	MJ	1,07E+01	7,39E-02	7,91E-01	1,23E-01	1,68E-03	4,88E-02	-8,79E-01
SM	kg	8,68E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	9,01E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	3,13E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3	1,45E-01	1,40E-05	6,80E-05	2,33E-05	6,90E-07	5,28E-05	-6,02E-04

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Avfall (End of life - Waste)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HW	kg	1,43E-02	4,35E-08	2,15E-06	7,26E-08	4,14E-09	7,26E-08	-8,53E-06
NHW	kg	5,57E-01	3,96E-03	3,56E-03	6,60E-03	1,27E-04	3,30E-01	-1,69E-01
RW	kg	INA*	INA*	INA*	INA*	INA*	INA*	INA*

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Utgangsfaktorer (End of life - Output flow)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
CR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MR	kg	5,00E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	INA*	INA*	INA*	INA*	INA*	INA*	INA*
ETE	MJ	INA*	INA*	INA*	INA*	INA*	INA*	INA*

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Norske tilleggskrav

Klimagassutslipp fra bruk av elektrisitet i produksjonsfasen

Nasjonal produksjonsmiks fra import, lavspenning (inkludert produksjon av overføringslinjer, i tillegg til direkte utslipp og tap i nett) er brukt for anvendt elektrisitet i produksjonsprosessen (A3). Bakgrunnsdata er presentert i tabellen under. Karakteriseringsfaktorer fra EN15804:2012+A1:2013 er benyttet.

Elektrisitetsmiks	Datakilde	Mengde	Enhet
El-mix, Norway (kWh)	ecoinvent 3.4	31,04	g CO2-ekv/kWh

Farlige stoffer

Produktet er ikke tilført stoffer fra REACH Kandidatliste eller den norske prioritetslisten.

Inneklima

Produktet vil ikke være eksponert for innemiljø, og derfor ikke ha påvirkning på dette.

Bibliografi

NS-EN ISO 14025:2010 Miljømerker og deklarasjoner - Miljødeklarasjoner type III - Prinsipper og prosedyrer.
NS-EN ISO 14044:2006 Miljøstyring - Livsløpsvurderinger - Krav og retningslinjer.
NS-EN 15804:2012+A1:2013 Bærekraftig byggverk - Miljødeklarasjoner - Grunnleggende produktkategoriregler for byggevarer.
ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products.
ecoinvent v3, Allocation, cut-off by classification, Swiss Centre of Life Cycle Inventories.
Iversen et al., (2018) eEPD v3.0 - Background information for EPD generator system. LCA.no rapportnummer 04.18.
Vold et al., (2019) EPD generator for Norsk Stålforbund - Background information for industry application and LCA data, LCA.no rapportnummer 09.19.
NPCR Part A: Construction products and services. Ver. 1.0. April 2017, EPD-Norge.

epd-norge.no The Norwegian EPD Foundation	**Programoperatør og utgiver** Næringslivets Stiftelse for Miljødeklarasjoner Pb. 5250 Majorstuen 0303 Oslo Norway	Telefon: e-post: web:	+47 23 08 80 00 post@epd-norge.no www.epd-norge.no
Kamstål AS Vi gir jernet en ny dimensjon	**Eier av deklarasjon** Kamstål AS Gamle Forusveien 11 4031 Stavanger	Telefon: Fax: e-post: web:	48219948 magnus@kamstal.no kamstal.no
LCA.no	**Forfatter av livsløpsrapporten** LCA.no AS Dokka 1C 1671 Kråkerøy	Telefon: Fax: e-post: web:	+47 916 50 916 post@lca.no www.lca.no
LCA.no	**Utvikler av EPD-generator** LCA.no AS Dokka 1C 1671 Kråkerøy	Telefon: e-post: web:	+47 916 50 916 post@lca.no www.lca.no

Ver. 1 2015

epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Eier av deklarasjonen:	Moelven Industrier ASA
Programoperatør:	Næringslivets Stiftelse for Miljødeklarasjoner
Utgiver:	Næringslivets Stiftelse for Miljødeklarasjoner
Deklarasjonsnummer:	NEPD-2546-1284-NO
Publiseringsnummer:	NEPD-2546-1284-NO
ECO Platform registreringsnummer:	
Godkjent dato:	23.11.2020
Gyldig til:	23.11.2025

Skurlast av gran eller furu

Moelven Industrier ASA

www.epd-norge.no

Generell informasjon

Produkt:
Skurlast av gran eller furu

Eier av deklarasjonen:
Moelven Industrier ASA
Kontaktperson: Kundesenter Moelven Wood AS
Tlf: +47 63 95 97 50
e-post: post.wood@moelven.no

Program operatør:
Næringslivets Stiftelse for Miljødeklarasjoner
Postboks 5250 Majorstuen, 0303 Oslo
Tlf: +47 23 08 80 00
e-post: post@epd-norge.no

Produsent:
Moelven Wood

Deklarasjon nummer:
NEPD-2546-1284-NO

Produksjonssteder:
Moelven Edanesågen, Moelven Van Severen, Moelven Soknabruket, Moelven Valåsen.

ECO Platform registreringsnummer:

Kvalitet/Miljøsystem:
PEFC Certifikatsnummer: 1700162-02
Certifikatets sista giltighetsdag: 14 januari 2021
PEFC Certificate No: 2018-SKM-PEFC-248
Certificate Expiry Date: 01 September 2021

FSC Certificate Code: SCS-COC-003149
Certifikatets sista giltighetsdag: 21 June 2025
FSC Certificate DNV-COC-000538
Certificate Expiry Date: 01 02 October 2022

Deklarasjonen er basert på PCR:
CEN Standard EN 15804 tjener som kjerne PCR
NPCR 015 version 3.0 - Part B for wood and wood-based products for use in construction (04/2019).

Org. no.:
914 348 803

Erklæringen om ansvar:
Eieren av deklarasjonen skal være ansvarlig for den underliggende informasjon og bevis. EPD Norge skal ikke være ansvarlig med hensyn til produsent informasjon, livsløpsvurdering data og bevis.

Godkjent dato:
23.11.2020

Gyldig til:
23.11.2025

Deklarert enhet:
Produksjon av 1 m^3 skurlast av gran eller furu

Årstall for studien:
2020

Deklarert enhet med opsjon:
Produksjon av 1 m^3 skurlast av gran eller furu som er avfallsbehandlet ved endt levetid

Sammenlignbarhet:
EPD av byggevarer er nødvendigvis ikke sammenlignbare hvis de ikke samsvarer med NS-EN 15804 og ses i en bygningskontekst.

Funksjonell enhet:

Miljødeklarasjonen er utarbeidet av:
Vegard Ruttenborg
Norsk Treteknisk Institutt

Vegard Ruttenborg

Treteknisk

Verifikasjon:
Uavhengig verifikasjon av deklarasjonen og data, i henhold til ISO 14025:2010

☐ internt ☑ eksternt

Tredjeparts verifikator:

Ellen Soldal

Ellen Soldal, PhD
(Uavhengig verifikator godkjent av EPD Norge)

Godkjent

Håkon Hauan

Håkon Hauan
Daglig leder av EPD-Norge

Produkt

Produktbeskrivelse:
Skurlast av gran eller furu produseres av nordisk råstoff. Skurlast er saget og tørkede produkter i ulike dimensjoner. Produktene leveres i stor grad til egne, integrerte høvlerier, men også til frittstående høvlerier. Produktene kan leveres styrkesortert fra C14 til C30.

Tekniske data:
Skurlast av gran og furu har tørrvekt på 375 kg/m^3 gran og 435 kg/m^3 furu. Fuktigheten ligger mellom 12 og 20%, avhengig av bruksområde. I tillegg spiller trestrukturen stor rolle i tørrvekt.Skurlast produseres ihht NS-EN-1:1999+A1 og styrkesortert konstruksjonsvirke ihht NS-EN 14081.

Produktspesifikasjon:
Det er stor variasjon i trevirkets densitet. I beregningene er det tatt utgangspunkt i teknisk spesifikasjon for furu med en tørrvekt på 435 kg/m^3 og fuktighet relativt til tørrvekt på 17%.

Markedsområde:
Primært Norge og Sverige.

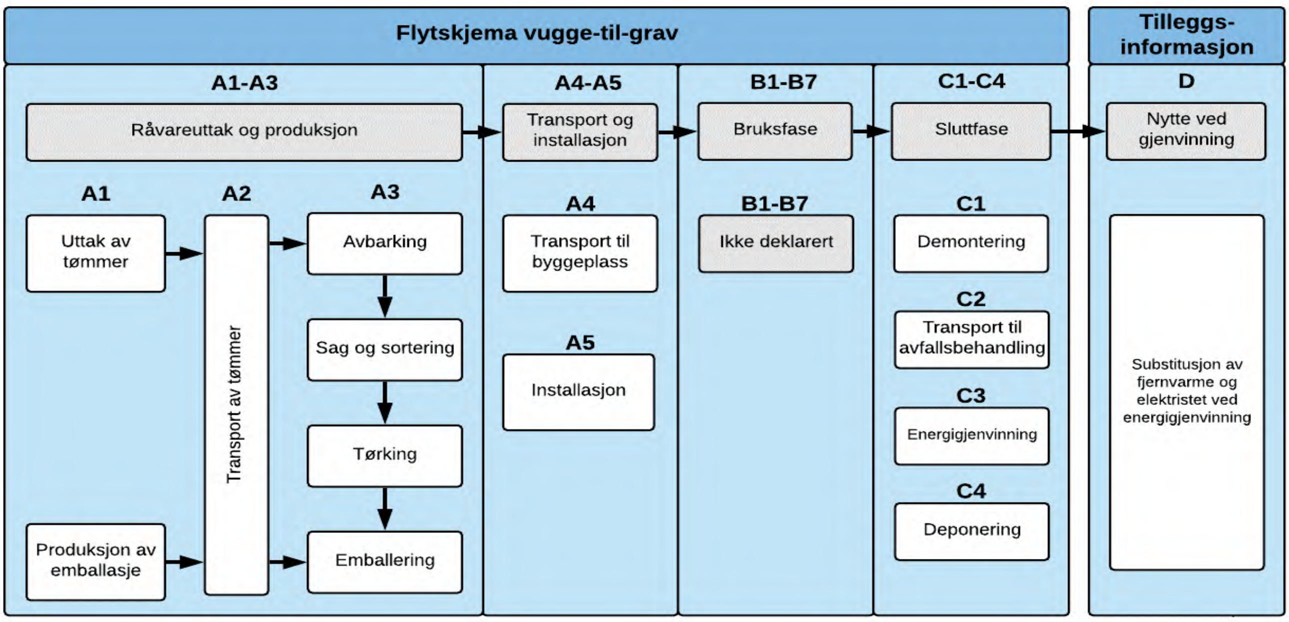
Materialer	kg	%
Trevirke, tørrvekt	435.00	85.47 %
Vann i treverket	73.95	14.53 %
Sum produkt	**508.95**	**100.00 %**
Treemballasje	1.64	
Plastemballasje	0.73	
Sum med emballasje	**511.31**	

Levetid:
Produktet er et råstoff og referanselevetid er derfor ikke oppgitt.

LCA: Beregningsregler

Deklarert enhet:
Produksjon av 1 m3 skurlast av gran eller furu

Systemgrenser:
Flytskjema for livsløpet er vist under. Modul D er beregnet med energisubstitusjon og er nærmere forklart under scenarioene.



Datakvalitet:
Produksjonsdata er innhentet fra produksjonsstedet i 2019 med tall for 2018. Data for uttak av tømmer er basert på rapporten av Timmermann og Dibdiokova (2013) og produksjon av fjernvarme er basert på data fra Statistisk Sentralbyrå (2018a,b,c). Resterende data er basert på Ecoinvent v3.0-3.5, men hvor alle oppstrømsprosesser er fra Ecoinvent v3.5 Systemmodell for Ecoinvent prosesser er "Allocation cut-off by classification". Modellering og beregninger er utført med SimaPro 9.0.0.48.

Cut-off kriterier:
Alle viktige råmaterialer og all viktig energibruk er inkludert. Produksjonsprosessen for råmaterialene og energistrømmer som inngår med veldig små mengder (<1%) er ikke inkludert. Summen av utelatte material- og energistrømmer er ikke over 5% per modul. Disse cut-off kriteriene gjelder ikke for farlige materialer og stoffer.

Allokering:
Allokering er gjort i henhold til bestemmelser i EN 15804. Inngående energi, vann, avfall og interntransport er delt opp i underprosesser og så allokert etter inntekt mellom hoved- og biproduktene. Påvirkning for primærproduksjonen av resirkulerte materialer er allokert til hovedproduktet der materialet ble brukt.

Beregning av biogent karboninnhold:
Opptak og utslipp av karbondioksid fra biologisk opphav er beregnet basert på NS-EN 16485:2014. Denne metoden er basert på modularitetsprinsippet i EN 15804:2012, og hvor utslipp skal telles med i den livsløpsmodulen hvor det faktisk skjer. Mengden karbondioksid er beregnet i henhold til NS-EN 16449:2014. Nettobidraget til GWP fra biogent karbon er vist for hver modul på side 8. Trevirke kommer fra bærekraftig skogbruk og har PEFC og FSC sertifisert sporbarhet (PEFC 2018; 2019; FSC 2019; 2020).

LCA: Scenarier og annen teknisk informasjon

Følgende informasjonen beskriver scenariene for modulene i EPDen.

Transport fra produksjonssted til bruker (A4)
En stor andel av ferdig produkt er råstoff til egen videreforedling. En liten andel kjøres derfor til andre industrikunder. Transport går utelukkende på store lastebiler, primært Euro 6.

Type	Kapasitetsutnyttelse inkl. retur (%)	Kjøretøytype	Distanse km	Brennstoff/ Energiforbruk	Brennstoff/ Energiforbruk
Lastebil	60 %	EURO6, >32 tonn	50	0.023 l/tkm	0.31 l/km

Byggefase (A5)
Det er kun antatt avfallshåndtering av emballasje. Andre aktiviteter er ikke relevant da den deklarerte enhten er et industriprodukt.

	Enhet	Verdi
Hjelpematerialer	kg	
Vannforbruk	m^3	
Elektrisitetsforbruk	MJ	
Andre energikilder	MJ	
Materialtap	kg	
Materialer fra avfallsbehandling	kg	2.36
Støv i luften	kg	

Sluttfase (C1, C3, C4)
Det er antatt 1 MJ energiforbruk for demontering ved endt levetid. Trevirke blir behandlet som rent trevirke (1141) i henhold til NS 9431:2011 og blir behandlet med energigjenvinning.

	Enhet	Verdi
Farlig avfall	kg	
Blandet avfall	kg	509.0
Gjenbruk	kg	
Resirkulering	kg	
Energigjenvinning	kg	509.0
Til deponi	kg	

Transport avfallsbehandling (C2)
Transporten av treavfall er basert på gjennomsnittsavstanden for 2007 i Norge og utgjør 85 km (Raadal et al. (2009).

Type	Kapasitetsutnyttelse inkl. retur (%)	Kjøretøytype	Distanse km	Brennstoff/ Energiforbruk per tkm	Brennstoff/ Energiforbruk per km
Bil	44 %	Uspesifisert	85	0.03 l/tkm	0.28 l/km

Gevinst og belastninger etter endt levetid (D)
Gevinsten av eksportert energi fra energigjenvinning i kommunalt avfallsanlegg er beregnet med erstatning av norsk el-miks og norsk fjernvarmemiks. Data for el-miks er samme som brukt i A1-A3 og fjernvarmemiks er basert på produksjonen i 2017.

	Enhet	Verdi
Substitusjon av elektrisk energi	MJ	699.5
Substitusjon av termisk energi	MJ	4808.9
Substitusjon av råmaterialer	kg	0.0

LCA: Resultater

Globalt oppvarmingspotensial i A1-A3 inkluderer opptak av 797 kg CO2 gjennom fotosyntensen som er bundet som karbon i treverket i produktet. Den samme mengden CO2 slippes ut igjen ved forbrenning av trevirket i modul C3. I tillegg er det bundet 2,4 kg karbon i treemballasjen i A1-A3. Dette blir sluppet ut igjen ved forbrenning av emballasjen i modul A5. Nettobidraget fra biogent karbon i hver modul er vist på side 8.

Systemgrenser (X = inkludert, MID = modul ikke deklarert, MIR = modul ikke relevant)

Produktfase			Konstruksjon installasjon fase		Bruksfase							Sluttfase				Etter endt levetid
Råmaterialer	Transport	Tilvirkning	Transport	Konstruksjon installasjon fase	Bruk	Vedlikehold	Reparasjon	Utskiftinger	Renovering	Operasjonell energibruk	Operasjonell vannbruk	Demontering	Transport	Avfallsbehandling	Avfall til sluttbehandling	Gjenbruk-gjenvinning-resirkulering-potensiale
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MID	MID	MID	MID	MID	MID	MID	X	X	X	X	X

Miljøpåvirkning

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP	kg CO_2 -ekv	-7.38E+02	2.07E+00	2.40E+00	0.00E+00	5.43E+00	8.04E+02	4.00E-02	-3.40E+01
ODP	kg CFC11-ekv	1.12E-05	4.24E-07	0.00E+00	0.00E+00	1.02E-06	5.17E-07	1.56E-08	-3.77E-06
POCP	kg C_2H_4 -ekv	2.09E-02	3.23E-04	0.00E+00	0.00E+00	8.92E-04	2.13E-03	1.19E-05	-1.85E-02
AP	kg SO_2 -ekv	2.92E-01	5.32E-03	0.00E+00	0.00E+00	1.77E-02	6.08E-02	2.72E-04	-1.88E-01
EP	kg PO_4^{3-}-ekv	7.06E-02	1.12E-03	0.00E+00	0.00E+00	2.92E-03	2.08E-02	4.92E-05	-5.02E-02
ADPM	kg Sb-ekv	1.96E-04	4.81E-06	0.00E+00	0.00E+00	1.50E-05	9.46E-06	5.57E-08	-1.39E-04
ADPE	MJ	9.28E+02	3.39E+01	0.00E+00	0.00E+00	8.88E+01	5.81E+01	1.51E+00	-4.56E+02

GWP Globalt oppvarmingspotensial; ODP Potensial for nedbryting av stratosfærisk ozon; POCP Potensial for fotokjemisk oksidantdanning; AP Forsurningspotensial for kilder på land og vann; EP Overgjødslingspotensial; ADPM Abiotisk uttømmingspotensial for ikke-fossile ressurser; ADPE Abiotisk uttømmingspotensial for fossile ressurser

Ressursbruk

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
RPEE	MJ	1.94E+03	6.15E-01	0.00E+00	0.00E+00	9.09E-01	8.35E+03	2.36E-02	-2.94E+03
RPEM	MJ	6.98E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-8.35E+03	0.00E+00	0.00E+00
TPE	MJ	8.92E+03	6.15E-01	0.00E+00	0.00E+00	9.09E-01	1.67E+00	2.36E-02	-2.94E+03
NRPE	MJ	1.10E+03	3.50E+01	0.00E+00	0.00E+00	9.02E+01	6.05E+01	1.55E+00	-5.60E+02
NRPM	MJ	3.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	1.13E+03	3.50E+01	0.00E+00	0.00E+00	9.02E+01	6.05E+01	1.55E+00	-5.60E+02
SM	kg	2.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	5.27E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.12E+03
NRSF	MJ	3.52E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.41E+03
W	m^3	2.20E+00	8.27E-03	0.00E+00	0.00E+00	1.47E-02	1.08E-01	1.84E-03	-1.18E+01

RPEE Fornybar primærenergi brukt som energibærer; RPEM Fornybar primærenergi brukt som råmateriale; TPE Total bruk av fornybar primærenergi; NRPE Ikke fornybar primærenergi brukt som energibærer; NRPM Ikke fornybar primærenergi brukt som råmateriale; TRPE Total bruk av ikke fornybar primærenergi; SM Bruk av sekundære materialer; RSF Bruk av fornybart sekundære brensel; NRSF Bruk av ikke fornybart sekundære brensel; W Netto bruk av ferskvann

Livsløpets slutt - Avfall

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HW	kg	2.40E-01	1.85E-05	0.00E+00	0.00E+00	6.26E-03	4.75E-02	5.56E+00	-2.27E-01
NHW	kg	4.38E+01	3.20E+00	0.00E+00	0.00E+00	5.35E+00	1.24E+00	6.93E-01	-1.15E+01
RW	kg	7.84E-03	2.45E-04	0.00E+00	0.00E+00	5.74E-04	1.48E-04	9.01E-06	-2.51E-03

HW Avhendet farlig avfall; NHW Avhendet ikke-farlig avfall; RW Avhendet radioaktivt avfall

Livsløpets slutt - Utgangsfaktorer

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
CR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	3.42E-01	0.00E+00	7.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	1.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	5.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.99E+02	0.00E+00	-6.99E+02
ETE	MJ	5.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E+03	0.00E+00	-4.81E+03

CR-komponenter for gjenbruk, MR Materialer for resirkulering, MER Materialer for energigjenvinning, EEE Eksportert elektrisk energi; ETE Eksportert termisk energi

Lese eksempel: 9,0 E-03 = $9{,}0*10^{-3}$ = 0,009

Norske tilleggskrav

Klimagassutslipp fra bruk av elektrisitet i produksjonsfasen
Norsk og svensk markedsmiks med import på lavspenning, inkludert produksjon av overføringslinjer og nettap, er anvendt for elektrisitet i produksjonprosessen (A3).

Data kilde	Mengde	Enhet
Ecoinvent v3.5 (august 2018) - Norge	31.7	gram CO_2-ekv./kWh
Ecoinvent v3.5 (august 2018) - Sverige	48.0	gram CO_2-ekv./kWh

Farlige stoffer
- ☑ Produktet inneholder ingen stoffer fra REACH Kandidatliste eller den norske prioritetslisten
- ☐ Produktet inneholder stoffer som er under 0,1 vekt% på REACH Kandidatliste eller den norske prioritetslisten.
- ☐ Produktet inneholde stoffer fra REACH Kandidatliste eller den norske prioritetslisten, se tabell under Spesifikke norske krav.
- ☐ Produktet inneholder ingen stoffer på REACH Kandidatliste eller den norske prioritetslisten. Produktet kan karakteriseres som farlig avfall (etter Avfallsforskiften, Vedlegg III), se tabell under Spesifikke norske krav.

Transport
Transport fra produksjonssted til videreforedling i Norge i henhold til senario i A4: 50 km

Inneklima
Ikke relevant for dette produktet.

Bærekraftig skogbruk
PEFC og FSC sertifikatene som dokumenterer bærekraftig skogbruk er ikke gyldig i hele gyldighetsperioden for EPD og må derfor oppdateres for at EPD skal være gyldig i hele perioden. (PEFC 2018; 2019; FSC 2019; 2020).

Klimadeklarasjon
For å øke transparensen i bidraget til klimapåvirkning, så er indikatoren GWP blitt delt opp her i underindikatorer:
GWP-IOBC Klimapåvirkning beregnet etter umiddelbar oksidasjon av biogent karbon prinsippet.
GWP-BC Klimapåvirkning fra netto opptak og utslipp av biogent karbon fra materialene i hver modul.

Klimapåvirkning

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-IOBC	kg CO_2 -ekv	6.17E+01	2.07E+00	0.00E+00	0.00E+00	5.43E+00	6.79E+00	4.00E-02	-3.40E+01
GWP-BC	kg CO_2 -ekv	-8.00E+02	0.00E+00	2.40E+00	0.00E+00	0.00E+00	7.98E+02	0.00E+00	0.00E+00
GWP	kg CO_2 -ekv	-7.38E+02	2.07E+00	2.40E+00	0.00E+00	5.43E+00	8.04E+02	4.00E-02	-3.40E+01

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FSC (2019)	*FSC Chain of custody certificate. Certificate No. DNV-COC-000538*
FSC (2020)	*FSC mixed; FSC Controlled Wood. Certificate Code: SCS-COC-003149*
ISO 21930:2007	*Sustainability in building construction - Environmental declaration of building products*
NPCR 015 version 3.0	*Product category rules. Part B for wood and wood-based products for use in construction (04/2019)*
NS-EN 16449:2014	*Tre og trebaserte produkter - Beregning av biogent karboninnhold i tre og omdanning til karbondioksid*
NS-EN ISO 14025:2010	*Miljømerker og deklarasjoner - Miljødeklarasjoner type III - Prinsipper og prosedyrer.*
NS-EN 16485:2014	*Tømmer og skurlast - Miljødeklarasjoner - Produktkategoriregler for tre og trebaserte produkter til bruk i byggverk*
NS-EN 15804:2012+A1:2013	*Bærekraftig byggverk - Miljødeklarasjoner - Grunnleggende produktkategoriregler for byggevarer*
NS 9431:2011	*Klassifikasjon av avfall*
NS-EN 14081-1:2005+A1:2011	*Trekonstruksjoner - Styrkesortert konstruksjonsvirke med rektaungulært tversnitt - Del 1: Generelle krav*
NS-EN 1611-1:1999+A1	*Skurlast - Sortering av bartrevirke etter utseende - Del 1: Gran, edelgran, furu, Douglas-gran og lerk (innbefattet endringsblad A1:2002)*
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Environmental Product Declaration

according to ISO 14025 and EN 15804

This declaration is for:

International Interzinc 52E (Part A & Part B)

Provided by:

AkzoNobel

program operator
Stichting MRPI®
publisher
Stichting MRPI®
www.mrpi.nl

MRPI® registration
1.1.00113.2020
EPD registration
00001172
date of first issue
10-04-2020
date of this issue
10-04-2020
expiry date
10-04-2025

ECO PLATFORM EPD EN 15804 VERIFIED

MRPI milieu relevante product informatie

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Felling, Gateshead United Kingdom

https://www.international-pc.com/

PRODUCT
International Interzinc 52E (Part A & Part B)

MRPI® REGISTRATION
1.1.00113.2020

EPD REGISTRATION
00001172

DATE OF ISSUE
10-04-2020

EXPIRY DATE
10-04-2025

DECLARED UNIT/FUNCTIONAL UNIT
All impacts are calculated using the declared unit “decoration of 1 m2 of surface”

SCOPE OF DECLARATION
This MRPI®-EPD certificate is verified by **ing. Kamiel Jansen, Primum.**
The LCA study has been done by **Max Sonnen, Ecomatters.**
The certificate is based on an LCA-dossier according to ISO14025 and NEN-EN15804+A1. It is verified according to the 'EPD-MRPI® verification protocol May 2017.v3.1'. EPDs of construction products may not be comparable if they do not comply with NEN-EN15804+A1. Declaration of SVHC that are listed on the 'Candidate List of Substances of Very High Concern for authorisation' when content exceeds the limits for registration with ECHA.

VISUAL PRODUCT

DESCRIPTION OF PRODUCT
Interzinc 52E is a high solid, two component, metallic zinc-rich epoxy primer utilising phenalkamine technology to offer productivity through fast dry and rapid recoatability.

MORE INFORMATION
https://www.international-pc.com/product/interzinc-52e

DEMONSTRATION OF VERIFICATION
CEN standard EN15804 serves as the core PCR[a]
Independent verification of the declaration and data, according to EN ISO 14025:2010: internal: external: X
(where appropriate[b]) Third party verifier: Jansen Kamiel Jansen, Primum
[a] Product Category Rules [b] Optional for B-to-B communication, mandatory for B-to-C communication (see EN ISO 14025:2010, 9.4).

DETAILED PRODUCT DESCRIPTION

Interzinc 52E is a high solid, two component, metallic zinc-rich epoxy primer utilising advanced phenalkamine technology to offer improved productivity through fast dry and rapid recoatability.

Typical use

As a high performance primer to give maximum protection as part of any anti-corrosive coating system for aggressive environments including those found on offshore structures, petrochemical facilities, pulp and paper plants, bridges and power plants.

Application Method

Airless Spray, Air spray, Brush.

Production process and conditions of delivery

During paint production, the raw materials are pre-weighed according to the percentage of each in the formulation. The pigment is then dispersed in a mixture of binder using a variety of machines. Finally, the paint undergoes QC (quality control), is filtered and filled into the appropriate packaging container(s). All paint containers are transported from the production sites to a distribution center and finally to the customers.

Pack size

10 litre composite pack (2 part) as standard.

COMPONENT (> 1%)	[kg / %]
Pigment: Lightfast Pigments	Confidential
Binder: Ethylene copolymer	Confidential
Solvent: Water	Confidential

(*) > 1% of total mass

SCOPE AND TYPE

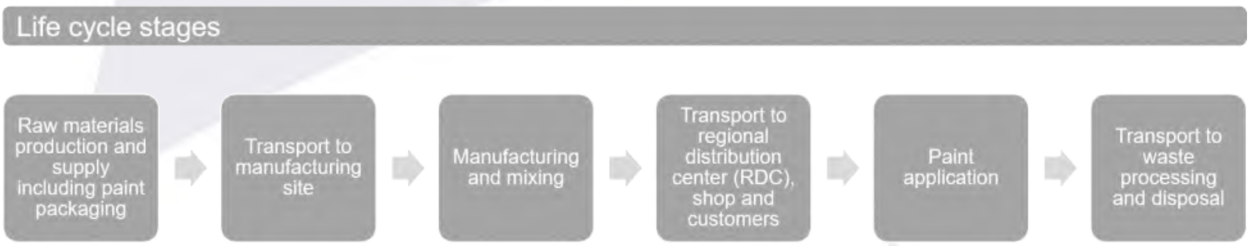
The type of this EPD is Cradle-to-Gate with options. All major steps from the extraction of natural resources to the final disposal of the product are included in the environmental performance of the manufacturing phase, except those that are not relevant to the environmental performance of the product. This declaration does not imply an indicator result of zero. The coating is produced in Sweden, China, Indonesia, Saudi Arabia, United States and India and the application market is for customers around the world. Likewise, for the end-of-life, the fate of the coating product is described within a global context.
The software GaBi 9.2 Professional is used to perform the LCA. In the model Ecoinvent 3.5 database was used. The validity of this EPD is in correspondence with the specifications of the LCA project report.

All impacts associated with the upstream production of materials and energy are included in the system boundaries. Mining activities and controlled landfills are included in the product systems. Similarly, wastewater treatment activities are also considered within the technological systems. The emissions and resource extractions derived from these processes are considered elementary exchanges between the product systems and the environment.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport gate to site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling- potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MNA

X = Module assessed

MNA = Module not assessed



REPRESENTATIVENESS

The coating is manufactured in different production sites (Sweden, China, Australia, Saudi Arabia, United States and India) and therefore, the following average calculation rule is used: the weighted average of the coating characteristics based on the production volumes per production site.

The used data is representative for all locations and thus this EPD is considered to be representative for products produced in Sweden, China, Indonesia, Saudi Arabia, United States and India which are sold in a global market.

Unit	Quantity
Density (kg/l)	2232
Coverage (kg/m2)	0.206
Number of Layers	1
Total product used (kg/m2)	0.206

ENVIRONMENTAL IMPACT per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADPE	kg Sb-eq.	1.36 E -3	1.59 E -7	1.70 E -8	1.36 E -3	9.54 E -8	3.53 E -8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59 E -9	0.00	1.03 E -7	0.00
ADPF	MJ	1.76 E +1	9.00 E -1	6.71 E -1	1.92 E +1	6.60 E -1	9.24 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.93 E -2	0.00	3.69 E +0	0.00
GWP	kg CO2-eq.	1.25 E +0	5.87 E -2	6.94 E -2	1.38 E +0	4.19 E -2	1.69 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83 E -3	0.00	8.24 E -1	0.00
ODP	kg CFC11-eq.	5.59 E -8	1.08 E -8	2.29 E -10	6.69 E -8	7.95 E -9	2.67 E -9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.55 E -10	0.00	8.54 E -9	0.00
POCP	kg ethene-eq.	7.57 E -4	2.79 E -5	4.69 E -5	8.32 E -4	1.83 E -5	3.81 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.03 E -7	0.00	7.21 E -4	0.00
AP	kg SO2-eq.	1.29 E -2	3.24 E -4	1.49 E -4	1.34 E -2	1.75 E -4	3.81 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25 E -6	0.00	1.65 E -3	0.00
EP	kg (PO4)3--eq.	4.26 E -3	7.67 E -5	2.47 E -5	4.36 E -3	5.05 E -5	1.54 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.19 E -6	0.00	6.21 E -4	0.00

INA = Indicator Not Assessed
ADPE = Abiotic Depletion Potential for non-fossil resources
ADPF = Abiotic Depletion Potential for fossil resources
GWP = Global Warming Potential
ODP = Depletion potential of the stratospheric ozone layer
POCP = Formation potential of tropospheric ozone photochemical oxidants
AP = Acidification Potential of land and water
EP = Eutrophication Potential

RESOURCE USE per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	1.47 E +0	9.96 E -3	2.61 E -2	1.51 E +0	6.71 E -3	4.96 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13 E -4	0.00	1.45 E -1	0.00
PERM	MJ	4.85 E -4	0.00	-4.20 E -6	4.81 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	1.47 E +0	9.96 E -3	2.61 E -2	1.51 E +0	6.71 E -3	4.96 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13 E -4	0.00	1.45 E -1	0.00
PENRE	MJ	1.84 E +1	9.14 E -1	6.89 E -1	2.00 E +1	6.69 E -1	9.68 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98 E -2	0.00	3.72 E +0	0.00
PENRM	MJ	6.07 E -4	0.00	1.08 E -10	6.07 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENRT	MJ	1.84 E +1	9.15 E -1	6.89 E -1	2.00 E +1	6.69 E -1	9.68 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98 E -2	0.00	3.72 E +0	0.00
SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m3	2.36 E -2	1.65 E -4	-1.53 E -4	2.36 E -2	1.27 E -4	1.93 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.89 E -6	0.00	4.89 E -4	0.00

INA = Indicator Not Assessed
PERE = Use of renewable energy excluding renewable primary energy resources
PERM = Use of renewable energy resources used as raw materials
PERT = Total use of renewable primary energy resources
PENRE = Use of non-renewable primary energy resources excluding non-renewable energy resources used as raw materials
PENRM = Use of non-renewable primary energy resources used as raw materials
PENRT = Total use of non-renewable primary energy resources
SM = Use of secondary materials
RSF = Use of renewable secondary fuels
NRSF = Use of non renewable secondary fuels
FW = Use of net fresh water

OUTPUT FLOWS AND WASTE CATEGORIES per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	0.00	0.00	1.86 E -3	1.86 E -3	0.00	3.71 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.06 E -1	0.00
NHWD	kg	0.00	0.00	3.18 E -3	3.18 E -3	0.00	9.75 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	0.00	0.00	0.00	0.00	0.00	1.07 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ETE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

INA = Indicator Not Assessed
HWD = Hazardous Waste Disposed
NHWD = Non Hazardous Waste Disposed
RWD = Radioactive Waste Disposed
CRU = Components for reuse
MFR = Materials for recycling
MER = Materials for energy recovery
EEE = Exported Electrical Energy
ETE = Exported Thermal Energy

CALCULATION RULES

Cut off criteria

There is no cut-off of inputs and outputs in any of the processes during the life cycle stage, hence the environmental impact of all unit processes of each life cycle stage are considered.

Data quality and data collection period

Specific data was collected from AkzoNobel though a questionnaire, including inquiries about coating characteristics and packaging, logistics data (e.g. transport), production information and end-of-life. The data collection period for specific data was the year 2019.

Data gaps (i.e. transport data for two productions sites Australia and India) were covered with data generic values for transport as described in the Product Environmental Footprint Category Rules - Decorative Paints document version 1.0 published by CEPE and reviewed in April 2018. Further data gaps (i.e. end-of-life transport data) were covered with data from internal AkzoNobel LCA studies concerning the same type of products (paints and coatings). Generic data (i.e. upstream acquisition and production of raw materials, energy generation, waste treatment processes) was selected from Ecoinvent 3.5 database. In the case of missing data, a relevant proxy was searched and adjusted to the corresponding unit process.

Allocation procedure

To allocate the emissions and inputs to the manufactured products, the decision-hierarchy in ISO 14044 is used (ISO 2006). It is not possible to sub-divide the site data into a more detailed level or find physical causalities between inputs and outputs, thus allocation is done based on mass, considering an annual production of coating product for each site. The coating production is basically a process of mixing ingredients and, therefore, the environmental impact is fairly to be related to the mass of the products.

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

A1. Raw materials supply

This module considers the extraction and processing of all raw materials and energy which occur upstream to the International Interzinc 52E manufacturing process, as well as waste processing up to the end-of waste state.

A2. Transport of raw materials to manufacturer

This includes the transport distance of the raw materials to the manufacturing facility via road and boat. On average, the transport characteristics for this life cycle stage are the following:

Transport Type	Truck 1	Truck 2	Container ship coast
Distance (km)	232.74	1135.56	1855.71
Capacity	34-40 t ,60% payload	40-60 t, 60% payload	70% utilization factor
Bulk density of transported products	2232 kg/m3	2232 kg/m3	2232 kg/m3

A3. Manufacturing

This module covers the manufacturing of the International Interzinc 52E coating and includes all processes linked to production such as storing, mixing, packing and internal transportation. Use of electricity and fuels in coating production are taken into account as well.

Data regarding coating production was provided for the manufacturing sites where International Interzinc 52E coating is produced: Sweden, China, Australia, Saudi Arabia, United States and India. Furthermore, the specific transport distances and transportation modes for raw materials, coating packaging and transportation to customer were collected from the AkzoNobel logistics department, except for two production sites were generic data is used. Primary data and site-specific data were retrieved. For electricity sources, Ecoinvent datasets were used for each of the countries where the production site is located. For upstream (raw material processes) and downstream processes (application, use, and waste processing) generic data is used when no specific data is obtained.

The construction site data includes lighting, heating, offices, etc. The manufacture of production equipment and infrastructure is not included in the system boundary. Packaging-related flows in the production process and all up-stream packaging are included in the manufacturing module. For the end-of-life packing of the coatings a landfill scenario is assumed.

A4. Transport to Regional Distribution Centre and customer

All coating containers are transported from the manufacturing facilities into a distribution centre and then finally, to the customer. On average, the transport characteristics for this life cycle stage are the following:

PARAMETER	Transport from factory to RDC	Transport from RDC to customer
Transport Type	Truck 1	Truck 2
Distance (km)	2,727.87	377.67
Capacity	34-40 t ,60% payload	40-60 t, 60% payload
Bulk density of transported products	2232 kg/m3	2232 kg/m3

A5. Application and use

This module includes the environmental aspects and impacts associated with the application and of the coating. The use of energy from air spray for coating application purposes is included.

PARAMETER	(KWh/ kg)
Energy for application	0.1

C2. Transport to incineration or landfill

This module includes one-way transportation distance of the demolition or sorting site to the dump site.

PARAMETER	Transport to waste processing
Vehicle type	Truck 34t-40t payload average fleet
Distance	100 km
Capacity utilisation	60%
Bulk density of transported products	2232 kg/m3

C3. Waste processing and C4. Disposal

The end of life stage is encompassed in these modules. It is assumed that part of the coating is lost during application and the rest is applied. After its lifetime, it is assumed that the coatings end up in incineration. These assumptions are based on best knowledge of the end of life of coating from direct contact with AkzoNobel.

ADDITIONAL INFORMATION ON ENVIRONMENTAL IMPACTS

The CML-IA methods do not have characterization factors for the “unspecified VOC” emission flow in the Global Warming Potential environmental impact category. However, VOCs are known to have influence in this category. In order to include the impacts of the VOCs and align with current practice of AkzoNobel, it was decided to calculate the VOC impact on Global Warming Potential separately. The Global Warming Potential impact category has been modified, adding a generic factor of 4.23 kgCO2-eq/kg VOC, which is sourced from IPCC 2013 data. This is also in line with Akzo Nobel’s current methodology for carbon reporting.

Environmental Impact	UNIT	A1	A2	A3	A4	A5	C2	C4
Global Warming potential (GWP 100 years)	[kg CO2-Eq.]	1.25E+0	5.87E-2	6.94E-2	4.19E-2	1.69E-1	1.83E-3	8.24E-1
Global Warming potential (GWP 100 years) incl. VOC char. fact.	[kg CO2-Eq.]	1.25E+0	5.87E-2	6.98E-2	4.19E-2	7.76E-1	1.83E-3	8.24E-1

DECLARATION OF SVHC

None of the substances contained in the product are listed in the “Candidate List of Substances of Very High Concern for authorisation”, or they do not exceed the threshold with the European Chemicals Agency.

REFERENCES

• EN 15804:2012+A1:2013 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products, of 11/2013.

• ISO 14040/14044 on Life Cycle Assessments

• Product Environmental Footprint Category Rules - Decorative Paints version 1.0, 2018. Developed by the Technical Secretariat Decorative Paints of the European Council of the Paint, Printing Ink and Artists' Colours Industry.

• Stephenson A. Personal communication with Adam Stephenson, AkzoNobel Protective Coatings, United Kingdom (2020).

• Thinkstep GaBi Software-System and Database for Life Cycle Engineering. Copyright 1992-2017 ThinkStep AG.

• Ecoinvent 3.5 database (2019).

REMARKS

None

Environmental Product Declaration

according to ISO 14025 and EN 15804

milieu relevante product informatie

This declaration is for:

International Interthane 990E (Part A & Part B)

Provided by:

AkzoNobel

program operator

Stichting MRPI®

publisher

Stichting MRPI®

www.mrpi.nl

MRPI® registration

1.1.00116.2020

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10-04-2025

ECO PLATFORM EPD EN 15804 VERIFIED

PROGRAM OPERATOR

Stichting MRPI®
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Amsterdam

COMPANY INFORMATION

AkzoNobel
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NE10 0JY
Felling, Gateshead United Kingdom

https://www.international-pc.com/

PRODUCT

International Interthane 990E (Part A & Part B)

MRPI® REGISTRATION

1.1.00116.2020

EPD REGISTRATION

00001175

DATE OF ISSUE

10-04-2020

EXPIRY DATE

10-04-2025

DECLARED UNIT/FUNCTIONAL UNIT

All impacts are calculated using the declared unit “decoration of 1 m2 of surface”

SCOPE OF DECLARATION

This MRPI®-EPD certificate is verified by **ing. Kamiel Jansen, Primum.**
The LCA study has been done by **Max Sonnen, Ecomatters.**
The certificate is based on an LCA-dossier according to ISO14025 and NEN-EN15804+A1. It is verified according to the 'EPD-MRPI® verification protocol May 2017.v3.1'. EPDs of construction products may not be comparable if they do not comply with NEN-EN15804+A1. Declaration of SVHC that are listed on the 'Candidate List of Substances of Very High Concern for authorisation' when content exceeds the limits for registration with ECHA.

VISUAL PRODUCT

DESCRIPTION OF PRODUCT

Interthane 990E is a two-component solvent borne, high solids acrylic polyurethane topcoat with optimised application properties and superior aesthetics.

MORE INFORMATION

https://www.international-pc.com/product/interthane-990E

DEMONSTRATION OF VERIFICATION
CEN standard EN15804 serves as the core PCR[a]
Independent verification of the declaration and data, according to EN ISO 14025:2010: internal: external: X
(where appropriate[b]) Third party verifier: Kamiel Jansen, Primum
[a] Product Category Rules [b] Optional for B-to-B communication, mandatory for B-to-C communication (see EN ISO 14025:2010, 9.4).

DETAILED PRODUCT DESCRIPTION

This EPD is representative for the 8 product paints belonging to International Interthane 990E:

- Interthane 990E White;
- Interthane 990E Ultra Light tinted;
- Interthane 990E Light tinted;
- Interthane 990E Deep tinted;
- Interthane 990E Yellow tinted;
- Interthane 990E Light grey;
- Interthane 990E Green;
- Interthane 990E Red.

Typical use

Interthane 990E is ideal for use for new constructions or maintenance in a wide variety of environments for both industrial and commercial projects, from manufacturing and infrastructure to power generation and a wide variety of oil and gas assets.

Application Method

Airless Spray, Air Spray, Brush, Roller.

Production process and conditions of delivery

During paint production, the raw materials are pre-weighed according to the percentage of each in the formulation. The pigment is then dispersed in a mixture of binder using a variety of machines. Finally, the paint undergoes QC (quality control), is filtered and filled into the appropriate packaging container(s). All paint containers are transported from the production sites to a distribution center and finally to the customers.

Pack size

20 litre composite pack (2 part) as standard.

COMPONENT (> 1%)	[kg / %]
Pigment: Lightfast Pigments	Confidential
Binder: Ethylene copolymer	Confidential
Solvent: Water	Confidential

(*) > 1% of total mass

SCOPE AND TYPE

The type of this EPD is Cradle-to-Gate with options. All major steps from the extraction of natural resources to the final disposal of the product are included in the environmental performance of the manufacturing phase, except those that are not relevant to the environmental performance of the product. This declaration does not imply an indicator result of zero. The coating is produced in Sweden, China, USA, Thailand and Korea, and the application market is for customers around the world. Likewise, for the end-of-life, the fate of the coating product is described within a global context.

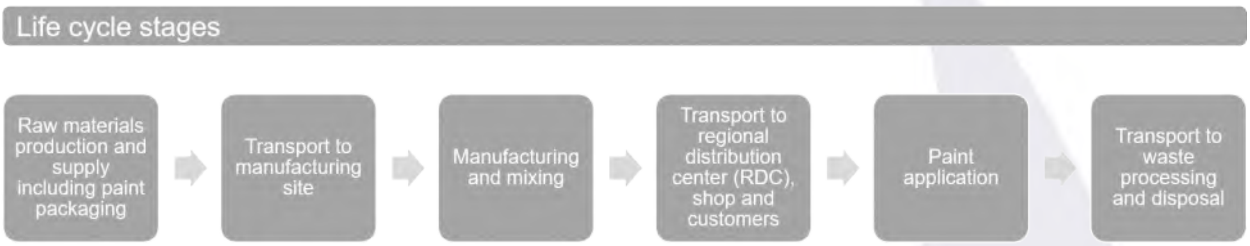
The software GaBi 9.2 Professional is used to perform the LCA. In the model Ecoinvent 3.5 database was used. The validity of this EPD is in correspondence with the specifications of the LCA project report.

All impacts associated with the upstream production of materials and energy are included in the system boundaries. Mining activities and controlled landfills are included in the product systems. Similarly, wastewater treatment activities are also considered within the technological systems. The emissions and resource extractions derived from these processes are considered elementary exchanges between the product systems and the environment.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport gate to site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MNA

X = Module assessed

MNA = Module not assessed



REPRESENTATIVENESS

The coating is manufactured in different production sites (Sweden, China, USA, Thailand and Korea) and therefore, the following average calculation rule is used: the weighted average of the coating characteristics based on the production volumes per production site of each of the following 6 products is calculated.

- Interthane 990E White;
- Interthane 990E Ultra Light tinted;
- Interthane 990E Light tinted;
- Interthane 990E Deep tinted;
- Interthane 990E Yellow tinted;
- Interthane 990E Light grey;
- Interthane 990E Green;
- Interthane 990E Red.

The used data is representative for all locations and thus this EPD is considered to be representative for products produced in Sweden, China, USA, Thailand and Korea, which are sold in a global market.

Unit	Quantity
Density (kg/l)	1,418
Coverage (kg/m2)	0.104
Number of Layers	1
Total product used (kg/m2)	0.104

A sensitivity analysis is performed to assess the representativeness of the representative product. The environmental impact results for the individual International Interthane 990E products have a maximum positive difference of 38% when compared with the representative product, within a particular impact category (Acidification Potential for Interthane 990E Ultra Light tinted).

ENVIRONMENTAL IMPACT per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADPE	kg Sb-eq.	1.62 E -6	5.99 E -8	1.08 E -8	1.69 E -6	8.37 E -8	1.95 E -8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.82 E -9	0.00	5.23 E -8	0.00
ADPF	MJ	7.19 E +0	3.02 E -1	3.34 E -1	7.83 E +0	6.09 E -1	4.82 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48 E -2	0.00	1.87 E +0	0.00
GWP	kg CO2-eq.	3.40 E -1	1.97 E -2	3.47 E -2	3.94 E -1	3.85 E -2	8.83 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.28 E -4	0.00	4.17 E -1	0.00
ODP	kg CFC11-eq.	5.75 E -8	3.64 E -9	2.34 E -10	6.14 E -8	7.35 E -9	1.51 E -9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80 E -10	0.00	4.32 E -9	0.00
POCP	kg ethene-eq.	3.00 E -4	7.94 E -6	2.79 E -5	3.35 E -4	1.66 E -5	5.69 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.07 E -7	0.00	3.65 E -4	0.00
AP	kg SO2-eq.	3.06 E -3	7.89 E -5	7.55 E -5	3.21 E -3	1.53 E -4	1.97 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.67 E -6	0.00	8.34 E -4	0.00
EP	kg (PO4)3--eq.	5.41 E -4	2.36 E -5	1.34 E -5	5.78 E -4	4.59 E -5	8.30 E -5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11 E -6	0.00	3.14 E -4	0.00

INA = Indicator Not Assessed
ADPE = Abiotic Depletion Potential for non-fossil resources
ADPF = Abiotic Depletion Potential for fossil resources
GWP = Global Warming Potential
ODP = Depletion potential of the stratospheric ozone layer
POCP = Formation potential of tropospheric ozone photochemical oxidants
AP = Acidification Potential of land and water
EP = Eutrophication Potential

RESOURCE USE per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	3.40 E -1	3.02 E -3	1.31 E -2	3.56 E -1	6.12 E -3	2.53 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59 E -4	0.00	7.35 E -2	0.00
PERM	MJ	1.78 E -4	0.00	-2.03 E -6	1.76 E -4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	3.40 E -1	3.02 E -3	1.31 E -2	3.56 E -1	6.12 E -3	2.53 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59 E -4	0.00	7.35 E -2	0.00
PENRE	MJ	7.67 E +0	3.06 E -1	3.44 E -1	8.32 E +0	6.18 E -1	5.04 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51 E -2	0.00	1.88 E +0	0.00
PENRM	MJ	1.47 E -7	0.00	5.21 E -11	1.47 E -7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENRT	MJ	7.67 E +0	3.06 E -1	3.44 E -1	8.32 E +0	6.18 E -1	5.04 E -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51 E -2	0.00	1.88 E +0	0.00
SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m3	9.13 E -2	5.44 E -5	-1.74 E -5	9.13 E -2	1.18 E -4	9.43 E -5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98 E -6	0.00	2.47 E -4	0.00

INA = Indicator Not Assessed
PERE = Use of renewable energy excluding renewable primary energy resources
PERM = Use of renewable energy resources used as raw materials
PERT = Total use of renewable primary energy resources
PENRE = Use of non-renewable primary energy resources excluding non-renewable energy resources used as raw materials
PENRM = Use of non-renewable primary energy resources used as raw materials
PENRT = Total use of non-renewable primary energy resources
SM = Use of secondary materials
RSF = Use of renewable secondary fuels
NRSF = Use of non renewable secondary fuels
FW = Use of net fresh water

OUTPUT FLOWS AND WASTE CATEGORIES per functional unit or declared unit

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	0.00	0.00	1.47 E -3	1.47 E -3	0.00	1.88 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04 E -1	0.00
NHWD	kg	0.00	0.00	1.17 E -3	1.17 E -3	0.00	9.33 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	0.00	0.00	0.00	0.00	0.00	1.03 E -2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ETE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

INA = Indicator Not Assessed
HWD = Hazardous Waste Disposed
NHWD = Non Hazardous Waste Disposed
RWD = Radioactive Waste Disposed
CRU = Components for reuse
MFR = Materials for recycling
MER = Materials for energy recovery
EEE = Exported Electrical Energy
ETE = Exported Thermal Energy

CALCULATION RULES

Cut off criteria

There is no cut-off of inputs and outputs in any of the processes during the life cycle stage, hence the environmental impact of all unit processes of each life cycle stage are considered.

Data quality and data collection period

Specific data was collected from AkzoNobel though a questionnaire, including inquiries about coating characteristics and packaging, logistics data (e.g. transport), production information and end-of-life. The data collection period for specific data was the year 2019.

Data gaps (i.e. transport data for one production site in Thailand) were covered with data generic values for transport as described in the Product Environmental Footprint Category Rules - Decorative Paints document version 1.0 published by CEPE and reviewed in April 2018 are use. Further data gaps (i.e. end-of-life transport data) were covered with data from internal AkzoNobel LCA studies concerning the same type of products (paints and coatings). Generic data (i.e. upstream acquisition and production of raw materials, energy generation, waste treatment processes) was selected from Ecoinvent 3.5 database. In the case of missing data, a relevant proxy was searched and adjusted to the corresponding unit process.

Allocation procedure

To allocate the emissions and inputs to the manufactured products, the decision-hierarchy in ISO 14044 is used (ISO 2006). It is not possible to sub-divide the site data into a more detailed level or find physical

causalities between inputs and outputs, thus allocation is done based on mass, considering an annual production of coating product for each site. The coating production is basically a process of mixing ingredients and, therefore, the environmental impact is fairly to be related to the mass of the products.

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

A1. Raw materials supply

This module considers the extraction and processing of all raw materials and energy which occur upstream to the International Interthane 990E manufacturing process, as well as waste processing up to the end-of waste state.

A2. Transport of raw materials to manufacturer

This includes the transport distance of the raw materials to the manufacturing facility via road and boat. On average, the transport characteristics for this life cycle stage are the following:

Transport Type	Truck 1	Truck 2	Container ship coast
Distance (km)	11.92	909.86	51.55
Capacity	34-40 t ,60% payload	40-60 t, 60% payload	70% utilization factor
Bulk density of transported products	1418 kg/m3	1418 kg/m3	1418 kg/m3

A3. Manufacturing

This module covers the manufacturing of the International Interthane 990E coating and includes all processes linked to production such as storing, mixing, packing and internal transportation. Use of electricity and fuels in coating production are taken into account as well.

Data regarding coating production was provided for the manufacturing sites where International Interthane 990E coating is produced: Sweden, China, USA, Thailand and Korea. Furthermore, the specific transportation distances and transportation modes for raw materials, coating packaging and transportation to customer were collected from the AkzoNobel logistics department, except for four production sites were generic data is used. Primary data and site-specific data were retrieved. For electricity sources, ecoinvent datasets were used for each of the countries where the production site is located. For upstream (raw material processes) and downstream processes (application, use, and waste processing) generic data is used when no specific data is obtained.

The construction site data includes lighting, heating, offices, etc. The manufacture of production equipment and infrastructure is not included in the system boundary. Packaging-related flows in the production process and all up-stream packaging are included in the manufacturing module. For the end-of-life packing of the coatings a landfill scenario is assumed.

A4. Transport to Regional Distribution Centre and customer

All coating containers are transported from the manufacturing facilities into a distribution centre and then finally, to the customer. On average, the transport characteristics for this life cycle stage are the following:

PARAMETER	Transport from factory to RDC	Transport from factory to RDC	Transport from RDC to customer
Transport Type	Truck 1	Container ship coast	Truck 2
Distance (km)	2,618.99	369.23	29.75
Capacity	34-40 t ,60% payload	70% utilization factor	40-60t, 60% payload
Bulk density of transported products	1418 kg/m3	1418 kg/m3	1418 kg/m3

A5. Application and use

This module includes the environmental aspects and impacts associated with the application and of the coating. The use of energy from air spray for coating application purposes is included.

PARAMETER	(kWh/ kg)
Energy for application	0.1

C2. Transport to incineration or landfill

This module includes one-way transportation distance of the demolition or sorting site to the dump site.

PARAMETER	Transport to waste processing
Vehicle type	Truck 34t-40t payload average fleet
Distance	100 km
Capacity utilisation	60%
Bulk density of transported products	1418 kg/m3

C3. Waste processing and C4. Disposal

The end of life stage is encompassed in these modules. It is assumed that part of the coating is lost during application and the rest is applied. After its lifetime, it is assumed that the coatings end up in incineration. These assumptions are based on best knowledge of the end of life of coating from direct contact with AkzoNobel.

ADDITIONAL INFORMATION ON ENVIRONMENTAL IMPACTS

The CML-IA methods do not have characterization factors for the “unspecified VOC” emission flow in the Global Warming Potential environmental impact category. However, VOCs are known to have influence in this category. In order to include the impacts of the VOCs and align with current practice of AkzoNobel, it was decided to calculate the VOC impact on Global Warming Potential separately. The Global Warming Potential impact category has been modified, adding a generic factor of 4.23 kgCO2-eq/kg VOC, which is sourced from IPCC 2013 data. This is also in line with Akzo Nobel’s current methodology for carbon reporting.

Environmental Impact	UNIT	A1	A2	A3	A4	A5	C2	C4
Global Warming potential (GWP 100 years)	[kg CO2-Eq.]	3.40E-1	1.97E-2	3.47E-2	3.85E-2	8.83E-2	9.28E-4	4.17E-1
Global Warming potential (GWP 100 years) incl. VOC char. fact.	[kg CO2-Eq.]	3.40E-1	1.97E-2	3.49E-2	3.85E-2	9.97E-1	9.28E-4	4.17E+0

DECLARATION OF SVHC

None of the substances contained in the product are listed in the “Candidate List of Substances of Very High Concern for authorisation”, or they do not exceed the threshold with the European Chemicals Agency.

REFERENCES

• EN 15804:2012+A1:2013 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products, of 11/2013.

• ISO 14040/14044 on Life Cycle Assessments

• Product Environmental Footprint Category Rules - Decorative Paints version 1.0, 2018. Developed by the Technical Secretariat Decorative Paints of the European Council of the Paint, Printing Ink and Artists' Colours Industry.

• Stephenson A. Personal communication with Adam Stephenson, AkzoNobel Protective Coatings, United Kingdom (2020).

• Thinkstep GaBi Software-System and Database for Life Cycle Engineering. Copyright 1992-2017 ThinkStep AG.

• Ecoinvent 3.5 database (2019).

REMARKS

None

epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

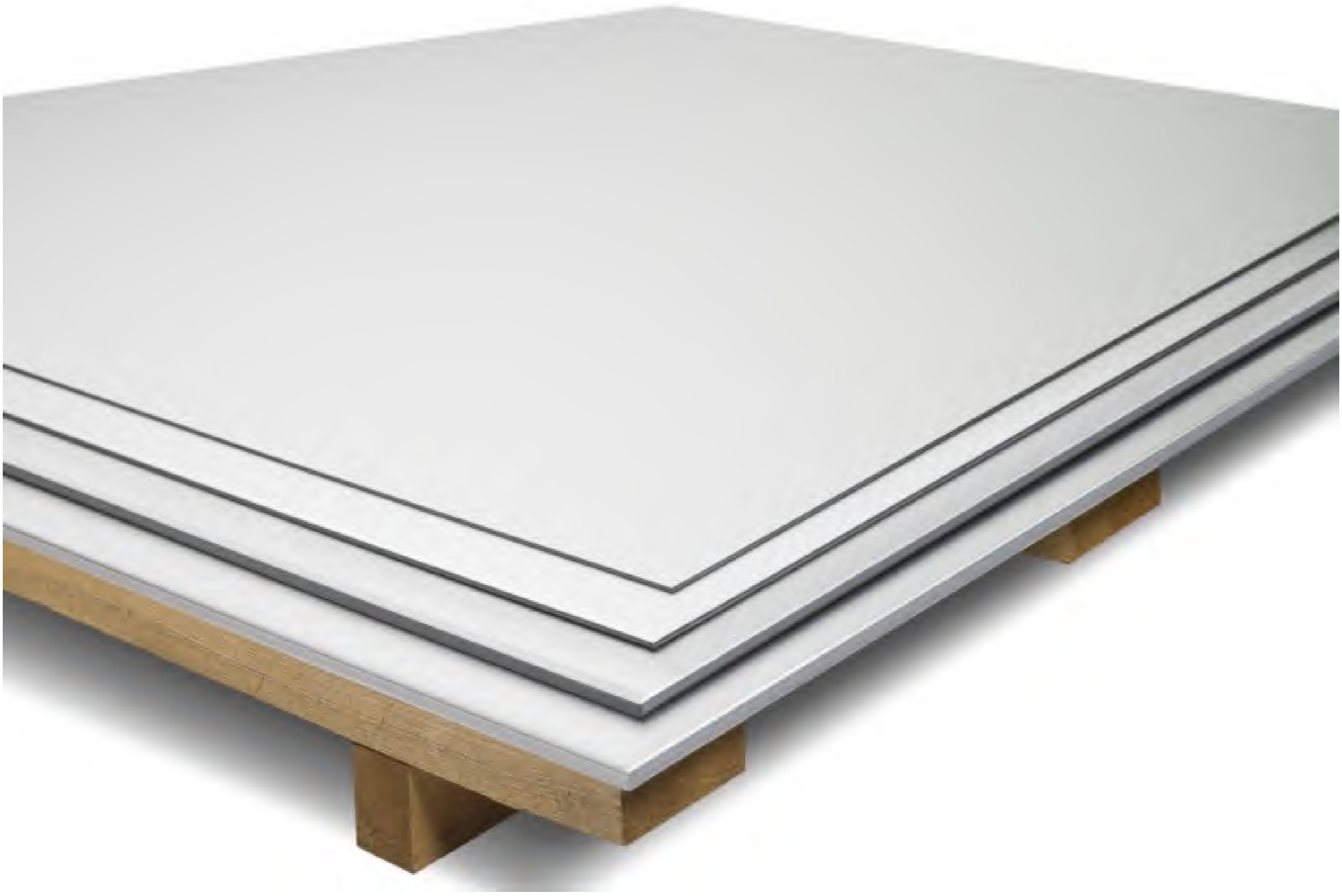
Eier av deklarasjonen:	Norsk Stål AS
Programoperatør:	Næringslivets Stiftelse for Miljødeklarasjoner
Utgiver:	Næringslivets Stiftelse for Miljødeklarasjoner
Deklarasjonsnummer:	NEPD-2523-1266-NO
Publiseringsnummer:	NEPD-2523-1266-NO
ECO Platform registreringsnummer:	-
Godkjent dato:	09.11.2020
Gyldig til:	09.11.2025

Rustfrie og syrefaste Varmvalsedeplater og Coils

Norsk Stål AS

NORSK STÅL

www.epd-norge.no



NORSK STÅL

Generell informasjon

Produkt:

Rustfrie og syrefaste Varmvalsedeplater og Coils

Eier av deklarasjonen:

Norsk Stål AS
Kontaktperson: Morten Johnsen
Telefon: +47 90 11 58 88
e-post: mj@norskstaal.no

Programoperatør:

Næringslivets stiftelse for Miljødeklarasjoner
Pb. 5250 Majorstuen, 0303 Oslo
Phone: +47 23 08 80 00
e-post: post@epd-norge.no

Produsent:

Norsk Stål AS

Deklarasjonsnummer:

NEPD-2523-1266-NO

Produksjonssted:

ECO Platform registreringsnummer:

Kvalitet/Miljøsystem:

ISO 9001:2015, ISO14001:2018, ISO45001:2015, NS-EN 1090, NS-EN 10080:2005, NS 3576-2:2012, NS 3576-3:2012

Deklarasjonen er basert på PCR:

EN 15804:2012+A1:2013 tjener som kjerne-PCR

Org. no.:

959 493 715

Erklæring om ansvar:

Eieren av deklarasjonen skal være ansvarlig for den underliggende informasjon og bevis. EPD Norge skal ikke være ansvarlig med hensyn til produsent informasjon, livsløpsvurdering data og bevis.

Godkjent dato: 09.11.2020

Gyldig til: 09.11.2025

Deklarert enhet:

1 kg Rustfrie og syrefaste Varmvalsedeplater og Coils

Årstall for studien:

2020

Deklarert enhet med opsjon:

A1,A2,A3,A4,C1,C2,C3,C4,D

Sammenlignbarhet:

EPD av byggevarer er nødvendigvis ikke sammenlignbare hvis de ikke samsvarer med NS-EN 15804 og ses i en bygningskontekst.

Funksjonell enhet:

Miljødeklarasjonen er utarbeidet av:

Deklarasjonen er utviklet ved bruk av eEPD v4.0 fra LCA.no
Godkjenning:
Bedriftsspesifikke data er

Samlet og registrert av: Helge Nuland

Kontrollert av: Morten Johnsen

Verifikasjon:

Uavhengig verifikasjon av data, annen miljøinformasjon og EPD er foretatt etter ISO 14025:2010, kapittel 8.1.3 og 8.1.4

Ekstern

Tredjeparts verifikator:

Sign

Fredrik Moltu Johnsen

(Uavhengig verifikator godkjent av EPD Norge)

Godkjent:

Sign

Håkon Hauan
Daglig leder av EPD-Norge

Produkt

Produktbeskrivelse:

Denne EPD beskriver varmvalset rustfritt stål levert som bånd eller plater. Varmvalset rustfritt stål har en metallgrå matt overflate, med gode formingsegenskaper og styrke. Leveres i forskjellige formater, alt etter gjeldende standarder for rustfritt stål.
Denne EPD kan brukes i bygge- og anleggsindustrien

Produktspesifikasjon:

Denne EPD gjelder for 1 kg av varmvalset rustfritt stål. EPD dekker rustfritt stål levert som bånd eller plate til forskjellige bruksområder i anlegg og byggevirksomhet.
Varmvalsede produkter har et stort anvendelsesområde innenfor bygg og anlegg, mekanisk industri. Eksempler kan være lastbærende konstruksjoner innen tungtransport, broer, vannkraft og bygninger.

Material	%
Steel	100,00

Tekniske data:

Produktene er i h.h.t. følgende standarder og sertifikater: EN 10088-1, EN 10088-4, EN 10029, ISO 18286, EN 10028-7, ASTM A240/A480, EN 10204.

Egenvekt 7900 kg/m3
Varmeutvidelseskoeffisient 14 10-6K-1
Varmeledningsevne 21 W/(mK)
Elastisitetsmodul 205 GPa
Smeltepunkt 1450 °C
Flytegrense Rp0.2 210-530 MPa
Bruddgrense Rm 420-950 MPa
Forlengelse A 18-45 %

Markedsområde:

Verden

Levetid, produkt:

Levetid, bygg:

LCA: Beregningsregler

Deklarert enhet:

1 kg Rustfrie og syrefaste Varmvalsedeplater og Coils

Cut-off kriterier:

Alle viktige råmaterialer og all viktig energibruk er inkludert. Produksjonsprosessen for råmaterialene og energistrømmer som inngår med veldig små mengder (mindre enn 1%) er ikke inkludert. Disse cut-off kriteriene gjelder ikke for farlige materialer og stoffer.

Allokering:

Allokering er gjort iht. bestemmelser i EN 15804. Inngående energi og vann, samt produksjon av avfall i egen produksjon er allokert likt mellom alle produktene gjennom masseallokering. Miljøpåvirkning og ressursforbruk for primærproduksjonen av resirkulerte materialer er allokert til det opprinnelige produktsystemet. Bearbeidingsprosessen og transport av materialet til produksjonssted er allokert til analysen i denne EPDen.

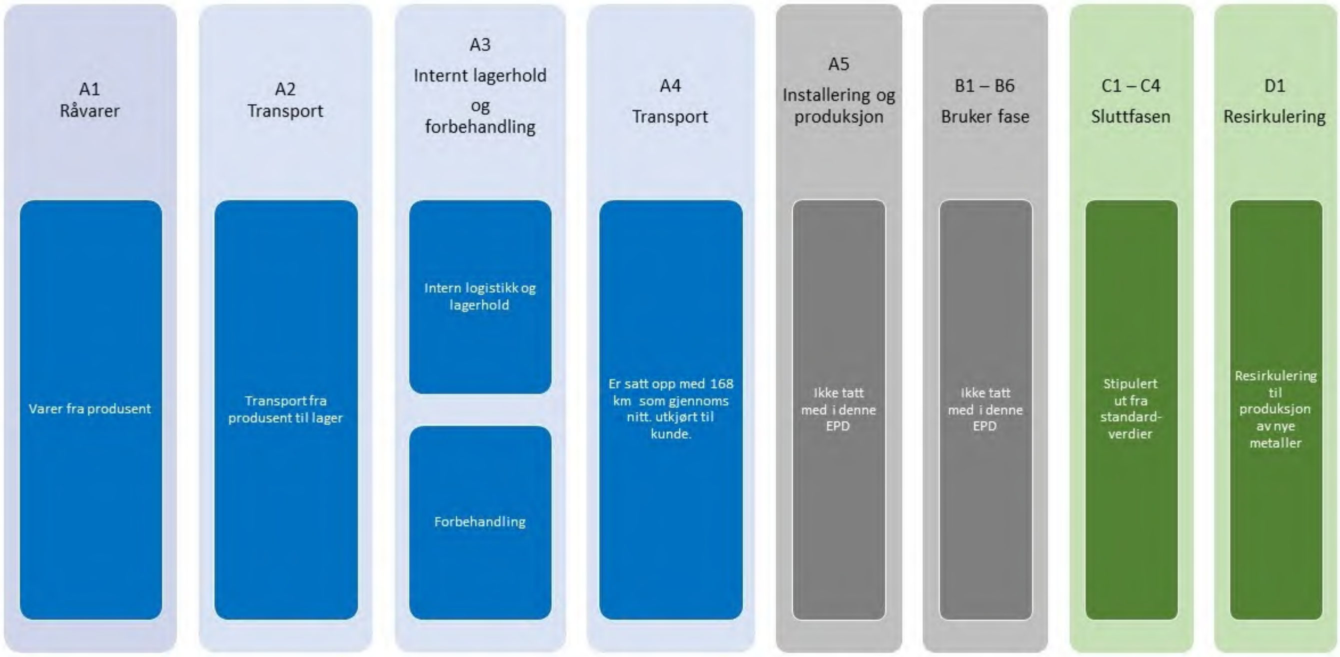
Datakvalitet:

Spesifikke data for produktsammensetningen er fremskaffet av produsenten. De representerer produksjonen av det deklarerte produktet og ble samlet inn for EPD-utvikling i det oppgitte året for studien. Bakgrunnsdata er basert på registrerte EPDer i henhold til EN 15804, Østfoldforskning sine databaser, ecoinvent og andre LCAdatabaser. Datakvaliteten for råmaterialene i A1 er presentert i tabellen nedenfor.

Materials	Source	Data quality	Year
Steel	ecoinvent 3.5	Database	2018
Steel	EPD-OTO-20190003-IBD1-EN	EPD	2019

Systemgrenser:

Flytskjemaet nedenfor illustrerer systemgrensene for analysen:



Teknisk tilleggsinformasjon

A3: Energiforbruket for lagring/produksjon hos Norsk Stål er beregnet til 3,47 E-02 kWt/KG. Dette er under 1% av forbrukt energi for fremstilling av produktet.
A4: Utgående transport fra Norsk Stål til kunde varierer. Vi benytter 168km som gjennomsnitt. Dette trekkes fra totalen dersom neste ledd inkluderer denne transporten.
D1: Det aller meste av stål resirkuleres, estimert til 95%.

NORSK STÅL

LCA: Scenarier og annen teknisk informasjon

Følgende informasjonen beskriver scenariene for modulene i EPDen.

Transport fra produksjonssted til bruker (A4)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	Brennstoff/Energi forbruk	Enhet	Verdi (l/t)
Bil	38,8 %	Truck, lorry 16-32 tonnes, EURO 6	168	0,043626	l/tkm	7,33
Jernbane					l/tkm	
Båt					l/tkm	
Annet					l/tkm	

Sluttfase (C1,C3,C4)

.	Enhet	Verdi
Farlig avfall	kg	
Blandet avfall	kg	
Gjenbruk	kg	
Resirkulering	kg	0,9500
Energigjenvinning	kg	
Til deponi	kg	0,0500

Transport avfallsbehandling (C2)

Type	Kapasitetsutnyttelse inkl retur %	Kjøretøytype	Distanse km	FBrennstoff/Energi forbruk	Enhet	Verdi (l/t)
Truck	55,0 %	Truck, lorry over 32 tonnes, EURO 5	168	0,022823	l/tkm	3,83
Jernbane					l/tkm	
Båt					l/tkm	
Annen transport					l/tkm	

..

Gevinst og belastninger etter endt levetid (D)

.	Enhet	Verdi
Substitution of primary construction steel, with net scrap steel (kg)	kg/DU	0,45

LCA: Resultater

Systemgrenser (X=inkludert, MND=modul ikke deklarert, MNR=modul ikke relevant)

Product stage			Construction installation stage		User stage							End of life stage				.	Beyond the system bondaries
Råmaterialer	Transport	Tilvirkning	Transport	Konstruksjons/ installasjonsfase	Bruk	Vedlikehold	Reparasjon	Utskiftinger	Renovering	Operasjonell energibruk	Operasjonell vannbruk	Demontering	Transport	Avfallsbehandling	Avfall til sluttbehandling		Gjenbruk/gjenvinning/ resirkulering-potensiale
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	.	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	.	X

Miljøpåvirkning (Environmental impact)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP	kg CO_2 -eq	2,56E+00	2,68E-02	5,67E-02	1,47E-02	7,11E-05	2,59E-04	-7,54E-01
ODP	kg CFC11 -eq	4,62E-08	5,04E-09	9,82E-09	2,86E-09	7,00E-12	8,60E-11	-3,11E-08
POCP	kg C_2H_4-eq	9,35E-04	4,05E-06	9,50E-06	2,37E-06	1,95E-08	7,91E-08	-5,26E-04
AP	kg SO_2 -eq	1,38E-02	6,29E-05	4,30E-04	4,76E-05	4,43E-07	1,89E-06	-3,37E-03
EP	kg PO_4^{3-} -eq	1,35E-03	8,26E-06	9,36E-05	7,99E-06	6,81E-08	3,34E-07	-1,12E-03
ADPM	kg Sb -eq	1,44E-04	8,32E-08	2,45E-10	3,31E-08	5,00E-12	5,00E-12	-1,46E-05
ADPE	MJ	3,02E+01	4,04E-01	7,84E-01	2,30E-01	6,61E-04	7,28E-03	-7,09E+00

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Merknad om miljøpåvirkningen

Denne generelle EPDen dekker varer fra flere produsenter, resirkuleringsgraden på innsatsmaterialet er opptil 71,35%.
Ved behov kan Norsk Stål AS utarbeide prosjekt-/leveransespesifikk EPD på forespørsel.

Ressursbruk (Resource use)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
RPEE	MJ	6,14E+00	5,97E-03	4,27E-03	4,16E-03	5,49E-03	5,95E-05	-6,39E-01
RPEM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TPE	MJ	6,14E+00	5,97E-03	4,27E-03	4,16E-03	5,49E-03	5,95E-05	-6,39E-01
NRPE	MJ	3,41E+01	4,14E-01	7,91E-01	2,37E-01	8,88E-04	7,39E-03	-6,73E+00
NRPM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TRPE	MJ	3,41E+01	4,14E-01	7,91E-01	2,37E-01	8,88E-04	7,39E-03	-6,73E+00
SM	kg	5,28E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3	2,77E-02	7,83E-05	6,80E-05	5,59E-05	3,66E-07	8,00E-06	-4,61E-03

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Avfall (End of life - Waste)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
HW	kg	6,19E-05	2,44E-07	2,15E-06	1,26E-07	2,20E-09	1,10E-08	-6,53E-05
NHW	kg	8,91E-01	2,22E-02	3,56E-03	2,15E-02	6,75E-05	5,00E-02	-1,29E+00
RW	kg	INA*	INA*	INA*	INA*	INA*	INA*	INA*

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Livsløpets slutt - Utgangsfaktorer (End of life - Output flow)

Parameter	Unit	A1-A3	A4	C1	C2	C3	C4	D
CR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,55E-01	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	INA*	INA*	INA*	INA*	INA*	INA*	INA*
ETE	MJ	INA*	INA*	INA*	INA*	INA*	INA*	INA*

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Leseeksempel 9,0 E-03 = 9,0*10 -3 = 0,009
*INA Indicator Not Assessed

Norske tilleggskrav

Klimagassutslipp fra bruk av elektrisitet i produksjonsfasen

Nasjonal produksjonsmiks fra import, lavspenning (inkludert produksjon av overføringslinjer, i tillegg til direkte utslipp og tap i nett) er brukt for anvendt elektrisitet i produksjonsprosessen (A3). Bakgrunnsdata er presentert i tabellen under. Karakteriseringsfaktorer fra EN15804:2012+A1:2013 er benyttet.

Farlige stoffer

Produktet er ikke tilført stoffer fra REACH Kandidatliste eller den norske prioritetslisten.

Inneklima

Bibliografi

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NS-EN 15804:2012+A1:2013 Bærekraftig byggverk - Miljødeklarasjoner - Grunnleggende produktkategoriregler for byggevarer.
ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products.
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NPCR 013 Part B for steel and aluminium construction products. Ver. 3.0 April 2019, EPD-Norge.

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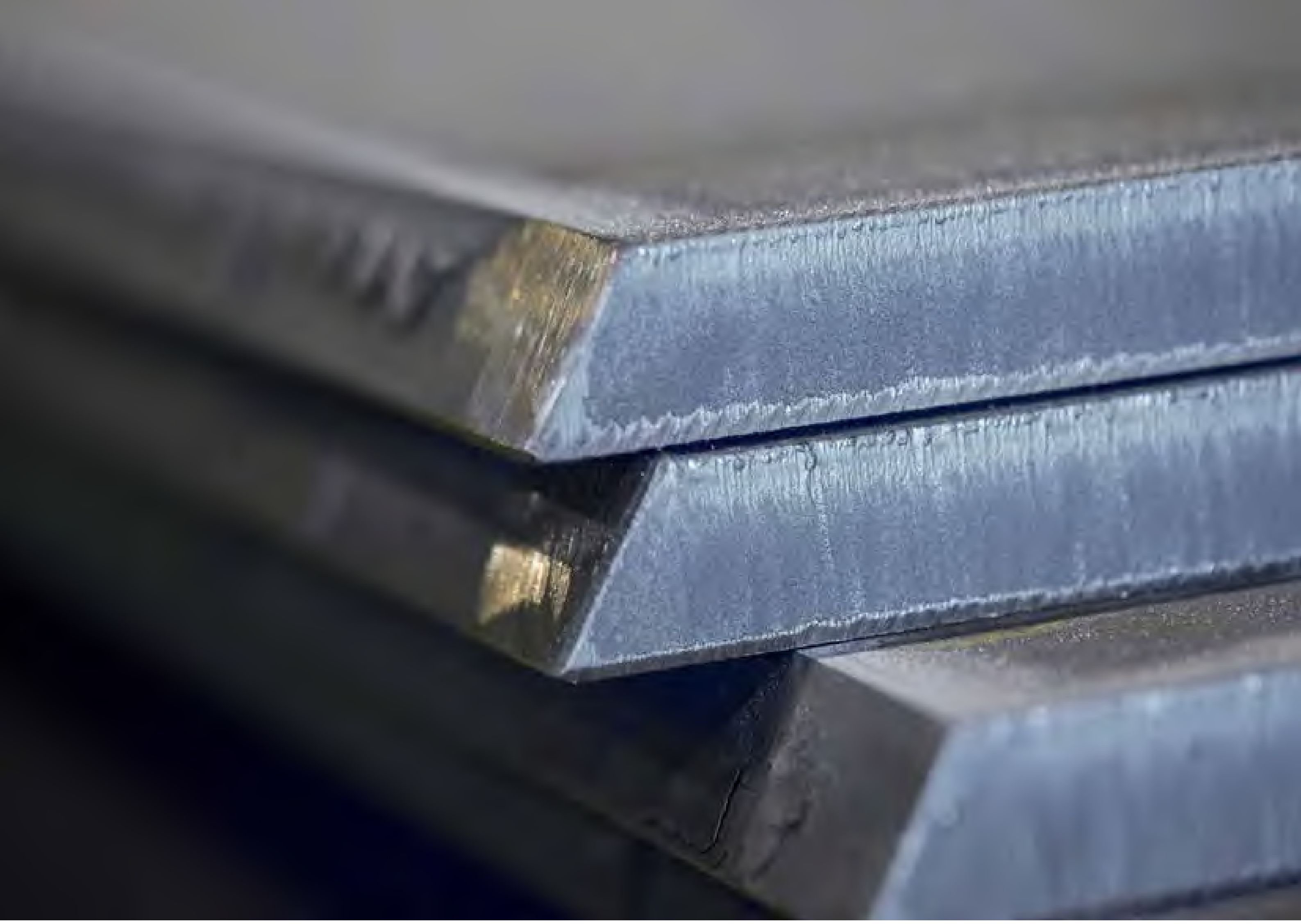
EPD®

Hot rolled steel plates

Environmental Product Declaration (EPD)
In accordance with ISO 14025 and EN 15804+A1

S-P-01918, version 1.0
UN CPC 412

SSAB



CONTENT

1. SSAB's vision – a stronger, lighter and more sustainable world

SSAB is a specialized global steel company driven by close relationships with our customers. SSAB develops and markets high performance steels that are either high strength or fit for purpose products designed for better performance and sustainability.

The company is a leading producer in the global market for Advanced High Strength Steels (AHSS) and Quenched & Tempered Steels (Q&T). We serve segments such as, automotive, mining and construction with strip, plate and tube products. SSAB's steels and services help to make end products lighter and better engineered, increasing their strength and lifespan.

SSAB has a cost-efficient and flexible production system. SSAB's production plants in Sweden, Finland and the US have an annual steel production capacity of approximately 8.8 million tonnes. In Sweden and Finland, the integrated blast furnace process is used, whereas in the US, electric arc furnaces are used in a scrap-based production process.

SSAB has been at the forefront of sustainability in many ways. With confidence deriving from our traditions, we now strive to do even more. SSAB aims to be fossil-free as a company by 2045.

SSAB's environmental management is based on the international environmental management systems standard, ISO 14001. All production facilities within the scope of this Environmental Product Declaration have third-party ISO 14001 certification.

2. SSAB in the circular economy

The term circular economy usually is used to describe a transition from linear business models, in which products are manufactured from raw materials, used and then discarded, to circular business models, where products or parts are repaired, re-used, returned and recycled. A circular economy promotes zero waste in order to create a more sustainable world.

In addition, it supports innovative design to promote recycling, a reduction in the amount of virgin materials used, and encourages the re-use and recycling of all materials. A circular economy can be applied by adopting a lifecycle approach and measuring the social, economic and environmental impact at each stage of a product's lifecycle, including end of life. In summary, steel products promote the core objective of a circular economy because steel can be recycled without weakening its properties.

3. Product

3.1 TECHNICAL INFORMATION AND APPLICATION

SSAB specializes in materials for demanding applications where strength, durability and weight saving are required. Hot rolled steel plates are used in many industries and applications, including the construction industry, shipbuilding, heavy machinery, pressure equipment and other metal structures.

SSAB's comprehensive selection of hot rolled steel plates ranges from standard products to complex customer-specific applications. The hot rolled plate product portfolio includes structural steels (i.e. for use in buildings, machinery and equipment, tanks, containers and bridges), wear-resistant and surface pressure resistant steels (i.e. for use in vehicles, industrial equipment and mining), and shipbuilding and offshore steels.

The steels are often customized to meet national and/or international standards as well as customer-specific or other Original Equipment Manufacturer (OEM) standards. Besides standardized steel grades, SSAB's hot rolled product portfolio also includes products unique to SSAB and which in some cases may be patented.

In addition to standard steel grades, the product portfolio includes SSAB's own brands, which are targeted at different segments and applications. The main brands are listed below:

3.1.1 STRENX®
Structural and cold-forming steels for stronger, lighter, safer, more competitive and more sustainable structures.

3.1.2 HARDOX® AND RAEX®
World-leading abrasion-resistant (AR) steels for extended service life and high productivity in challenging environments.

3.1.3 TOOLOX®
A modern engineering and tool steel of unmatched hardness and toughness.

3.1.4 ARMOX® AND RAMOR®
Armor protection steels with quality and performance you can trust.

3.1.5 SSAB BORON
A range of advanced steel grades for quench and press hardening to improve overall productivity, yield and end-product quality.

3.1.6 SSAB DOMEX®
A wide range of structural and cold-forming steels that deliver excellent cold forming, machining and welding performance.

3.1.7 SSAB LASER®
Structural and cold-forming steels for laser cutting. Designed to improve productivity, yield and end-product quality.

3.1.8 SSAB MULTISTEEL
Covers multiple steel grades and standards bundled into one steel.

3.1.9 SSAB WEATHERING AND COR-TEN®
Corrosion-resistant steels to minimize total lifecycle costs thanks to low or zero maintenance needs. COR-TEN® is a licensed brand and a part of the SSAB Weathering steel family.

Product-specific technical requirements regarding mechanical and other properties arise from national and/or international standards, such as EN 10025 or EN 10225, or customer-specific and/or other OEM standards. SSAB's unique products also have their own specific requirements.

For more detailed information about technical product properties and the product portfolio, please visit www.ssab.com.

3.2 PRODUCT COMPOSITION

Steel is an alloy of mainly iron and carbon, with small amounts of other alloying elements. These elements improve the chemical and physical properties of steel, such as strength, ductility, durability and corrosion resistance. The alloying elements of steel are physically bonded to the steels inherent crystalline structure.

The exact compositions of hot rolled products manufactured by SSAB depend on the requirements of the product. These requirements arise from national and/or international standards, such as EN 10025 or EN 10225, or customer specific and/or other OEM standards. SSAB's unique products also have their own specific requirements.

TABLE 1. EXAMPLE COMPOSITION OF A HOT ROLLED STRUCTURAL STEEL (SSAB MULTISTEEL SN)

Material	Content (%) of total product weight	Ingredient	Content (%, W/W)	CAS number
Structural Steel (SSAB Multisteel SN)	100	Iron (Fe)	> 97	7439-89-6
		Carbon (C)	< 0.18	7440-44-0
		Silicon (Si)	< 0.50	7440-21-3
		Manganese (Mn)	< 1.60	7439-96-5

Remarks
Physical state: solid
Odor: odorless
Color: metallic gray
Boiling point: 2,750°C
Melting point: 1,450 – 1,520°C
Steel density: 7,850 kg/m^3

Table 1 shows as an example the composition of a hot rolled structural steel (SSAB Multisteel SN, excluding packaging materials) produced by SSAB for different applications. This product is a typical example of a hot rolled steel grade used especially in the construction industry. This information is given based on hot rolled steel products made at SSAB's sites in both Sweden and Finland.

The values provided are based on European Standards EN 10219-1, EN 10149-2, EN 10025-2, EN 10025-3, EN 10025-4, EN 10025-6, EN 10130, EN 10268, EN10346 and EN 10169 requirements on maximum concentrations, and included in Table 1 if the maximum levels according to these standards are 0.1% by weight, or higher.

More detailed information about the composition of different steels is available from national and international standards as well as from SSAB's website www.ssab.com.

3.3 COMPLIANCE WITH CHEMICAL LEGISLATION

SSAB actively tracks and anticipates future changes in environmental, safety and chemical legislation and complies with valid EU chemical regulations, such as the REACH Regulation 1907/2006. Communication and cooperation throughout the supply chain plays an important role and SSAB requires full REACH compliance from its subcontractors. SSAB tracks the list of Substances of Very High Concern (SVHC) and other legislative requirements to ensure products meet legal and customer requirements. In addition, SSAB observes and complies with the requests and recommendations of many customers to withdraw products containing hazardous substances in the customer sector.

SSAB's steel products do not contain substances of very high concern (SVHC) as defined and listed in the European Chemicals Agency (ECHA) Candidate List of substances of very high concern for Authorisation, in levels above 0.01% by weight.

Steel contains very small amounts of impurities originating from natural raw materials and not added during the steel production process. The amount of impurities in the steels is minimal and, based on knowledge of the toxicity of these substances and their metallurgical bond in the steel matrix, does not pose a risk to the environment or human health.

For the construction industry, the Environmental Product Declaration will give benefits in rating schemes, such as BREEAM, LEED and Miljöbyggnad. Additionally, there are specific tools for material evaluation, such as BASTA, Byggvarubedömningen and SundaHus, where information from this Environmental Product Declaration is needed.

More information about the chemical composition of hot rolled steel plates can be found at www.ssab.com.

4. Production

4.1 PRODUCTION SITES

Hot rolled steel plates are manufactured at SSAB's production sites in Raahe, Finland and Oxelösund, Sweden. Steel production is based on the use of iron ore as a raw material. However, SSAB uses approximately 20 % of scrap steel in conjunction with steel production in the Nordics. The use of raw materials and energy has been optimized in steel production.

When scrap steel is used instead of virgin raw materials in steelmaking, the carbon dioxide emissions originating in steel production decrease accordingly. Steelmaking at SSAB uses scrap material from SSAB's own production processes and material sourced on the scrap steel market. Once steel has been made, it can be recycled without weakening its properties.

At SSAB, steelmaking processes have been continuously advanced and improved. As a result, SSAB's blast furnaces today are among the most efficient in the world in terms of minimizing carbon dioxide emissions from steel production.

Most of the energy used in ore-based steel production comes from coal, which is used as a reducing agent in ironmaking. The mineral products formed in SSAB's iron and steel production processes and the by-products generated in the coking process are recycled as industrial raw material or material to replace virgin resources. A high percentage of the dust originating in various processes is returned to the process to reduce waste and improve material efficiency.

4.2 LABELING AND PACKAGING

Products are labeled to be easily and permanently identifiable and traceable. Labeling complies with standards EN 10021 and EN 10204. The packaging and protection of our steel products is usually determined when ordering. Steel or plastic straps, wood props, paper or plastic film, corner protection and other accessories supporting packaging are used as appropriate and according to customer requirements.

Prefabricated flat products such as plate components and curved plates are packed and, depending on product size, strapped to an appropriate pallet or packed in crates suitable for that purpose. Also triangular struts are used in the packaging of flat products bent into shape.

This section of the declaration is for information purposes only. The packaging materials are not included in the LCA study.

More information about the labeling and packaging can be found at www.ssab.com.

4.3 SOURCING AND TRANSPORTATION

The general terms and conditions of all new or renewed raw material sourcing contracts require compliance with SSAB's Supplier Sustainability Policy. Ethical values, environmental concerns and energy efficiency are considered when choosing suppliers. As regards the main raw materials used in steel production, iron ore pellets are sourced from Sweden and Russia, metallurgical coal from North America, Australia and Russia, metallurgical coke from Japan, China and Poland, limestone from Sweden, Norway, France and Spain, and scrap from Sweden, Finland and Russia. Alloys are sourced from multiple origins including Brazil, Russia, China, South Korea, Chile and the US. The company's own logistics unit is responsible for most of SSAB's transportation of raw materials and products. Finished products are transported by sea, road or rail.

SSAB's environmental objectives in respect of logistics are managed through a certified environmental management system. The aim is to increase the share of logistics contracts with partners who have signed up for energy efficiency agreements in the logistics and transport sector. Around 85 % of SSAB's land transportations per tonne of products are carried by a partner signatory to energy efficiency agreements. Logistics companies outside an energy efficiency agreement are regularly encouraged to sign up to one. SSAB's international partners have certified environmental management systems. Logistics aims to optimize transport and maximize payloads and to combine transport as efficiently as possible.

5. Recycling and waste processing

Steel is a fully recyclable material and scrap steel has a strong market position: steel recovered from structures and end products at the end of their lifecycle is efficiently recycled and re-used.

No hazardous waste is formed from end products and steel does not harm the environment. According to the European Waste Catalogue, the waste code for steel products manufactured by SSAB after their useful life is 17 04 05 (iron and steel). All packaging materials for steel products can be recycled.

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6. Information about safe use

Steel poses no hazards to the environment in the forms supplied. Some grades of steel contain alloying elements such as manganese, chromium, niobium, vanadium, titanium, nickel, copper and silicon. None of these substances is released under normal or reasonably foreseeable conditions of use.

Dust and vapors may form when steel is melted, welded, cut or ground (or heated to very high temperatures). Long-term exposure to high dust and vapor concentrations may affect the health, especially the lungs. The composition of dust and vapor depends on the steel grade and methods employed.

Welding must be left to trained people. Personal protective equipment must be used and sufficient ventilation must be ensured in compliance with safety legislation. Instructions on the welding of metals and metal alloys can be found on the website of, for example, the European Steel Association www.eurofer.org.

The use and handling of steel does not endanger people or the environment and there are no specific exposure limits in place for this reason. Neither have any first aid measures, measures in the event of fire or unintentional emission, or measures as regards the handling and storage of steel been specified.

Normal precautions should be taken to avoid physical injuries caused mainly by the heavy weight or sharp edges of a product. Personal protective equipment such as special gloves and eye protection must be worn.

Hot rolled steel is not classified as dangerous under the EU's chemical regulation (REACH) and so no Safety Data Sheet or hazardous packaging, marking or transport rules and regulations are required.

6.1 SAFETY

- Always wear gloves and protective clothing when handling steel products.
- Be careful of sharp edges and corners.
- Always use official lifting equipment when moving steel products.
- Never use binding straps to lift a product.
- Straps under tension may cause injury when cut and the outer ring of a coil may rebound outwards.
- Never go under steel products when they are being moved.
- Make sure the securing straps are sufficiently strong and firmly attached.
- Always follow the industrial safety provisions in force and find out whether the installation site is subject to any particular safety requirements before beginning installation work.

7. LCA information

- **Functional unit / declared unit:** 1 tonne (1,000 kg) of hot rolled steel plates.
- **Reference service life:** Not applicable.
- **The LCA is based on data from the following SSAB production sites:**
  - SSAB EMEA AB, Oxelösund, Sweden
  - SSAB Europe Oy, Raahe, Finland
- **Data quality and representativeness:** Production data have been collected by SSAB directly from the production sites and are average values for the year 2017. The data have been measured and verified internally. The data are assumed to be the most relevant according to current conditions and production practices.
- **Database(s) and LCA software used:** The World Steel Association's 5th steel LCI dataset released in December 2018, the GaBi LCA Databases 2019 (SP39), the Gabi LCA Software (GaBi version 9).
- **Description of system boundaries:** Cradle-to-gate with options.
- **Cut-off:** The packaging material inflow is not included in the LCA. The packaging material represents less than 1 % of the total inflow by mass and is therefore well below the limits given by the cut-off rules, stated in EN 15804, as well as the relevant PCR document for this EPD.
- **Allocation:** By-products such as blast furnace slag are used as input material in a number of industries, for example in road construction and as a substitute for cement. This study has used a conservative approach and considered all the environmental burdens associated with the production of the steel products and by-products as belonging to the production of the steel.
- **End-of-Life Scenario:** A recycling rate of 95 % has been assumed for the steel product. That is to be seen as the proportion of the material in the product that will be recycled (or re-used) in a subsequent system. The recycling rate referring to the output of the recycling plant and all the material losses through the lifecycle have been taken into account, including material losses in the collection, sorting and recycling (or re-use) processes up to the point of final substitution. The scenario results in 5 % material losses in total, considered as landfilling steel scrap.
- **Net-scrap calculation:** To some extent SSAB uses external scrap in the steel production. Therefore, this amount of scrap has been deducted from the stated recycling rate. This is done to calculate the amount of net-scrap to be credited in Module D. This is the amount of steel scrap available for the next lifecycle. The re-circulation of internal scrap has not been considered in this calculation, since it represents a closed loop inside the system boundary for the LCA.

8. Scope of declaration

The scope of this declaration is for 1 tonne of hot rolled steel plate from cradle to the mill gate, including end-of-life processing and recycling: Modules A1 – A3, C3 – C4 and D (according to EN 15804). Modules A4 – A5, B1 – B7 and C1 – C2 have not been included, due to the inability to predict how the material will be used following manufacture.

The system boundary applied in this study extends from Module A1, the mining of raw materials, such as iron ore and coal; Module A2, transport to and within the manufacturing site; Module A3, coke, iron and steel manufacture; ancillary service operations; hot rolling of steel products and packaging for dispatch to customers at the exit gate of the manufacturing site.

The system boundary also includes manufacture of other required input materials, transport between processing operations, the production of external services such as electricity, natural gas and water, and the production of by-products within the steelmaking process. Wastes and emissions to air, land and water are also included, as are Modules C3 scrap processing, C4 disposal to landfill and D recovery for recycling.

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Re-use-, recovery-, recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

X=Module declared.
MND=Module not declared (such a declaration shall not be regarded as an indicator of a zero result).

9. Environmental performance

For SSAB, the Nordic production system should be considered as one entity. A customer order is normally not dedicated to a specific production location, since the technical specification (data sheet) is used to identify the product.

Although there is a spread larger than 10 % for some indicators, it would not be meaningful to report these at site level, since the actual customer business is not conducted at site level.

In the case of hot rolled plate, mainly the indicators ADP, ODP and POCP differ, which can be explained by differences in the product mix, rather than the performance of the sites per se. In particular this refers to the alloying content of the products, and the upstream impact thereof.

Tables 2a – 2c show the results of the lifecycle assessment.

TABLE 2A. POTENTIAL ENVIRONMENTAL IMPACT PER 1,000 KG OF HOT ROLLED STEEL PLATES

Parameter	Unit	A1-A3	C3	C4	D
Global warming potential (GWP)	kg CO_2 equiv.	2.71E+03	2.49E+00	7.44E-01	-1.48E+03
Eutrophication potential (EP)	kg $(PO_4)^{3-}$ equiv.	6.30E-01	4.22E-03	5.00E-04	-2.17E-01
Acidification potential (AP)	kg SO_2 equiv.	6.25E+00	1.76E-02	4.42E-03	-2.93E+00
Photo-oxidant formation potential (POCP)	kg ethene equiv.	6.51E-01	1.95E-03	3.42E-04	-6.86E-01
Ozone Layer Depletion Potential (ODP)	kg CFC11 equiv.	1.18E-09	8.13E-15	4.32E-15	8.29E-06
Abiotic depletion potential: fossil (ADP-fossil)	MJ, net calorific value	2.66E+04	4.83E+01	1.04E+01	-1.44E+04
Abiotic depletion potential: elements(ADP-elements)	kg Sb equiv.	2.11E-02	2.80E-06	7.41E-08	-4.56E-03

TABLE 2B. USE OF RESOURCES PER 1,000 KG OF HOT ROLLED STEEL PLATES

Parameter		Unit	A1-A3	C3	C4	D
Renewable primary energy	Used as energy carrier	MJ, net calorific value	1.85E+03	3.56E+00	1.37E+00	9.56E+02
	Used as raw materials	MJ, net calorific value	0	0	0	0
	Total	MJ, net calorific value	1.85E+03	3.56E+00	1.37E+00	9.56E+02
Non-renewable primary energy	Used as energy carrier	MJ, net calorific value	2.80E+04	5.01E+01	1.08E+01	-1.39E+04
	Used as raw materials	MJ, net calorific value	0	0	0	0
	Total	MJ, net calorific value	2.80E+04	5.01E+01	1.08E+01	-1.39E+04
Secondary material		kg	26	-	-	-
Renewable secondary fuels		MJ, net calorific value	1.35E-17	0	0	0
Non-renewable secondary fuels		MJ, net calorific value	1.58E-16	0	0	0
Net use of fresh water		m^3	3.18E+00	1.49E-02	2.72E-03	1.99E+00

TABLE 2C. WASTE PRODUCTION PER 1,000 KG OF HOT ROLLED STEEL PLATES

Parameter	Unit	A1-A3	C3	C4	D
Waste, hazardous	kg	6.08E-01	1.57E-06	1.84E-07	-9.72E-04
Waste, non-hazardous	kg	8.23E+01	1.02E-02	5.01E+01	1.60E+02
Waste, radioactive	kg	5.53E-01	0	0	0

10. Additional information

Steel is 100 % recyclable and its unique properties mean it can be recycled without loss of properties or performance.

11. Mandatory statements

- The EPD for construction products may not be comparable if they do not comply with EN 15804.
- EPDs within the same product category but from different programs or utilizing different PCRs may not be comparable.

12. Program-related information and verification

Program	The International EPD® System. EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. www.environdec.com
EPD registration number	S-P-01918
Published	2020-03-31
Valid until	2025-03-30
Product group classification	UN CPC 412
Reference year for data	2017
Geographical scope	Global

Core product category rules (c-PCR)	CEN standard EN 15804+A1 served as the core PCR.
Product category rules (PCR)	PCR 2012:01 Construction products and Construction services. Version 2.3, 2018-11-15.
PCR review was conducted by	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:2006:	☐ EPD Process Certification (internal) ☑ EPD Verification (external)
Third party verifier	Carl-Otto Nevén NEVÉN Miljökonsult
Accredited or approved by	The International EPD® System.

13. References

- ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures.
- General Programme Instructions of the International EPD® System. Version 3.01.
- EN 15804:2012+A1:2013 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- PCR 2012:01. Construction Products and Construction Services. Version 2.3, 2018-11-15.
- World Steel Association Life Cycle Inventory study report, 2018 data release. This study report corresponds to the steel LCI data released in December 2018 for 17 products. This is the 5th worldsteel LCI study and has been carried out in accordance with the worldsteel LCI methodology report.
- The GaBi LCA Databases 2019 (SP39).
- The GaBi LCA Software (GaBi version 9).
- LCA methodology report – SSAB steel products EPDs, as the basis for the publication of EPDs within The International EPD® System, IVL Report U 6256, 2020.

14. Contact information

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Program operator	EPD International AB info@environdec.com

SSAB is a Nordic and US-based steel company. SSAB offers value added products and services developed in close cooperation with its customers to create a stronger, lighter and more sustainable world. SSAB has employees in over 50 countries. SSAB has production facilities in Sweden, Finland and the US. SSAB is listed on the Nasdaq OMX Nordic Exchange in Stockholm and has a secondary listing on the Nasdaq OMX in Helsinki.

885-en EPD - Hot Rolled Plate v1.0 2020. Confetti.

SSAB

epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Owner of the declaration:	Dywidag Norge AS
Program operator:	The Norwegian EPD Foundation
Publisher:	The Norwegian EPD Foundation
Declaration number:	NEPD-1235-389-EN
Registration number:	NEPD-1235-389-EN
ECO Platform reference number:	-
Issue date:	10.01.2017
Valid to:	10.01.2022

Permanent Strand Anchor
Type 0.60, 12 strands

Dywidag Norge AS

DSI
DYWIDAG-SYSTEMS INTERNATIONAL

General information

Product:
Permanent Strand Anchor Type 0.60, 12 strands

Owner of the declaration:
Dywidag Norge AS
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Manufacturer:
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e-mail: geotechnik@dywidag-systems.com

Declaration number:
NEPD-1235-389-EN

Place of production:
Koenigsbrunn, Germany

ECO Platform reference number:
-

Management system:

This declaration is based on Product Category Rules:
CEN Standard EN 15804 serves as core PCR
NPCR 013 Steel as Construction Material Rev 1 (08/2013)

Organisation no.(Norway):
929063376

Statement of liability:
The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Issue date:
10.01.2017

Valid to:
10.01.2022

Declared unit:
1 kg strand anchor

Year of study:
2016

Comparability:
EPD of construction products may not be comparable if they not comply with EN 15804 and seen in a building context.

The EPD has been worked out by:
GLOBAL & LOCAL environmental management

Annik Magerholm Fet

Verification:
The CEN Norm EN 15804 serves as the core PCR.
Independent verification of the declaration and data, according to ISO14025:2010

☐ internal ☑ external

Third party verifier:

Martin Erlandsen

(Independent verifier approved by EPD Norway)

Approved

Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:
The permanent strand anchor type 0.60, 12 strands, is a steel anchor with corrosion protection, mounted in the ground - used to anchor large constructions such as i.e. bridges, buildings etc.

Technical data:
In compliance with standards DIN 4125 and EN 1537.
The main component of the anchor analysed, the steel strands, has the nominal diameter of 15,2 mm each. Total weight of the anchor with 12 strands, with the average length 15m: 284 kg.

Product specification:
Components from suppliers are transported to Dywidags factory in Königsbrunn, Germany, where the strand anchors are assembled, before they are transported to construction sites in Norway.

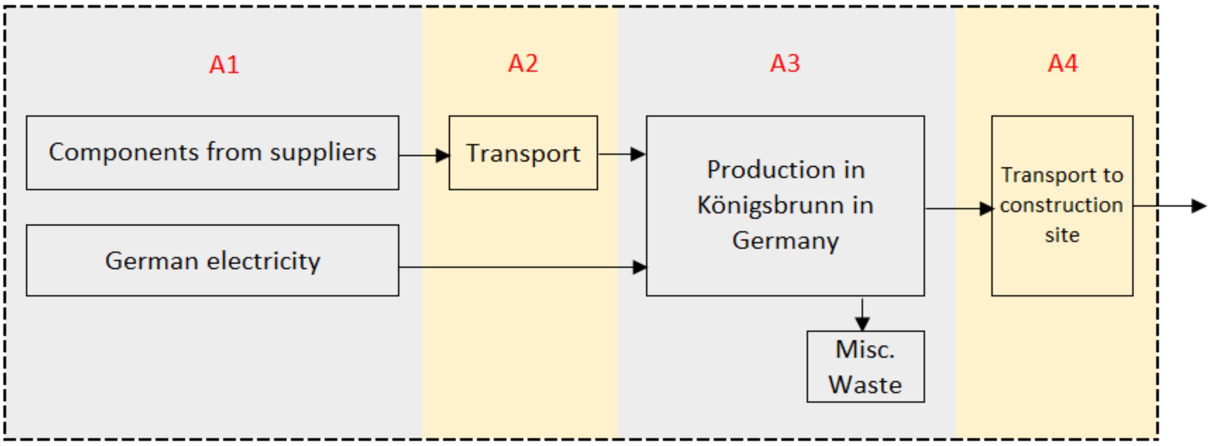
Materials	kg	%
Steel	249,9	88
Plastic	26,9	9
Grease	7,2	3

Market:
Norway

Reference service life, product:
110

LCA: Calculation rules

Declared unit:
1 kg strand anchor, with the expected service life of 110 years



System boundary:
System boundaries are shown in the flowchart. Cradle to gate (A1-A3) plus transport to construction site (A4).

Data quality:
General requirements and guidelines concerning use of generic and specific data and the quality of those are as described in EN 15804: 2012, clause 6.3.6 and 6.3.7. The data is representative according to temporal, geographical and technological requirements.

Temporal:
Data for use in module A3 is supplied by the manufacturer and consists of the recorded amount of specific material and energy consumption for the product studied. Specific data has been collected in 2016. Generic data has been created or updated within the last 10 years.

Geographical:
The geographic region of the production sites included in the calculation is Europe.

Technological:
Data represents technology in use. All generic (background) data has been gathered from the PE International GaBi 6 Professional Database and the Ecoinvent V3 database.

Cut-off criteria:
All major raw materials and all the essential energy is included. The production process for raw materials and energy flows that are included with very small amounts (<1%) are not included. This cut-off rule does not apply for hazardous materials and substances.

Allocation:
The production process at the company plant includes material and process data for the total manufacturing and assembly of the bar anchor, including energy consumption. The data was gathered specifically for the production of one bar anchor, including energy consumption for the duration of the product manufacturing. Thus, no allocation has been necessary.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD.

Transport from production place to user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption	Value (l/t)
Truck-trailer, diesel driven, Euro 5, cargo	85	34 - 40 t gross weight / 27t payload capacity	1930 km	0,0153 l/tkm	29,5

Truck transport is modelled using a generic 34-40t truck dataset for European conditions. The transport conditions may vary something from delivery to delivery, as products are transported directly from manufacturer to construction site, and varies depending on the product delivered. A average/default utilization rate has therefore been set to 85%, and a average distance to the Oslo-area where most products are delivered, is set to 1930 km.

LCA: Results

All key assumptions and estimates are either presented in the EPD or can be found in NPCR13Rev1 (08/2013).
The impacts generated in the life cycle stages described within the system boundaries are calculated using GaBi 6.
Background data is from the GaBi 6 professional database and Ecoinvent v3.
The impact assessment methodology used is CML 2001.

System boundaries (X=included, MND= module not declared, MNR=module not relevant)

Product stage			Assemby stage		Use stage							End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Environmental impact

Parameter	Unit	A1	A2	A3	A1- A3	A4
GWP	kg CO_2 -eqv	2,32E+00	6,55E-02	4,82E-03	2,39E+00	8,84E-02
ODP	kg CFC11-eqv	1,39E-10	1,65E-13	9,72E-14	1,39E-10	2,24E-13
POCP	kg C_2H_4 -eqv	1,07E-03	-4,72E-05	4,89E-08	1,02E-03	-6,37E-05
AP	kg SO_2 -eqv	7,43E-03	1,56E-04	1,04E-06	7,59E-03	2,12E-04
EP	kg PO_4^{3-}-eqv	6,34E-04	3,84E-05	1,86E-07	6,72E-04	5,18E-05
ADPM	kg Sb-eqv	1,65E-07	5,10E-09	2,06E-10	1,70E-07	6,86E-09
ADPE	MJ	2,92E+01	8,94E-01	4,19E-03	3,01E+01	1,20E+00

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

The negative POCP from the trucks in A2 is caused by the division of the NOX emissions into the two single emissions NO2 and NO during the upgrade from GaBi 4 to GaBi 5/6. The NO has a negative effect on the POCP since it reduces the close ground ozone formation.

Resource use

Parameter	Unit	A1	A2	A3	A1-A3	A4
RPEE	MJ	1,76E+00	6,17E-02	8,59E-02	1,91E+00	8,32E-02
RPEM	MJ	1,77E-06	2,44E-13	4,95E-12	1,77E-06	3,29E-13
TPE	MJ	1,76E+00	6,17E-02	8,59E-02	1,91E+00	8,32E-02
NRPE	MJ	2,98E+01	8,97E-01	4,01E-01	3,11E+01	1,21E+00
NRPM	MJ	4,78E-04	8,57E-05	2,99E-05	5,93E-04	1,16E-04
TRPE	MJ	2,98E+01	8,97E-01	4,01E-01	3,11E+01	1,21E+00
SM	kg	1,28E-01	0,00E+00	0,00E+00	1,28E-01	0,00E+00
RSF	MJ	-1,21E-02	3,44E-06	3,31E-06	-1,21E-02	4,65E-06
NRSF	MJ	-1,86E-01	5,24E-05	5,01E-05	-1,86E-01	7,07E-05
W	m^3	9,28E-01	4,59E-03	3,86E-02	9,71E-01	6,19E-03

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

End of life - Waste

Parameter	Unit	A1	A2	A3	A1- A3	A4
HW	kg	2,97E-08	1,14E-07	4,11E-10	1,44E-07	1,54E-07
NHW	kg	2,95E-02	1,13E-04	2,34E-04	2,98E-02	1,53E-04
RW	kg	3,64E-04	1,55E-06	1,89E-05	3,85E-04	2,10E-06

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

End of life - Output flow

Parameter	Unit	A1	A2	A3	A1- A3	A4
CR	kg	-	-	-	-	-
MR	kg	-	-	9,89E-04	9,89E-04	-
MER	kg	-	-	-	-	-
EEE	MJ	-	-	1,53E+00	1,53E+00	-
ETE	MJ	-	-	3,78E+00	3,78E+00	-

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Reading example: 9,0 E-03 = $9{,}0 \cdot 10^{-3}$ = 0,009

Additional Norwegian requirements

Greenhous gas emission from the use of electricity in the manufacturing phase
National production mix from import, low woltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing prosess(A3).

Data source	Amount	Unit
GaBi 6 Electricity mix (DE) (2012)	0,629	kg CO_2-eqv/kWh

Dangerous substances

☑ The product contains no substances given by the REACH Candidate list or the Norwegian priority list

☐ The product contains substances given by the REACH Candidate list or the Norwegian priority list that are less than 0,1 % by weight.

☐ The product contain dangerous substances, more then 0,1% by weight, given by the REACH Candidate List or the Norwegian Priority list, see table.

☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list. The product is classified as hazardous waste (Avfallsforskiften, Annex III), see table.

Carbon footprint
Carbon footprint has not been worked out for the product.

Bibliography

ISO 14025:2010	*Environmental labels and declarations - Type III environmental declarations - Principles and procedures*
ISO 14044:2006	*Environmental management - Life cycle assessment - Requirements and guidelines*
EN 15804:2012+A1:2013	*Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products*
ISO 21930:2007	*Sustainability in building construction - Environmental declaration of building products*
LCA-Report Dywidag Norge AS	Life Cycle Assessment Report: Permanent Strand Anchor Type 0.60, 12 strands
NPCR 013-2013	Product Category Rules: Steel as Construction Material

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ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

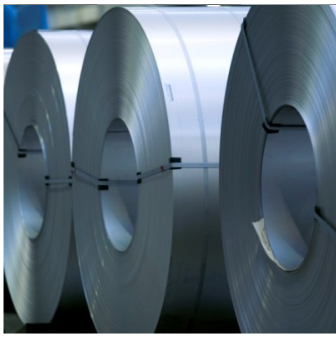
Owner of the Declaration	**Outokumpu Oyj**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-OTO-20190003-IBD1-EN
Issue date	28/06/2019
Valid to	27/06/2024

Hot Rolled Stainless Steel

Outokumpu Oyj

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com



1. General Information

Outokumpu Oyj	Hot Rolled Stainless Steel
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Outokumpu Oyj Salmisaarenranta 11 FI-00181 Helsinki Finland
Declaration number EPD-OTO-20190003-IBD1-EN	**Declared product / declared unit** This EPD applies to 1 ton of hot rolled stainless steel product. It covers steel delivered as sheet or as plate for various applications for building and civil work.
This declaration is based on the product category rules: Structural steels, 07.2014 (PCR checked and approved by the SVR) **Issue date** 28/06/2019 **Valid to** 27/06/2024	**Scope:** The declaration applies to 1 ton of hot rolled stainless steel product produced by Outokumpu. The Life Cycle Assessment is based on data from the following Outokumpu production plants: - Outokumpu Stainless AB, Avesta, Sweden - Outokumpu Stainless AB, Degerfors, Sweden - Outokumpu Stainless AB, Nyby, Torshalla, Sweden - Outokumpu Stainless Oy, Tornio, Finland - Outokumpu Nirosta GmbH, Dillenburg, Germany - Outokumpu Nirosta GmbH, Krefeld, Germany - Outokumpu Stainless USA LLC, Calvert, AL, USA Production has been modeled using annual production data from 2017. Where required averaging is based on production output from each site. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Dr. Alexander Röder (Head of Board IBU)	Dr.-Ing. Andreas Ciroth (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

This EPD describes hot rolled stainless steel products produced by Outokumpu Oyj. Hot rolled products are supplied as coil or as plate. Hot rolled stainless steel has excellent durability and strength. A number of sheet and plate widths, lengths and thicknesses are available to meet the various design specifications and requirements. Several surface finishes are available, e.g. pickled, brushed and ground surface. This EPD is applicable to homogeneous Outokumpu hot rolled products which are used in the construction and building industry.

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a declaration of performance taking into consideration/EN 10088-4:2009/, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes/, /Limiting dimension and shape tolerance: Tolerances according to ISO (EN) 9444-2/ 9445-2/, /EN 10029/ and the CE-marking. For the application and use the respective national provisions apply.

2.2 Application

Hot rolled products are used in a wide range of applications in building and construction. Typical applications are load bearing structures such as heavy transport, bridges and floodgates, building fixings, traffic barriers, and façade components.

the European Chemicals Agency are not contained in stainless steel in declarable quantities.

2.3 Technical Data

Constructional data

Name	Value	Unit
Density	7900	kg/m^3
Coefficient of thermal expansion	14	$10^{-6}K^{-1}$
Thermal conductivity	19	W/(mK)
Modulus of elasticity	205	GPa
Melting point	1450	°C
Proof strength Rp0.2	200-530	MPa
Tensile strength Rm	450-950	MPa
Elongation A	18-45	%
Impact strength KV	40-90 (transverse)	J
Weldability	covered by chemical composition	
Durability	covered by chemical composition	
Fracture toughness	covered by impact strength	
Cold formability	covered by elongation	

performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to /EN 10088-1:2014/, /EN 10028-7:2016/, /ASTM A240/, /ASME IID 2017/, /EN 10204:2005/, (not part of CE-marking).

2.4 Delivery status

Hot Rolled 1D and 1G surface finish condition according to /**EN 10088-1**/ and in accordance with /**EN 10204**/. The dimensions of the declared product may vary according to the final use.

The products are certified in accordance with product standards :
/EN 10088-1/
/EN 10028-7/
/ASTM A240/
/ASME IID/
/EN 10204/

2.5 Base materials / Ancillary materials

Manufacturing is based on recycling and ferrous scrap (predominantly stainless steel scrap) is used as a major raw material. Alloying elements are also added as ferroalloys or metals. The most common alloying elements are chromium, nickel, molybdenum, manganese and silicon. Other elements, for example nitrogen, niobium and titanium may also be present in the stainless steel. The presence and rates of these alloying elements depend on the stainless steel designation as set out in /**EN 10088-1**/. All stainless steels contain at least 10.5 % chromium.

Substances listed on the “Candidate List of Substances of Very High Concern for Authorisation” by the European Chemicals Agency are not contained in stainless steel in declarable quantities.

2.6 Manufacture

The steel scrap is melted in an electric arc furnace to obtain a steel melt. The liquid steel is further refined (adjustment of sulphur, carbon and phosphorous) and alloyed to give the stainless steel the required characteristics. The molten steel is then cast into semi-finished steel products like slabs or billets. The semi-finished steel products are hot rolled to the desired thickness and then annealed and pickled.

2.7 Environment and health during manufacturing

Environmental, occupational health and safety and quality management are in accordance with /**ISO 14001**/, /**ISO 9001**/ and /**OHSAS 18001**/

2.8 Product processing/Installation

Processing and installation of the steel coil, sheet or plate has to be carried out according to generally recognized engineering rules and the manufacturer’s recommendation depending on the respective application.
Eurocodes /**EC3**/ and /**EC4**/ apply to the design and construction. They include the requirements regarding performance, durability and fire resistance of steel structures. During handling and use of the products, normal occupational safety measures should be applied. Instructions from the manufacturer concerning welding as well as hot and cold forming are to be followed.
Under normal conditions no significant environmental impact to water, air or soil is known.
Residual material like steel scrap should be collected as it is 100% recyclable.

2.9 Packaging

Stainless sheets and plates are usually delivered with paper to protect the surface. This paper has been included in the EPD. In some cases, wooden pallets may be used for truck transport, although these have not been included in the EPD.

2.10 Condition of use

The maintenance requirements depend on the specific design and application, but typically stainless steel only requires a minimum of maintenance, for example, washing with mild detergents to maintain the product’s appearance.

2.11 Environment and health during use

Under normal conditions of use, no adverse health effects are known for stainless steel products.
Stainless steel does not release volatile organic compounds (VOCs) to indoor air.
Similarly no significant environmental impact to water, air or soil is expected, due to the extremely low metal release from stainless steel and the low maintenance need.

2.12 Reference service life

Service life is dependent upon physical and mechanical service conditions. Correct alloy designation choice can satisfy a required service life.

2.13 Extraordinary effects

Fire
Structural steel products meet the requirements of building material safety class A1 (i.e. non-flammable according to /**EN 13501-1**/).

Water
In the event of unforeseeable exposure to water caused by sudden flooding, no risks to the environment or human health are expected to occur.

Mechanical destruction
In the event of mechanical destruction, no risks to the environment or human health are expected to occur.

2.14 Re-use phase
Stainless steel panels and structures are not generally reused at end-of-life. Reuse is possible and could take place providing that the reused component was able to meet the technical specifications required. Stainless steel is usually recycled and can be recycled to the same quality of steel without loss of properties.

2.15 Disposal
Stainless steel scrap is a valuable resource with well-established recycling routes. Disposal is not recommended, but no adverse environmental impact is known.
The /**European Waste Catalogue/** code for iron and steel products is 17 04 05.

2.16 Further information
For further information on these products please refer to http://www.outokumpu.com.

3. LCA: Calculation rules

3.1 Declared Unit
The declaration applies to one ton of hot rolled stainless steel product. The declared unit is the production and recycling of one ton of hot rolled stainless steel product.

Declared unit

Name	Value	Unit
Declared unit	1000	kg

3.2 System boundary
This EPD is cradle-to-gate with options, and includes the following process steps:

- Upstream production of raw materials, fuels and energy and all relevant upstream transport processes.
- Production/manufacturing of the stainless steel product.
- Waste water and treatment of wastes generated on site including swarf, dusts, scrap, slag and waste water.
- End-of-life (recycling, remelting or disposal of steel scrap).

3.3 Estimates and assumptions
95 % of hot rolled structural steel products are assumed to be recycled at end-of-life. The average hot rolled product produced by Outokumpu has a stainless steel scrap content of 71.35 % hence the net stainless steel scrap output is 23.65 % (95 % -71.35 %). This stainless steel scrap is declared as a credit in module D. This means that for each 1000 kg of hot rolled stainless steel product produced, 236.5 kg stainless steel scrap is credited.
The carbon steel scrap used as input is not included in these numbers as carbon steel scrap is considered an open loop with own burden.

End-of-Life Scenario
At end-of-life, a 95 % recycling rate for the steel product is assumed. The remaining 5 % is assumed to remain uncollected or to go to disposal e.g. landfill.

3.4 Cut-off criteria
All reported data were incorporated and modelled i.e. all raw materials, water, thermal and electrical energy and production waste.
The principal material transport processes (such as alloys and scrap) are also considered. Thus, even minor material and energy flows of less than 1 % mass are included.
Data for the sites were cross-checked with one another to identify potential data gaps. No processes, materials or emissions that are known to make a significant contribution to the environmental impact of the products studied have been omitted.
It can be assumed, that all excluded flows contribute less than 5% to the impact assessment categories.
Packaging materials and its transportation are neglected due to low contribution to the overall life cycle results.
Machines, facilities and infrastructure required during manufacture are not taken into account.

3.5 Background data
Background data for upstream materials, fuels and energy production are taken from the /**GaBi Database**/.

3.6 Data quality
Production has been modeled using 2017 average production data provided by Outokumpu's own sites and has been quality-checked by Outokumpu and thinkstep.

3.7 Period under review
Modelling is based on production data from 2017. Background data used are from the 2018 version of /**GaBi Database**/. Documentation related to all the processes used in the stainless steel production model can be found in the GaBi documentation /**GaBi Documentation**/.

3.8 Allocation
Slag generated as a by-product of electric arc furnace (EAF) steelmaking is used as an input to a variety of industries including as a constituent of cement, in road building or as fill material.

This study has adopted a conservative approach and has assumed that all the environmental burdens associated with the production of stainless steel products and EAF slag are allocated to the production of steel, with slag included under the material for recycling (MFR) category.

Production losses of steel during the production process are recycled in a closed loop reducing the requirement for external scrap.

Specific information on allocation within the background data is given in the GaBi datasets documentation (/**GaBi Documentation/)**.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

.

4. LCA: Scenarios and additional technical information

For this steel product folling average end of life scenarios were considered with the corresponding benefits and burdens:
Landfilling of 5%, a recycling rate of 95%.
The stainless steel scrap input into Modul A is 713,5 kg; this results in a value of scrap benefit of 236,5 kg.

End of life (C3)

Name	Value	Unit
Landfilling	5	%

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
End-of-life recycling rate	95	%
Stainless steel scrap input (into module A)	71.35	%
Net stainless steel scrap credit	23.65	%
Equiv. Mass of stainless steel scrap credited per ton product	236.5	kg

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling- potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 t Hot Rolled Stainless Steel product

Parameter	Unit	A1-A3	C3	D
Global warming potential	[kg CO_2-Eq.]	2.74E+3	2.48E+0	-1.19E+3
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.29E-9	7.00E-12	-9.17E-13
Acidification potential of land and water	[kg SO_2-Eq.]	1.45E+1	9.61E-3	-7.50E+0
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	9.78E-1	1.19E-3	-4.14E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	8.89E-1	6.99E-4	-4.48E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.86E-1	1.14E-6	-6.54E-2
Abiotic depletion potential for fossil resources	[MJ]	3.24E+4	2.87E+1	-1.43E+4

RESULTS OF THE LCA - RESOURCE USE: 1 t Hot Rolled Stainless Steel product

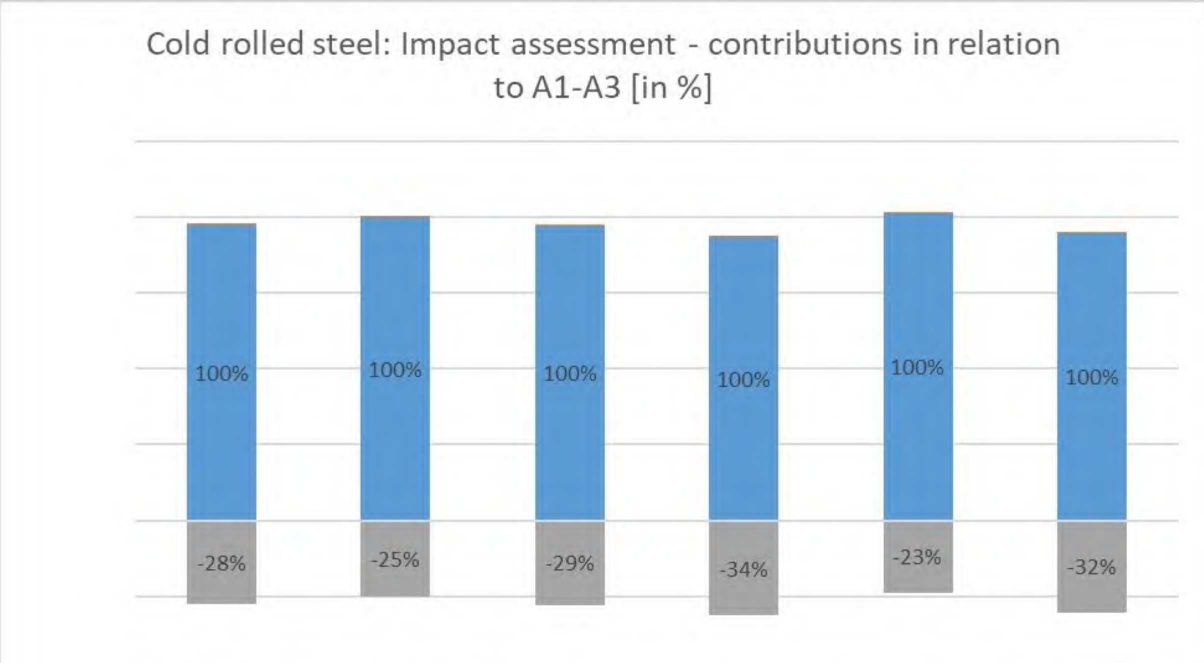
Parameter	Unit	A1-A3	C3	D
Renewable primary energy as energy carrier	[MJ]	7.67E+3	1.20E+1	-2.28E+3
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	7.67E+3	1.20E+1	-2.28E+3
Non-renewable primary energy as energy carrier	[MJ]	3.72E+4	4.07E+1	-1.45E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	3.72E+4	4.07E+1	-1.45E+4
Use of secondary material	[kg]	7.14E+2	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	3.40E+1	1.65E-2	-1.67E+1

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 t Hot Rolled Stainless Steel product

Parameter	Unit	A1-A3	C3	D
Hazardous waste disposed	[kg]	4.61E-2	3.28E-7	-1.50E-1
Non-hazardous waste disposed	[kg]	3.20E+2	5.01E+1	1.58E+1
Radioactive waste disposed	[kg]	1.95E+0	4.80E-3	-1.23E-1
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	9.50E+2	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

This chapter contains an interpretation of the Life Cycle Impact Assessment categories with regards to the functional unit – 1 ton of stainless steel product. It focuses on the dominant contributions during the production process and recycling steel at its end of life.



	GWP [kg CO2-Eq.]	AP [kg SO2-Eq.]	EP [kg PO4-Eq.]	POCP [kg C2H4-Eq.]	ADPE [kg Sb-Eq.]	ADPF [MJ]
D	-28%	-25%	-29%	-34%	-23%	-32%
C3	0,1%	0,0%	0,1%	0,1%	0,0%	0,1%
A1-A3	100%	100%	100%	100%	100%	100%

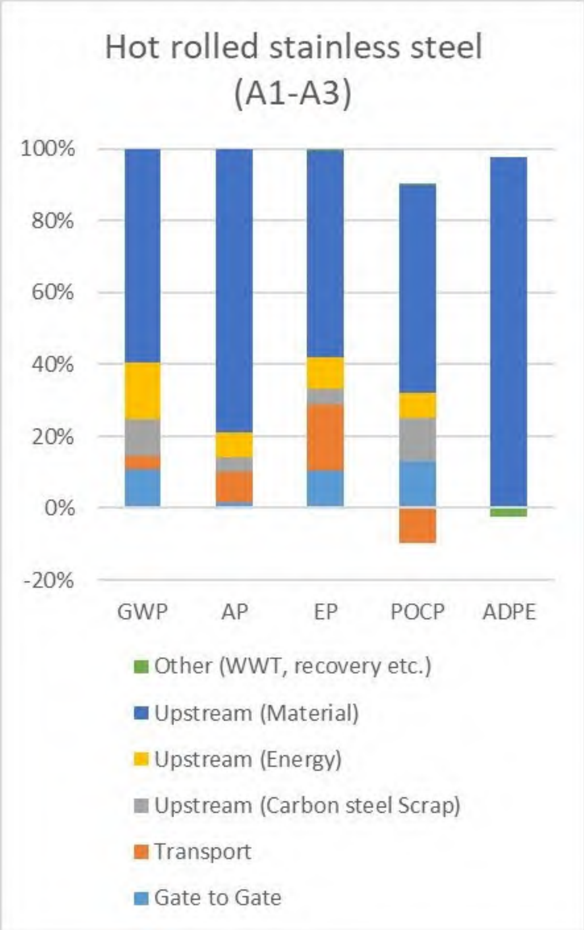
The figure above shows the relative contribution of the production stages (Module A1-A3), waste treatment (Module C3) and the benefits and loads beyond the product system boundary (Module D).
For all categories, the results for product stage (A1-3) contributes with the highest shares. Overall, C3 has a minimized contribution. The credits in Module D have a considerable share, thanks to the recycling.

The most relevant emissions on stainless steel production:
for **Global Warming Potential (GWP**) are CO2, CH4
for **Acidication Potential** (**AP)** are SO2 and NOx;
for **Eutrophication Potential (EP**) are NOx
for **Photochemical Ozone Creation Potential (POCP)** are CO, SO2, NOx, and NMVOC.

The main contribution to A1-A3 is the production of upstream materials, which is dominated by the production of the Fe-alloys Fe-Cr, Fe-Ni, Fe-Si, and Fe-Mo. The production of the listed Fe-alloys is high in energy consumption on Primary Energy Demand and registers high emissions of carbon dioxide, nitrogen oxides and sulphur dioxide with the resulting effect on Global Warming Potential, Acidification Potential, Eutrophication Potential and Photochemical Ozone Creation Potential.

In addition to the upstream material production, a certain influence on the overall results is given by the upstream energy production related to the electricity and fuel consumption on-site. Depending on the location of the site this influence might vary related to the country specific energy supply.

The figure below summarises percentage contributions to selected impact category for each of the products (cradle-to-gate), showing the large contribution from upstream materials.



7. Requisite evidence

This EPD covers hot rolled products which are likely to be employed in a variety of applications including structures such as heavy transport, bridges and floodgates, building fixings, traffic barriers, and façade components, many of which will require further processing and fabrication related to the final application. Consequently, further documentation is not applicable.

7.1 Weathering performance

Where hot rolled stainless steel is used in an external application, no corrosion shall occur as stainless steel is inherently non-corrosive. For this reason, stainless steel products are often applied where corrosion resistance is a key performance characteristic.

8. References

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/EN 10088-1/
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/EN 10088-4:2009/, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes

/EN 10028-7/
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ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and

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/ISO 14001/
ISO 14001:2015: Environmental management

/OHSAS 18001/
BS OHSAS 18001:2007: Occupational health and safety management systems – Requirements

/EC3/
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/GaBi Documentation/
GaBi ts Documentation GaBi ts: Documentation of the GaBi datasets for Life Cycle Engineering. IABP, University of Stuttgart und thinkstep AG, 2018. http://www.gabi-software.com/international/support/gabi/

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Outokumpu Oyi**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-OUT-2013-0159-CBD2-EN
Issue date	19.07.2013
Valid to	18.07.2018

Stainless Steel - Long products

Outokumpu Oyi

Institut Bauen und Umwelt e.V.

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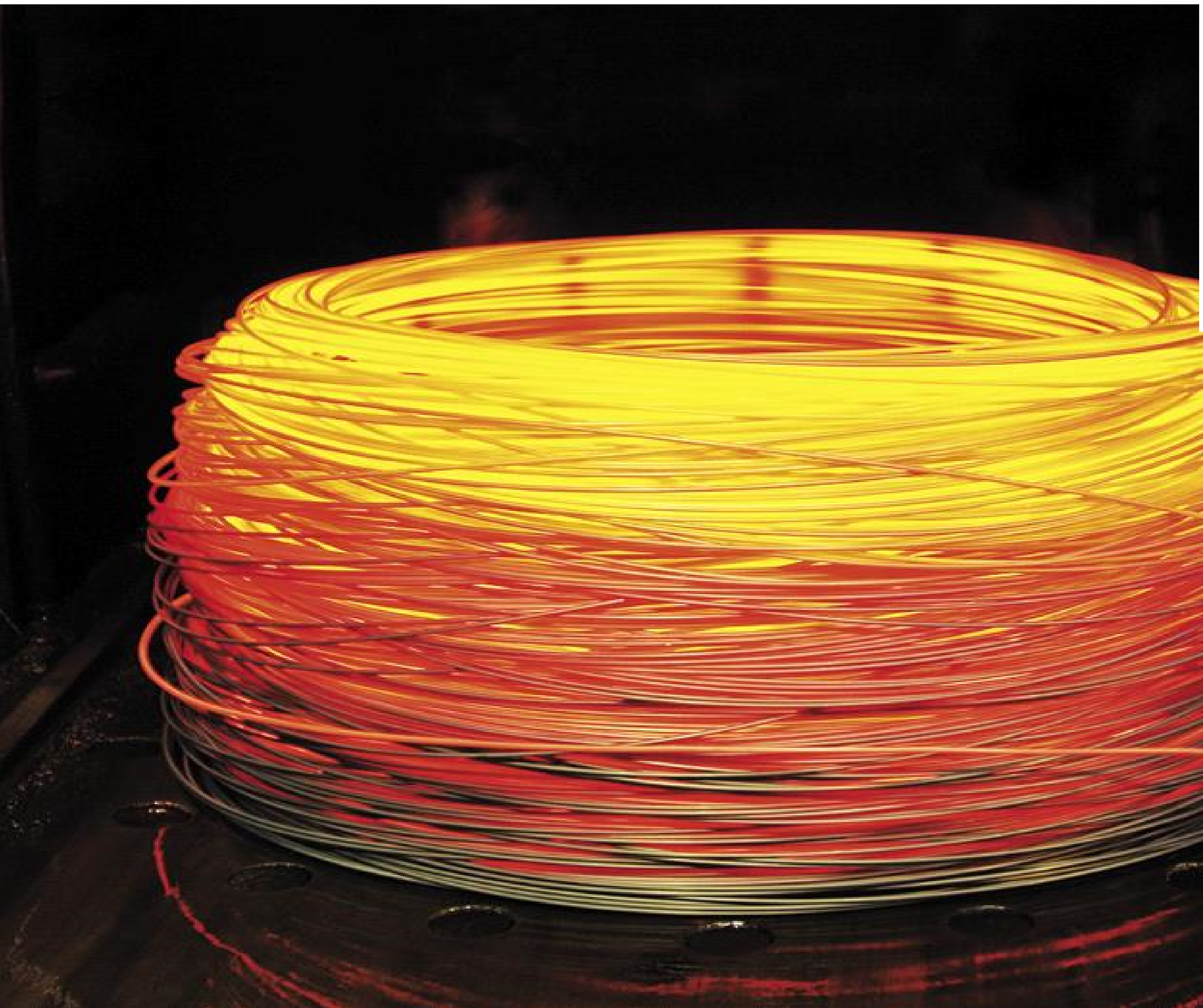


1. General Information

Outokumpu	Stainless Steel - Long products
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** Outokumpu Oyj Salmisaarenranta 11 FI-00181 Helsinki Finland
Declaration number EPD-OUT-2013-0159-CBD2-EN	**Declared product / Declared unit** This EPD applies to 1 ton of stainless steel long product. It covers steel delivered as wire rod coil, cold drawn bar and heavy bar for various applications for building and civil works.
This Declaration is based on the Product Category Rules: Structural steels, 07.2014 (PCR tested and approved by the SVR) **Issue date** 19.07.2013 **Valid to** 18.07.2018	**Scope:** The declaration applies to 1 ton of stainless steel long product produced by Outokumpu. The Life Cycle Assessment is based on data from the following Outokumpu production plants: • SMACC, Sheffield, UK • ASR Rod Mill, Sheffield, UK • Sheffield Stainless Bar, Sheffield, UK • Outokumpu Stainless AB, Degerfors, Sweden • Outokumpu Stainless Bar, Richburg, SC, USA Production has been modeled using annual production data from 2011. Where required averaging is based on production output from each site. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Dr. Burkhart Lehmann (Managing Director IBU)	Mr Olivier Muller (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The declared products must be described..

This EPD describes stainless steel long products produced by Outokumpu. Long products are supplied as black, peeled or cold drawn bar or as rod coil. The computerised process control of our rolling mills, heat treatment facilities, and finishing lines ensures consistency and superior control of the targeted properties. Stainless steel long products are available in a wide range of sizes in both standard and special grades. This EPD is applicable to homogeneous Outokumpu stainless steel long products which are used in the construction and building industry. The data have been provided by a representative mix of five manufacturing plants in the UK, USA and Sweden.

The products are produced in accordance with various national and/or international technical regulations. The products are certified in accordance with product standards:

/EN 10088-5:2009/, Stainless steels
/EN 10272:2007/, Stainless steel bars for pressure purposes
/ASTM A276/, Standard specification for stainless steel bars and shapes
/ASME IID/, Materials
/JIS G4303:2012/, Stainless steel bars

More detailed information on technical properties in Outokumpu brochure "Steel Grades, Properties and Global Standards".

2.2 Application

Long products are used in a wide range of applications in building and construction. Typical applications are fixings, wall ties, couplings and dowel bars.

2.3 Technical Data

The technical specifications of the products that are within the scope of the EPD are to name with reference to the individual assessment rules (for example, standards).
For products with CE marking, in particular the performances must be specified in accordance with the performance declaration.

Constructional data

Name	Value	Unit
Density	7700 - 8100	kg/m³
Modulus of elasticity	190000 - 220000	N/mm²
Coefficient of thermal expansion (RT to 100°C)	10 - 16	$10^{-6}K^{-1}$
Thermal conductivity	15	W/(mK)

The products are produced in accordance with various national and/or international technical regulations. The products are certified in accordance with product standards:
/EN 10088-5:2009/, Stainless steels
/EN 10272:2007/, Stainless steel bars for pressure purposes
/ASTM A276/, Standard specification for stainless steel bars and shapes
/ASME IID/, Materials
/JIS G4303:2012/, Stainless steel bars
More detailed information on technical properties in Outokumpu brochure "Steel Grades, Properties and Global Standards".

2.4 Delivery status

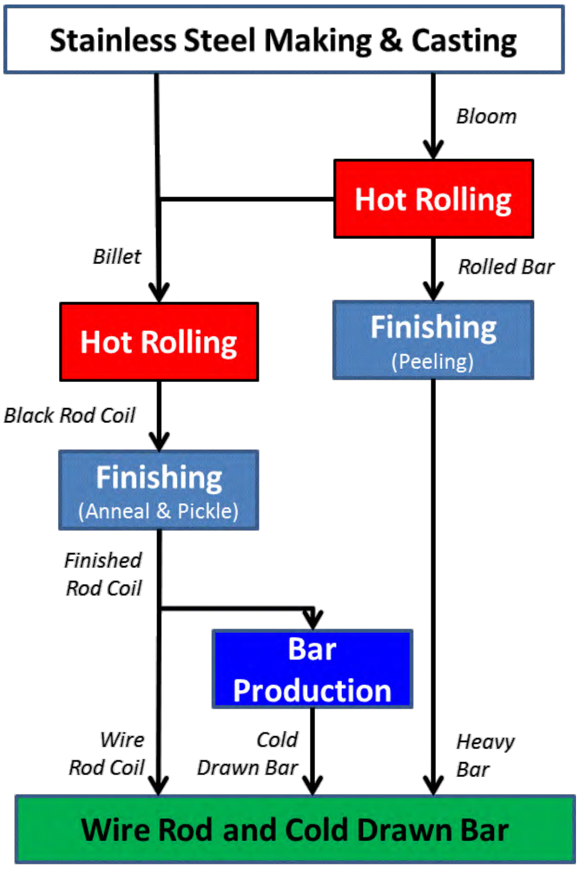
The dimensions of the declared product may vary according to the final use.

2.5 Base materials / Ancillary materials

Manufacturing is based on recycling and ferrous scrap, (predominantly stainless steel scrap) is used as raw material. Alloying elements are also added as ferroalloys or metals. The most common alloying elements are chromium, nickel, molybdenum and manganese. Other elements, for example nitrogen, niobium, titanium and silicon may also be present in the stainless steel. The presence and rates of these alloying elements depend on the stainless steel designation as set out in **/EN 10088-1/**. All stainless steels contain at least 10.5% chromium.
Substances listed on the "Candidate List of Substances of Very High Concern for Authorisation" by the European Chemicals Agency are not contained in the stainless steel in declarable quantities.

2.6 Manufacture

The steel scrap is melted in an electric arc furnace to obtain a steel melt. The liquid steel is further refined (adjustment of sulphur, carbon and phosphorous) and alloyed to give the stainless steel the required characteristics. The steel is then cast into semi-finished stainless steel products, for example billets. The billets are hot rolled to the desired bar size or the billets are hot rolled to rod coil and then annealed and pickled. The bar can also be peeled and the rod coil cold drawn and cut to bar.



2.7 Environment and health during manufacturing

Production Stage
Environmental, occupational health and safety and quality management are in accordance with /**ISO 14001**/, /**ISO 9001**/ and /**OHSAS 18001**/

2.8 Product processing/Installation

Processing of the rod coil or bar lengths has to be carried out depending on the respective application according to the generally recognised rules of engineering and the manufacturer's recommendation. Eurocode 3 and 4 (EC3 and EC4) apply to the design of construction. EC3 and EC4 include requirements regarding performance, durability and fire resistance of steel and composite structures.
During handling and the use of the products, normal occupational safety measures should be applied. Any instructions from the manufacturer concerning welding as well as hot and cold forming are to be followed.
Under normal conditions there will be no significant environmental impact to water, air or soil.
Residual material, for example steel scrap, should be collected as it is 100% recyclable.

2.9 Packaging

Stainless steel long products are supplied in rod coil form or bar lengths using a combination of the following packaging systems

- Plastic straps
- Galvanised strapping and plastic sleeves
- Lamiflex
- Plasticised paper
- Wooden boxes

- Polyweave
- Plastic straps and pallets.

2.10 Condition of use

Maintenance in the Use Stage
The maintenance requirements depend on the specific design and application, but typically stainless steel only requires a minimum or no maintenance.

2.11 Environment and health during use

Under normal conditions of use, stainless steel products do not cause adverse health effects and stainless steel does not release VOCs to indoor air. Similarly no significant environmental impact to water, air or soil is expected, due to the extremely low metal release from stainless steel and the low maintenance need.

2.12 Reference service life

Service life is dependent upon corrosion environment, physical and mechanical service conditions. Correct alloy designation choice can satisfy a required service life.

2.13 Extraordinary effects

Fire
Fire resistance of long stainless steel products are dependent on several use conditions. How to estimate the fire resistance is explained in **/Feuerwiderstand von Bauteilen aus Stahl /** and nomograms for data are given.

Fire protection

Name	Value
Building material class	-
Burning droplets	-
Smoke gas development	-

Water
no impact

Mechanical destruction

In the event of mechanical destruction, no risks to the environment or human health are expected to occur.

2.14 Re-use phase

Stainless steel long products can be re-used after recovery.
Stainless steel is 100% recyclable and keeps the same high quality when recycled. Recycling routes are well-established and recycling is therefore the preferred disposal route.

2.15 Disposal

Stainless steel scrap is a valuable resource with well-established recycling routes. Disposal is not recommended, but has no adverse environmental impact.
The European Waste Index code for iron and steel products is 17 04 05.

2.16 Further information

For stainless steel long products in construction an end-of-life recycling rate of 92% has been used, based on work carried out by the International Stainless Steel Federation (ISSF) /**ISSF**/.

3. LCA: Calculation rules

3.1 Declared Unit

The declaration applies to 1 tonne of stainless steel long product. The declared unit is the production and recycling of one tonne of stainless steel long product.

Declared unit

Name	Value	Unit
Declared unit	1000	kg
Thickness not applicable	-	mm
Density	7700 - 8100	kg/m^3
Conversion factor to 1 kg not applicable	-	-

3.2 System boundary

This EPD is cradle-to-gate with options, and includes the following process steps:

- Upstream production of raw materials, fuels and energy and all relevant upstream transport processes
- Production/manufacture of the stainless steel long product
- Waste water and treatment of wastes generated on site including swarf, dusts, scrap, slag and waste water
- End-of-life (recycling, remelting or disposal of steel scrap)

3.3 Estimates and assumptions

92% of structural steel long products are assumed to be recycled at end of life. The average long product produced by Outokumpu has a stainless steel scrap content of 72.5% hence the net stainless steel scrap output is 19.5% (92% - 72.5%). This stainless steel scrap is declared as a credit in module D.
It means each 1000 kg of stainless steel long product produced, 195 kg stainless steel scrap is credited.

End-of-Life Scenario
At end-of-life a 92% recycling rate for the steel product is assumed. The remaining 8% is assumed to remain uncollected or go to disposal e.g. landfill.

3.4 Cut-off criteria

All data gathered from the production data acquisition are considered, i.e. all raw materials, water, thermal and electrical energy, packaging materials, and production waste. The principal material transport processes (such as alloys and scrap) are also considered. Thus, even minor material and energy flows of less than 1% mass are included. The total sum of neglected processes per module A and D (for the sub-modules covered) does not exceed 5%. Machines, facilities and infrastructure required during manufacture are not taken into account.

3.5 Background data

Background data for upstream materials, fuels and energy production are taken from the /**GaBi 5 Software**/ produced by PE INTERNATIONAL.

3.6 Data quality

Production has modelled using average 2011 production data provided by Outokumpu's own sites and has been quality-checked by Outokumpu and PE INTERNATIONAL.

3.7 Period under review

Modelling is based on production data from 2011. Background data used are from the period 2006 to 2012 and are taken from the /**GaBi 5 Software**/. Documentation related to all the processes used in the stainless steel production model can be found in the /**GaBi 5 Documentation**/.

3.8 Allocation

Module A1-A3: In modelling production, treated waste (which has metal content) and energy (electrical or thermal) produced on site is considered as a closed loop, and is given a credit by avoiding production of the same amount of primary product within module A. Slag generated as a by-product of EAF steelmaking is used as an input to a variety of industries including as a constituent of cement, in road building or as a fill material. An allocation methodology to account for this in line with the requirements of EN 15804 is still under development by European steel industry partners, but is not available at the present time. In the interim, this study has adopted a conservative approach and has assumed that all the environmental burdens associated with the production of stainless steel products and EAF slag are allocated to the production of steel.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. The used background database has to be mentioned.

4. LCA: Scenarios and additional technical information

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Stainless steel scrap input (into module A)	72,5	%
End-of-life recycling rate	92	%
Net stainless steel scrap credit	19,5	%
Equiv. mass of stainless steel scrap credited per to product	195	kg/t

5. LCA: Results

The following tables show the results of the LCA environmental impact assessment, resource use, waste flows and other output flows for 1t of stainless steel long product produced by Outokumpu.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1t of stainless steel long product

Parameter	Unit	A1	A2	A3	D
Global warming potential	[kg CO_2-Eq.]	2.87E+3	3.32E+2	4.60E+2	-1.04E+3
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.84E-6	1.84E-6	5.18E-7	-6.40E-6
Acidification potential of land and water	[kg SO_2-Eq.]	2.50E+1	3.15E-1	9.31E-1	-9.55E+0
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.15E+0	4.28E-2	1.26E-1	-5.60E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.45E+0	2.46E-2	1.28E-1	-5.98E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	5.22E-1	1.45E-6	1.62E-6	-1.03E-1
Abiotic depletion potential for fossil resources	[MJ]	3.66E+4	4.23E+2	8.02E+2	-1.06E+4

RESULTS OF THE LCA - RESOURCE USE: 1t of stainless steel long product

Parameter	Unit	A1	A2	A3	D
Renewable primary energy as energy carrier	[MJ]	4.87E+3	2.22E+1	4.20E+1	-4.69E+2
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	4.87E+3	2.22E+1	4.20E+1	-4.69E+2
Non-renewable primary energy as energy carrier	[MJ]	4.27E+4	4.89E+2	9.63E+2	-1.11E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	4.27E+4	4.89E+2	9.63E+2	-1.11E+4
Use of secondary material	[kg]	9.00E+2	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	IND	IND	IND	IND

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1t of stainless steel long product

Parameter	Unit	A1	A2	A3	D
Hazardous waste disposed	[kg]	IND	IND	IND	IND
Non-hazardous waste disposed	[kg]	IND	IND	IND	IND
Radioactive waste disposed	[kg]	2.39E+0	2.34E-2	6.64E-2	-7.82E-2
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	0.00E+0	0.00E+0	4.09E+2	1.95E+2
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

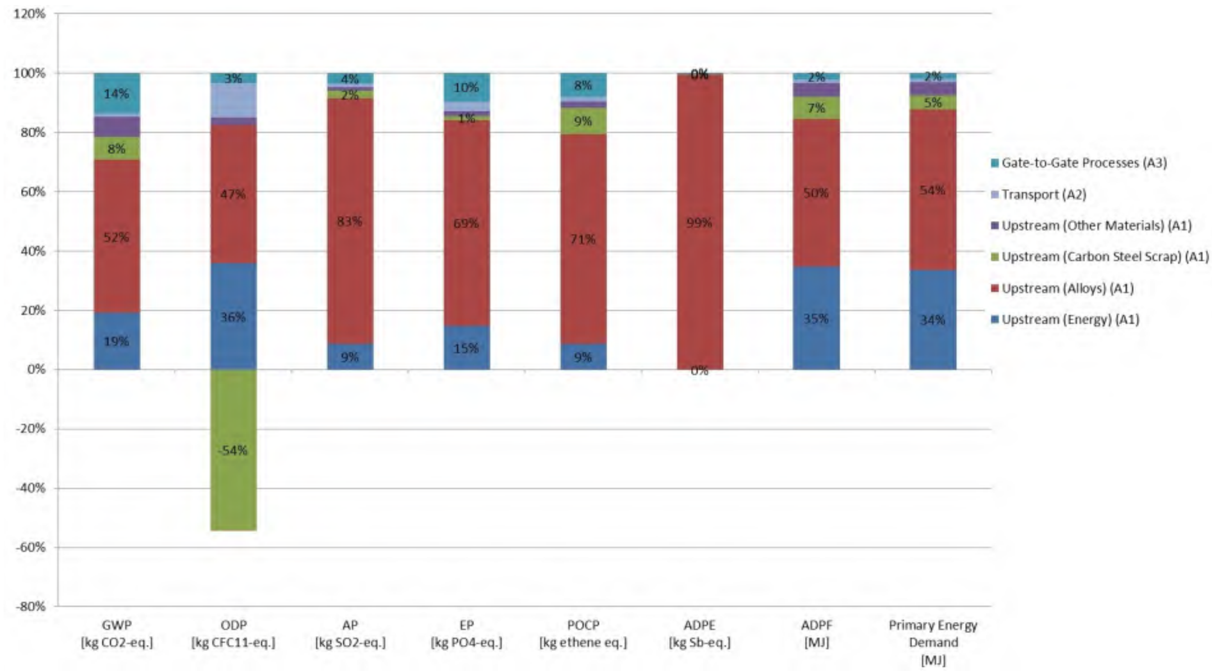


Figure 1: Environmental impact shares of production stages

Figure 1 illustrates the percentage contribution of various production stages to the cradle-to-gate environmental impact of 1t of stainless steel long product. For the vast majority of the seven impact categories as well as primary energy demand, upstream production of alloying materials, energy/fuel production and the burden of carbon steel scrap are the three most significant categories. Outokumpu's own on-site (gate-to-gate) processes contributes 13% to the cradle-to-gate **Global Warming Potential (GWP)** of 1t of rebar, but less than 5% to ozone depletion potential, acidification potential, abiotic depletion categories and primary energy demand.

Ozone depletion potential (ODP) is shown as gaining a large credit from the consumption of carbon steel scrap. The burden of carbon steel scrap is calculated as the LCI of a 100% primary production route (Blast furnace/Basic OxygenFurnace) minus the LCI of a 100% secondary production route (Electric Arc Furnace). The ODP of EAF steel is generally higher than that of BF/BOF steel due to higher electricity consumption, resulting in the "credit" seen in figure 1.

The contribution to GWP and primary energy demand of some of the key individual alloys and auxiliary materials used in the manufacture of stainless steel long product is illustrated in figure 2. In total, the material categories in figure 2 account for 58% of the cradle-to-gate GWP and 60% of the primary energy demand, the most significant alloys being nickel/ferronickel, silicon/ferrosilicon and ferrochrome. Auxiliary materials, including slag minerals, chemical compounds used in finishing, refractories etc. contributed 7% and 4% respectively to the overall cradle-to-gate GWP and primary energy demand.

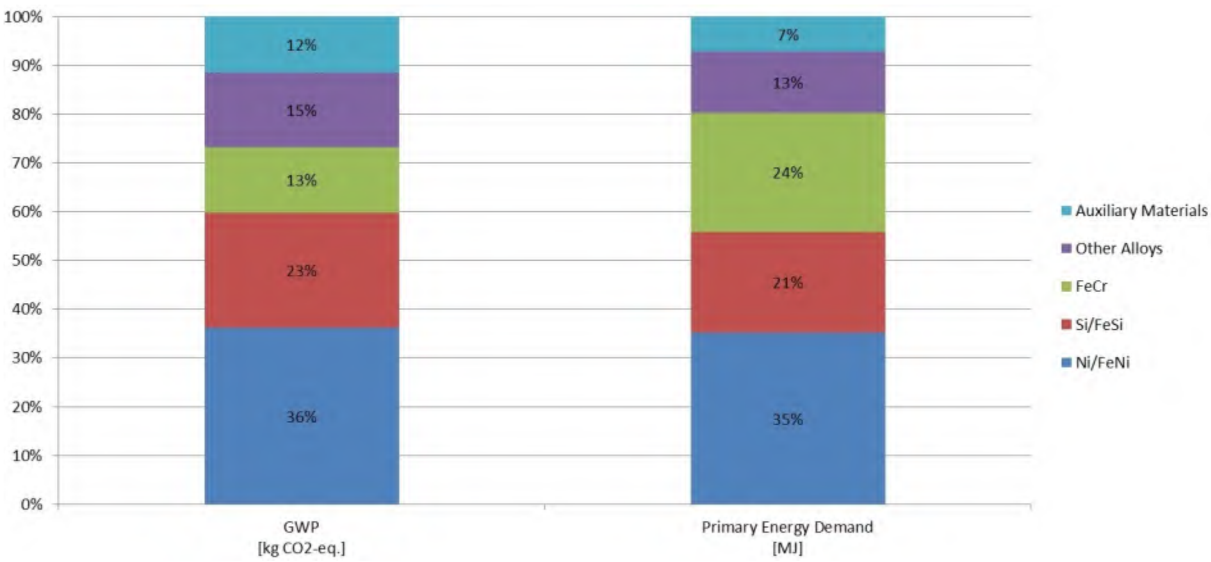


Figure 2: Impact share of alloying elements and auxiliary materials

7. Requisite evidence

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

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

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

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

EPD Information

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

General product information

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

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

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

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

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

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

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

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

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

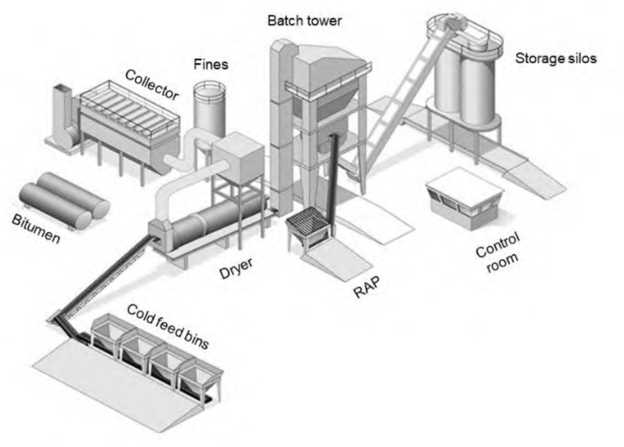

Figure 1: Schematic illustration of an asphalt plant

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

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

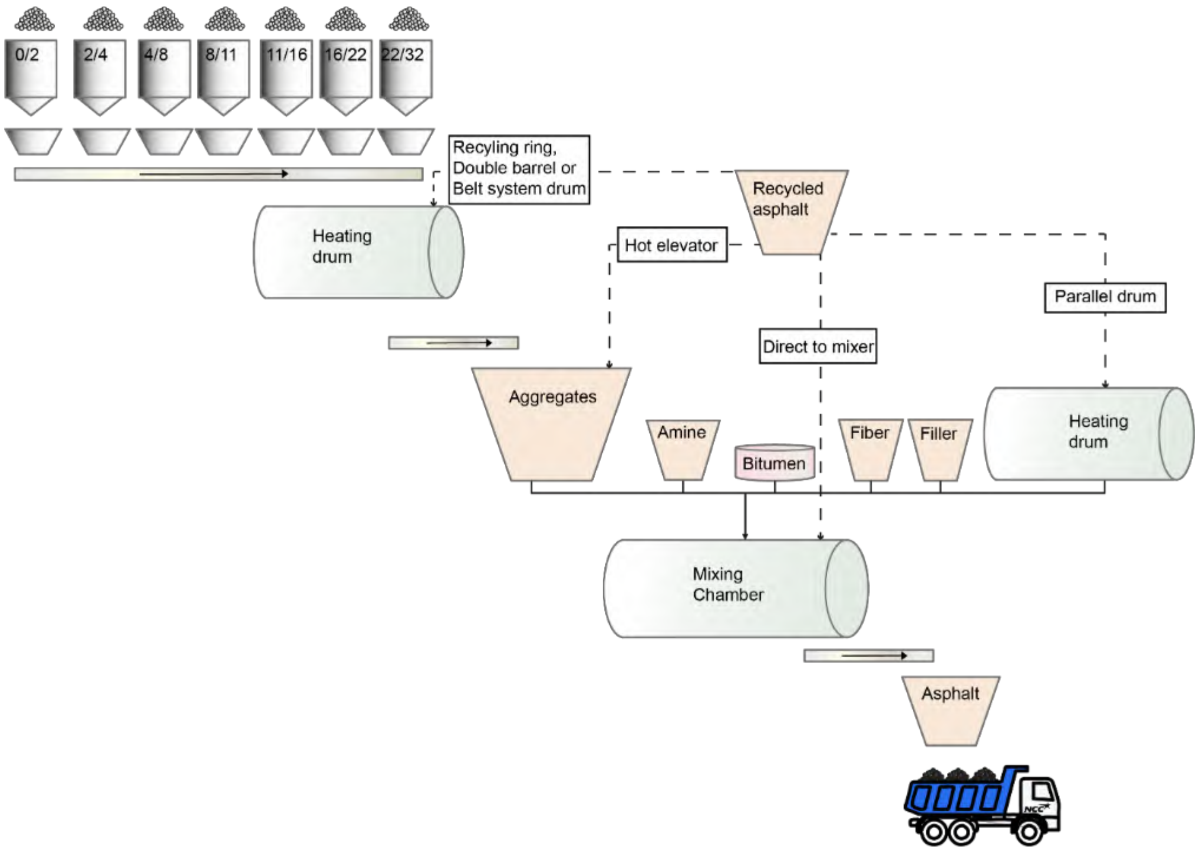

Figure 2: Illustration of the general production process of asphalt.

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

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

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

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

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

Declared unit

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

System boundary

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

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

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

	Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	SE/ EU	SE/ EU	SE	-	-	-	-	-	-	-	-	-	SE	SE	SE	SE	SE
Specific data	>90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

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

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

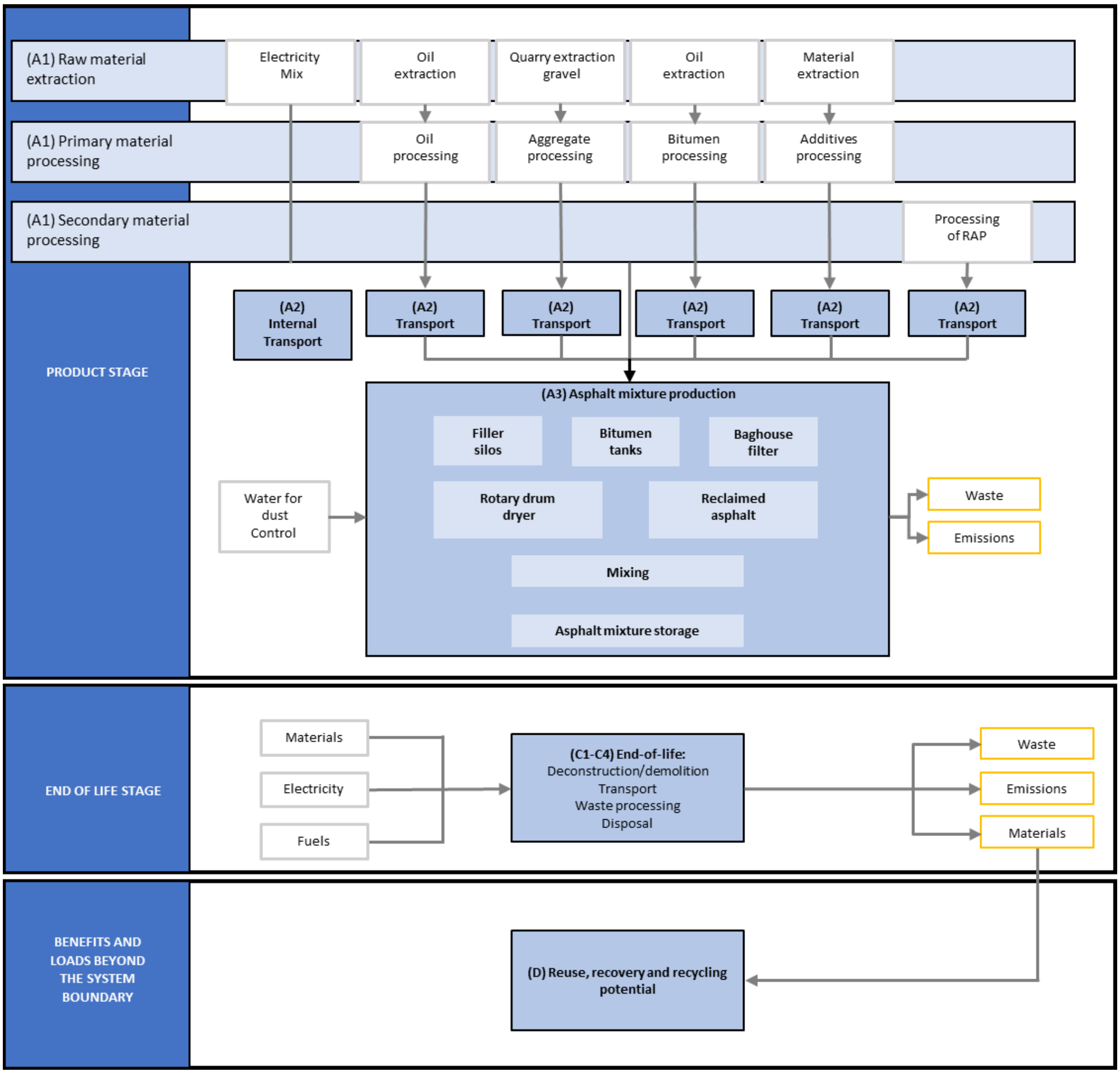

Figure 4: System boundaries for the studied product system.

Assumptions and approximations

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

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

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

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

Allocation

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

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

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

Table 3: Temperature classes and corresponding average production temperatures.

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

Cut-offs

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

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

The following cut-offs have been made:

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

– Lubricants used in the asphalt plant production are negligible.

Software and database

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

Electricity in manufacturing

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

Table 4: Electricity in manufacturing (A3).

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

Data quality

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

About NCC

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

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

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

NCC's sustainability work is based on a holistic approach with all three dimensions of sustainability – social, environmental and economical. NCC´s sustainability framework is divided into eight impact areas: Data and expertise, Natural resources and biodiversity, Materials and circularity, Climate and energy, Health and safety, People and team, Ethics and compliance and Economic 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

EPD owner

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Content declaration including packaging

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

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

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

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

Environmental performance

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

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

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

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

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

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

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

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

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

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

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

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

Use of resources		1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Parameter	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	306	308	304	305	300	300	351	305
Use of renewable primary energy as raw materials	MJ, net calorific value	0	0	0	0	0	0	48	0
Total use of renewable primary energy	MJ, net calorific value	306	308	304	305	300	300	399	305
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	268	272	229	271	217	215	444	259
Use of non-renewable primary energy as raw materials	MJ, net calorific value	2095	2163	1350	2150	1240	1198	2404	1922
Total use of non-renewable primary energy	MJ, net calorific value	2363	2436	1579	2421	1458	1413	2849	2181
Use of secondary material	kg	316	232	360	330	373	373	174	350
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0	0
Use of net fresh water	m³	0.23	0.24	0.21	0.23	0.20	0.20	0.24	0.22

Use of resources		9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105- 50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100
Parameter	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value	306	372	344	302	376	348	324
Use of renewable primary energy as raw materials	MJ, net calorific value	0	48	16	0	48	48	16
Total use of renewable primary energy	MJ, net calorific value	306	420	360	302	424	396	340
Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value	260	546	453	230	723	390	283
Use of non-renewable primary energy as raw materials	MJ, net calorific value	1934	2568	1942	1482	2647	2679	2290
Total use of non-renewable primary energy	MJ, net calorific value	2194	3114	2395	1712	3371	3070	2573
Use of secondary material	kg	306	163	208	306	89	89	38
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0	0
Use of net fresh water	m³	0.23	0.69	0.56	0.21	0.70	0.25	0.25

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

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

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

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

Waste categories & output flows		1 ABT 11 160/220	2 ABT 11 (H) 160/220	3 ABb 22 70/100	4 ABT 11 70/100	5 AG 22 70/100	6 AG 22 160/220	7 ABS 16 An<6 70/100	8 ABT 16 70/100
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
Hazardous waste disposed	kg	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04	2.2E-03	5.7E-04
Non-hazardous waste disposed	kg	0.36	0.37	0.36	0.36	0.36	0.36	0.43	0.36
Radioactive waste disposed	kg	6.6E-04	6.7E-04	6.6E-04	6.6E-04	6.5E-04	6.5E-04	1.1E-03	6.6E-04
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	8.9E-03	8.9E-03	8.9E-03	8.9E-03	8.9E-03	8.9E-03	0.043	8.9E-03
Materials for energy recovery	kg	0.030	0.030	0.030	0.030	0.030	0.030	0.041	0.030
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	0
Waste categories & output flows		9 ABT 16 160/220	10 ABS 16 40/100-75	11 Viacogrip 16 65/105-50	12 AG 16 160/220	13 ABS 16 An<6 45/80-55	14 ABS 16 An<7 70/100	15 ABb 16 70/100	
Parameter/Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	
Hazardous waste disposed	kg	5.7E-04	5.7E-04	5.7E-04	5.7E-04	2.3E-03	2.3E-03	5.7E-04	
Non-hazardous waste disposed	kg	0.36	0.45	0.41	0.36	0.47	0.43	0.40	
Radioactive waste disposed	kg	6.6E-04	9.3E-04	7.9E-04	6.6E-04	1.1E-03	9.8E-04	7.6E-04	
Components for re-use	kg	0	0	0	0	0	0	0	
Materials for recycling	kg	8.9E-03	8.9E-03	8.9E-03	8.9E-03	0.046	0.046	8.9E-03	
Materials for energy recovery	kg	0.030	0.030	0.030	0.030	0.042	0.042	0.030	
Exported energy	MJ per energy carrier	0	0	0	0	0	0	0	

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

General information

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

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

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

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

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

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

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

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

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

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

Scenario information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Programme information

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

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

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

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

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

Table 18: Verification details.

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

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

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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)

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Differences versus previous versions

Table 19: Versions of this EPD.

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

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2 for:

Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección

from

DRIZORO S.A.U.

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-06118
Publication date:	2022-07-19
Valid until:	2027-07-13
	An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

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

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): *PCR 2019:14 Construction products, version 1.11 Published on 2021.02.05, valid until: 2024.12.20.*
PCR review was conducted by *the Technical Committee of the International EPD® System. Chair: Claudia A. Peña. Contact via info@environdec.com*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: TECNALIA R&I Certificación S.L. Auditor: Cristina Gazulla Santos Accredited by: ENAC. Accreditation no.125/C-PR283
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

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

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

The verifier and the programme operator do not make any claim or have any responsibility of the legality of the product.

Descripción de la empresa

Propietario de la EPD: Drizoro S.A.U., +34916766676, http://www.drizoro.com/

Contacto: Para más información, puede solicitarla en el siguiente correo de contacto: info@drizoro.com

Descripción de la organización: Drizoro S.A.U. es una sociedad española con más de treinta y cinco años de experiencia en el sector de la industria química para la construcción. Pertenece al grupo societario, DRIZORO HOLDING, estructura empresarial que permite organizar sus diferentes unidades de actividad a nivel nacional e internacional dentro del sector de productos para la construcción.

Obtener el producto óptimo, adaptado a la necesidad real, hace de nuestra vocación empresarial una constante de trabajo para superar los retos de un sector globalizado y altamente competitivo.

El compromiso de mejora permanente de productos y procesos internos, incorporando siempre las últimas tecnologías, nos lleva a seguir una dirección clara y abierta, sirve de estímulo para todos los que formamos la compañía y nos hace abordar el presente y futuro con entusiasmo y profesionalidad.

Desde nuestra Sede Central y centro de producción en Torrejón de Ardoz (Madrid), se dirigen todas las operaciones de los distintos departamentos; producción, I+D y laboratorio, técnico, comercial, marketing y administración, además de la división internacional con estructura propia que ofrece un permanente servicio de comunicación y asistencia en los más de treinta países de los cinco continentes en los que operamos.

En el ámbito nacional nuestro servicio al cliente está apoyado por nuestros delegados técnicos regionales quienes en su área geográfica están facilitando las recomendaciones de uso de productos y asistencia técnica precisa, bien sea en obra, estudio, etc.

Certificaciones relacionadas con el producto o el sistema de gestión de la organización: Drizoro S.A.U. posee las siguientes certificaciones en su organización; ISO 9001:2015 (Sistema de Gestión de la Calidad) y ISO 14001:2015 (Sistema de Gestión Ambiental).

Nombre y localización de la planta de producción: Drizoro S.A.U., Calle Primavera 50-52, Polígono Industrial Las Monjas 28850, Torrejón de Ardoz (Madrid) España

Información del producto

Nombre del producto: Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección de Drizoro

Código UN CPC: No se ha encontrado un código suficientemente representativo para los productos a estudio.

Identificación del producto: La presente EPD cubre la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección, una familia específica de resinas sintéticas fabricadas por Drizoro destinadas para el recubrimiento e impermeabilización de superficies exteriores e interiores.

De esta familia de resinas se han analizado todas sus referencias (diez productos), mediante la ponderación de la composición de cada una de ellas en función su producción con respecto a la producción total de la familia a la que pertenecen.

El objetivo final es obtener un producto promedio representativo del cual se ha centrado el estudio y se presentará la interpretación de sus resultados ambientales.
La presente EPD cubre las siguientes referencias de la familia de resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección de Drizoro listadas a continuación:

MAXSHEEN, MAXSHEEN ELASTIC, MAXELASTIC -TH, MAXEPOX PRIMER -W, MAXURETHANE FLEX, MAXEPOX FLEX, MAXURETHANE 2C, MAXURETHANE 2C -W, MAXFLOOR y MAXELASTIC PUR THERMOCOAT.

Su uso previsto es el recubrimiento e impermeabilización de superficies exteriores e interiores.

Descripción del producto:

Los productos analizados son revestimientos compuestos de resinas acrílicas y de poliuretano para la impermeabilización de obras hidráulicas, cubiertas y fachadas, así como protección de pavimentos.

En la siguiente tabla, se describe la clasificación de los productos incluidos en la familia, así como su normativa de aplicación:

Familia de productos	Subfamilias	Número de productos	Normativa de aplicación	Referencias
Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección	Resinas en base acrílica	10	EN 1504-2	MAXSHEEN
				MAXSHEEN ELASTIC
				MAXELASTIC -TH
	Resinas en base epoxi o poliuretano			MAXEPOX PRIMER -W
				MAXURETHANE FLEX
				MAXEPOX FLEX
				MAXURETHANE 2C
				MAXURETHANE 2C -W
				MAXFLOOR
				MAXELASTIC PUR THERMOCOAT

La vida útil considerada para los productos a estudio es de 25 años, la cual se ha estimado en base a conocimientos de mercado.

En relación a sus características técnicas, éstas se muestran en la siguiente tabla:

Especificaciones técnicas del producto promedio representativo de la familia Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección	
Parámetros	Valores promedio
Permeabilidad al CO_2	SD > 50 m
Permeabilidad al vapor de agua	SD < 5 m
Absorción capilar y permeabilidad al agua	< 0,1 kg·m²·h0,5
Adherencia	> 0,8 N/mm²

Para mayor información, pueden consultar las fichas técnicas de los productos incluidos en la familia en la página web http://www.drizoro.com/

Alcance geográfico: Global

Los productos a estudio se fabrican en España, pero pueden utilizarse a escala global.

Análisis del Ciclo de Vida

Unidad declarada: 1 m2 de superficie cubierta con resina sintética (0,45 kg).

Representatividad temporal: Todos los datos específicos relativos al centro de producción, con los cuales se ha basado el estudio, corresponden al año 2020 (menos de dos años de antigüedad).

Base de datos y software de ACV utilizado: Los datos genéricos usados provienen de la base de datos Ecoinvent versión 3.7, actualizada en 2020. En relación al software utilizado para la realización del modelo de ACV, éste se corresponde a SimaPro versión 9.2

Todos los datos específicos relativos a los flujos de entrada y salida para el proceso de fabricación de la familia de resinas a estudio han sido facilitados por Drizoro S.A.U.

Se han utilizado datos específicos relativos a la composición de las resinas (por kg), los materiales de embalaje y las distancias consideradas para el transporte de las materias primas. Todos estos datos se han ponderado en función de la producción de cada una de las referencias y subreferencias que componen la familia de resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección de Drizoro respecto a la producción total de ésta. Para el consumo de electricidad y agua en la planta de producción, así como para representar la generación de residuos producidos, se ha realizado una asignación de cargas en función de la masa por kg de resina producido.

Descripción de los límites del sistema: De la cuna a la puerta (cradle to gate) con los módulos C1-C4 y módulo D.

El alcance de esta EPD cubre toda la Etapa de Producto (módulos A1, A2 y A3): Extracción y procesado de las materias primas, su transporte hasta la planta de producción y el proceso de fabricación de los morteros, así como también la Etapa de Fin de vida (módulos C1, C2, C3 y C4): Deconstrucción, transporte de los residuos a gestor, tratamiento de los residuos y eliminación final del producto.
Por último, también se incluye dentro del presente estudio el Módulo D Beneficios y cargas más allá de los límites del sistema, asociado al potencial de recuperación y/o reciclaje de los residuos del producto.

Etapas del ciclo de vida del producto excluidas: Etapa de construcción (módulos A4 y A5) y Etapa de uso (módulos B1-B7).

Tal y como requiere la PCR 2019:14 Construction products, version 1.11, se ha incluido en el presente estudio "de la cuna a la puerta" la Etapa de fin de vida (módulos C1-C4), así como el módulo D ya que algunos de los productos analizados no cumplen los siguientes requisitos enumerados a continuación:

- El producto o material se encuentra físicamente integrado con otros productos una vez instalado, por lo que no puede separarse en su fin de vida
- El producto o material no se puede identificar en su fin de vida debido a procesos de transformación fisicoquímica
- El producto o material no contiene carbono biogénico

En las siguientes páginas, se detalla la descripción de los módulos incluidos en los límites del sistema y los principales procesos que los componen

Etapa de Producto A1-A3: Esta etapa incluye los siguientes módulos enumerados a continuación; Módulo A1 Extracción y procesado de materias primas, Módulo A2 Transporte de las materias primas a la planta de producción y el Módulo A3 Fabricación.

Módulo A1 Extracción y procesado de materias primas: Se considera la extracción y procesado de materias primas utilizadas para la fabricación de las resinas. Así mismo, también se tiene en cuenta la producción de la energía necesaria para el proceso de fabricación del producto (producción de electricidad).

Módulo A2 Transporte de las materias primas a la planta de producción: Transporte de todas las materias primas que abarca el módulo A1, desde el lugar de extracción, producción y tratamiento hasta la puerta de la fábrica, considerando las distancias específicas de cada proveedor de material.

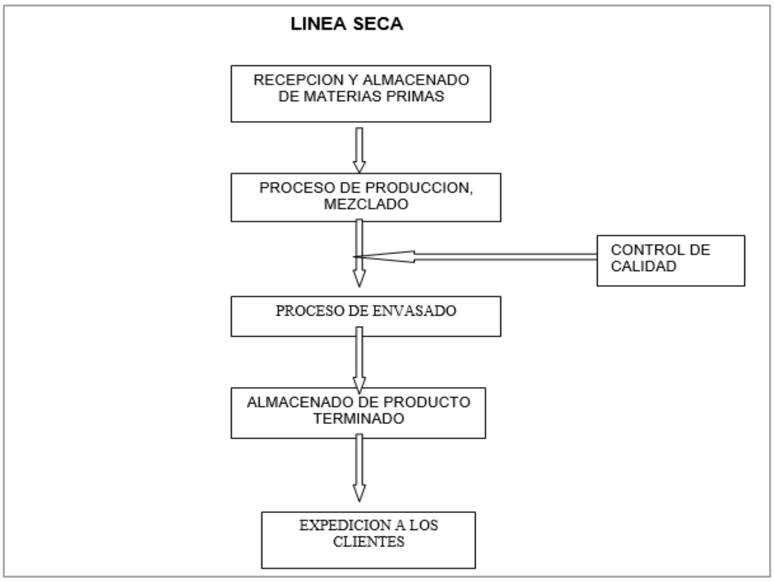
Módulo A3 Fabricación: Este módulo incluye el proceso de manufactura del producto final en las instalaciones de fábrica. Concretamente, se considera el transporte a fábrica y la producción de los diferentes embalajes primarios y secundarios de los productos analizados (garrafa de polietileno, bidón de hojalata electrolítica, cubo de polipropileno, tulipa de hojalata electrolítica, botella de polietileno, palés de madera, láminas de cartón y film plástico), el consumo de agua requerido para el proceso de manufactura, así como también el tratamiento y transporte de los residuos generados en la planta de producción.

A continuación, se describe a modo de resumen las principales fases que estructuran el proceso de fabricación de los productos de Drizoro:

El proceso productivo se compone de dos líneas de producción, seca y húmeda. En la línea seca se producen los morteros de cemento, mientras que la línea húmeda corresponde a la fabricación de las pinturas y los aditivos para hormigones.

LÍNEA SECA
Todo el proceso de línea seca es automático y está gobernado por ordenador en el cual se introducen las fórmulas, así como los tiempos de mezclado y envasado. El proceso de mezclado es de carácter físico y no se produce reacción química.

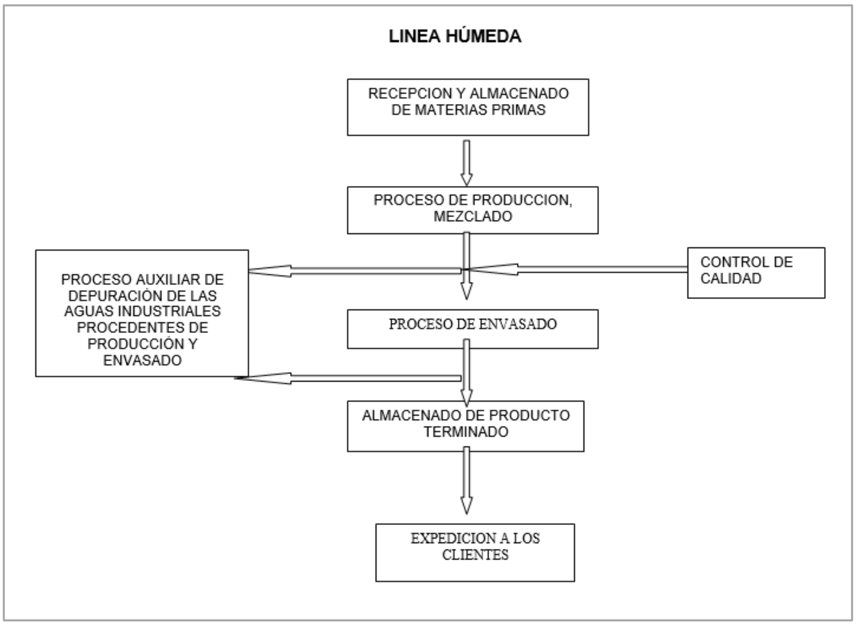
Ilustración 1. Diagrama de flujo del proceso de fabricación de línea seca



LÍNEA HÚMEDA

El proceso de fabricación en la línea húmeda no es automático, ya que se introducen manualmente las materias primas en los tanques, posteriormente se mezclan con un agitador y, por último, se envasan. De igual forma que en la línea de producción seca, el proceso de mezclado es de carácter físico sin reacción química

Ilustración 2. Diagrama de flujo del proceso de fabricación de línea húmeda



Los escenarios incluidos están vigentes actualmente y son representativos como una de las alternativas más probables.

Etapa de Fin de vida C1-C4: Esta etapa incluye los siguientes módulos relacionados con el fin de vida del producto; Módulo C1 Deconstrucción, Módulo C2 Transporte de los residuos del producto a gestor, Módulo C3 Tratamiento de residuos y Módulo C4 Eliminación.

Módulo C1 Deconstrucción, demolición: En este módulo se analizan los impactos ambientales asociados a la deconstrucción o desmantelamiento del producto. Para el presente estudio, se ha considerado que no se producen impactos ambientales cuantificables, ya que estos materiales de construcción acaban formando parte de la edificación donde son instalados y, en la gran mayoría de casos, no se desmantelan, por lo que están presentes en el edificio hasta su derribo. Por tanto, el impacto ambiental relativo a la deconstrucción de los productos analizados es despreciable en comparación a la demolición del edificio que formaban parte.

Módulo C2 Transporte hasta el lugar de tratamiento de los residuos: Este módulo comprende los impactos ambientales relacionados con el transporte de los residuos del producto a gestor.
Se ha considerado una distancia por defecto de 50 km entre la edificación donde se encontraba instalado el producto y el gestor de residuos.

Módulo C3 Tratamiento de los residuos: En este módulo se consideran los impactos ambientales asociados al tratamiento de los residuos del producto que van a sufrir una transformación fisicoquímica (incineración, procesos de reciclaje etc.). Para el presente estudio, no se ha asignado valor a este módulo ya que se ha considerado que el 100% de los residuos se destinan a vertedero, por lo que no se produce ningún tipo de transformación de estos residuos.

C4, Eliminación final: Este último módulo comprende el vertido final de los residuos que no han sido destinados a procesos de recuperación o tratamiento. Para el presente estudio se considera que el 100% de los residuos de los productos analizados son depositados en vertedero como residuo inerte, los cuales se encuentran mezclados con otros residuos de la construcción que formaban parte.

Consideraciones acerca del fin de vida del producto promedio representativo

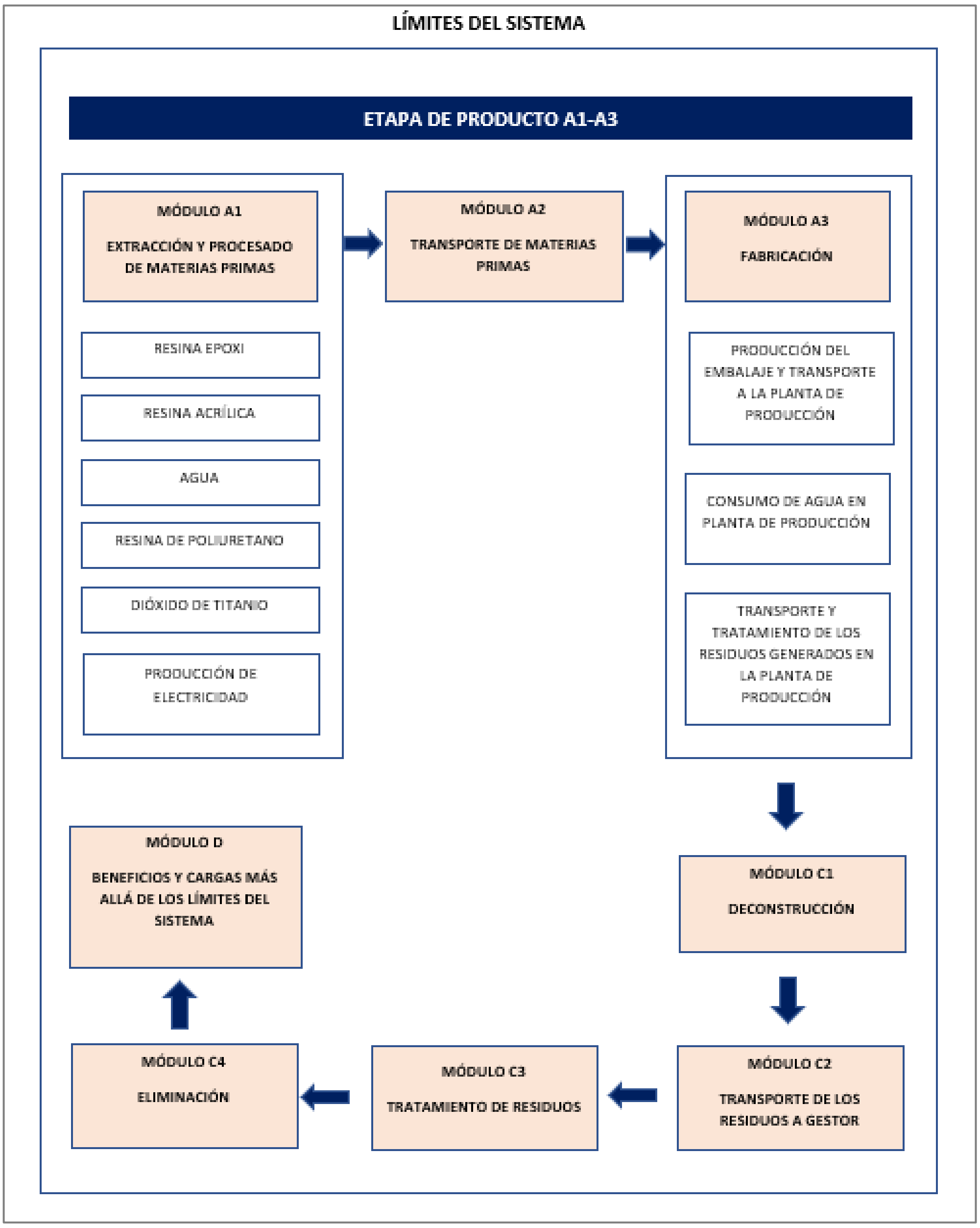
Parámetro	Unidades por Unidad Declarada (1m2)	Valor
Proceso de recogida de residuos, especificado por tipo	kg recogidos de manera separada	0
	kg recogidos mezclados con residuos de demolición	0,45
Proceso de recuperación de residuos, especificado por tipo	kg para reutilización	0
	kg para reciclaje	0
	kg para valorización energética	0
Eliminación de residuos	kg a vertedero	0,45 (100% del peso del producto)
Consideraciones acerca del transporte de residuos	km de distancia al gestor de residuos	50

Módulo D (Beneficios y cargas más allá de los límites del sistema del producto): El Módulo D analiza los beneficios y cargas relacionados con los procesos de recuperación, reutilización o reciclaje de los residuos de las resinas que puedan formar parte del ciclo de vida de un nuevo producto. Para el presente estudio, no se ha asignado valor a este módulo ya que no se produce ningún tipo de recuperación de los residuos de los productos analizados, al tener como destino final su deposición en vertedero.

Cabe añadir que no se ha tenido en cuenta el potencial de reciclaje del embalaje del producto, ya que la gestión de sus residuos comprende el módulo A5 Instalación, fuera de los límites del sistema, por lo que el destino final de éstos se desconoce.

En la siguiente página, se presenta un diagrama de flujo genérico a modo de resumen con los principales procesos incluidos dentro de los límites de sistema.

Ilustración 3. Diagrama de limites del sistema del producto



Para mayor información acerca de la consultoría de ACV que ha realizado la presente DAP:

Lavola – Anthesis Group
Rambla de Catalunya, 6, planta 2, 08007 Barcelona
+34 938 515 055
www.anthesisgroup.com

Reglas de corte aplicadas

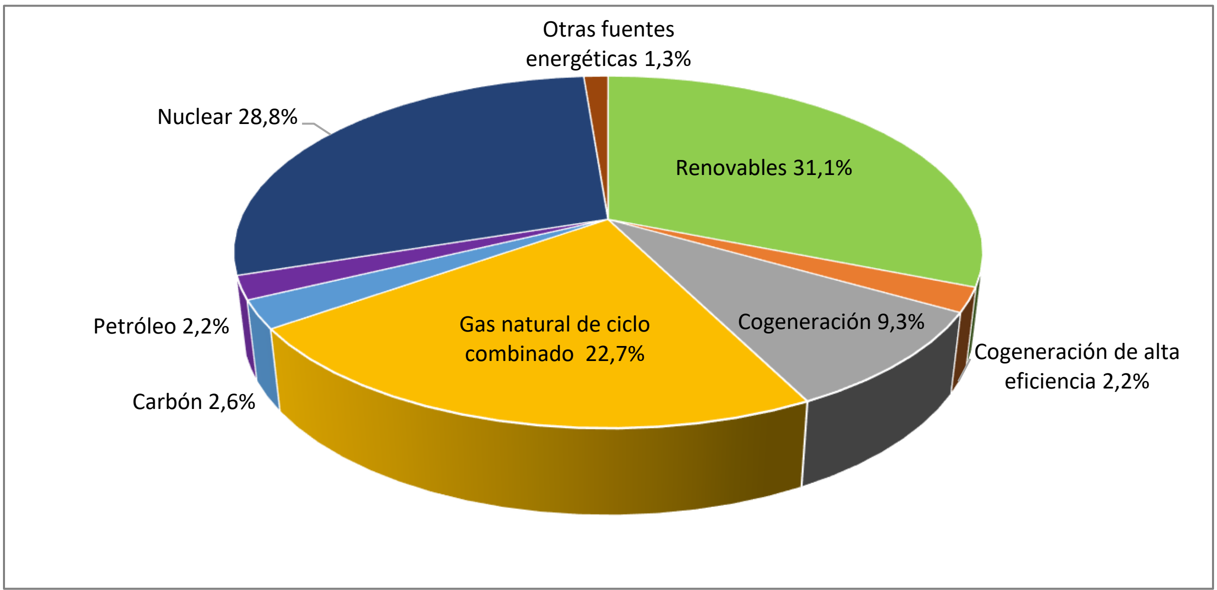
Según lo establecido en la RCP de productos de construcción y servicios de construcción, se ha incluido al menos el 95% de cada entrada y salida del sistema. Para este estudio, se considera el 100% del peso y los insumos del producto declarado, incluyendo los materiales de embalaje.

Se ha aplicado el principio de "quien contamina paga".

Además, no se han incluido los procesos que se indican a continuación:

- Fabricación de equipos de producción, edificios y otros bienes de equipo.
- Viajes de negocios del personal.
- Viajes de ida y vuelta al trabajo del personal.
- Emisiones a largo plazo.

Información adicional:
Debido a que el consumo de electricidad de la planta de producción supera el umbral del 30% sobre el consumo energético total de la Etapa de Producto A1-A3, a continuación, se representa el mix eléctrico de los proveedores de electricidad de esta, desglosado por sus fuentes energéticas, tal y como se indica en la norma UNE EN 15804:2012+A2 (2020) y la PCR 2019:14 Construction products, versión 1.11
En relación a su contribución sobre los impactos ambientales del producto, la producción de 1 kWh de electricidad consumida por la planta de fabricación de Drizoro S.A.U. de Torrejón de Ardoz (Madrid) en el año 2020 genera unas emisiones de 0,21 kg CO2 eq.



Mix eléctrico de los proveedores de electricidad de Drizoro S.A.U. desagregado por fuentes energéticas correspondiente a los consumos de planta de 2020

Módulos declarados, alcance geográfico, proporción de datos específicos empleados (en indicador GWP-GHG) y variación de datos:

	Etapa de producto			Etapa de instalacion		Etapa de uso							Etapa de fin de vida				Etapa de recuperacion de recursos
	Suministro de materias primas	Transporte	Fabricación	Transporte	Instalación	Uso	Mantenimiento	Reparación	Sustitución	Reacondicionamiento	Consumo de energía operacional	Consumo de agua operacional	Desmantelamiento	Transporte	Tratamiento de residuos	Eliminación	Potencial de reutilizacion-recuperación-reciclado
Módulo	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Módulos declarados	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geografía	RER	RER	ES	ND	ND	ND	ND	ND	ND	ND	ND	ND	GLO	GLO	GLO	GLO	GLO
Datos especificos empleados	>95% Para los módulos A1-A3 proviene de datos especificos de ICV					-	-	-	-	-	-	-	-	-	-	-	-
Variación – productos	Desde -53,8% hasta +140,6% respecto al producto promedio sobre la categoría de impacto GWP-GHG					-	-	-	-	-	-	-	-	-	-	-	-
Variación – ubicación	El producto se fabrica en una sola planta					-	-	-	-	-	-	-	-	-	-	-	-

X = Módulo declarado **ND** = No-Declarado **G** = Global

Información relacionada con la composición del producto

Composición del producto promedio representativo de la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección			
Materiales del producto	**Peso (%)**	**Materiales post-consumidor, peso-%**	**Materiales renovables, peso-%**
Resina epoxi	40-50%	0%	0%
Resina acrílica	10-20%	0%	0%
Agua	5-10%	0%	5-10%
Resina de poliuretano	5-10%	0%	0%
Dióxido de titanio	5-10%	0%	0%
Resina de poliol	1-5%	0%	0%
Catalizador	1-5%	0%	0%
Sílice	1-5%	1-3%	0%
Carbonato cálcico	1-5%	0%	0%
Otros compuestos	1-5%	0%	0%
TOTAL (kg/ unidad declarada)	**0,45**	1-3%	5-10%
Materiales de embalaje primario	**Peso, (kg)**	**Peso-% (versus producto)**	
Garrafa de polietileno de alta densidad	0,000084	0,02%	
Bidón de hojalata electrolítica	0,008521	1,89%	
Cubo de polipropileno	0,011591	2,58%	
Tulipa de hojalata electrolítica	0,003780	0,84%	
Botella de polietileno de alta densidad	0,000008	0,00%	
TOTAL (kg)	**0,0240**	**5,33%**	

Ninguno de los componentes presentes en el producto final se encuentra incluido en la "Lista de sustancias candidatas extremadamente preocupantes en procedimiento de autorización" del reglamento REACH.

En la tabla de la siguiente página, se muestra la clasificación de los compuestos presentes en el producto promedio representativo de la familia Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección:

Materiales del producto	Peso %	EC No	CAS No	Clasificación
Resina epoxi	40-50%	500-033-5	25068-38-6	H411, H319, H315, H317
Resina acrílica	10-20%			No Clasificado
Agua	5-10%	231-791-2	7732-18-5	No Clasificado
Resina de poliuretano	5-10%	500-060-2	28182-81-2	No Clasificado
Dióxido de titanio	5-10%	236-675-5	13463-67-7	No Clasificado
Resina de poliol	1-5%	232-293-8	8001-79-4	No Clasificado
Catalizador	1-5%	247-134-8	25620-58-0	H302, H412, H314, H317
Sílice	1-5%	262-373-8	60676-86-0	No Clasificado
Carbonato cálcico	1-5%	215-279-6	1317-65-3	No Clasificado
Otros compuestos	1-5%			H410

Embalaje

Embalaje del producto:
El embalaje del producto promedio representativo se compone de los siguientes materiales:

Embalaje primario:
Garrafa y botella de polietileno de alta densidad, bidón de hojalata electrolítica, cubo de polipropileno y tulipa de hojalata electrolítica, que contienen las diferentes resinas incluidas en la familia.

Embalaje secundario:
Los embalajes citados anteriormente, son almacenados en palés de madera y protegidos con láminas de cartón, así como por un recubrimiento compuesto de film plástico de polietileno de baja densidad.

Respecto a la modelización del embalaje, cabe remarcar que de igual modo que ocurre con las materias primas, se ha calculado una cantidad promedio de material en función de la producción. Por tanto, las cantidades finales de materiales de embalaje asignadas al producto promedio representativo han sido obtenidas mediante la ponderación de los embalajes específicos de cada una de las referencias contenidas en la familia de resinas a estudio respecto a la producción total de ésta.

Por último, como se ha comentado anteriormente, aunque se encuentra incluida la producción de los materiales de embalaje en el presente estudio no se ha considerado su posterior fin de vida, ya que los impactos derivados de la gestión de los residuos se analizan en el módulo A5 y su destino final se desconoce.

Materiales reciclados

Procedencia de materiales reciclados en el producto (pre-consumidor o post-consumidor):

El 70% del sílice presente en el producto promedio representativo de la familia de resinas proviene de vidrio reciclado.

Información ambiental

La información ambiental relativa a los productos analizados ha sido calculada con el software SimaPro versión 9.2. Tal y como requiere la PCR 2019:14, Construction products versión 1.11, se han usado los factores de caracterización indicados en el Anexo C de la normativa EN 15804:2012+A2 (EF 3.0 method adapted, en SimaPro) con el objetivo de estimar los impactos ambientales potenciales. Con respecto a los resultados correspondientes al resto de parámetros a estudio se han usado las siguientes metodologías: EDIP para el cálculo de la producción de residuos, CED (Cumulative energy Demand) para el cálculo de los usos de energía y ReCiPe para estimar la huella hídrica del producto.

A continuación, se muestran los resultados ambientales correspondientes al ciclo de vida del producto promedio representativo de la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección. Éstos se encuentran desglosados por módulos, cubriendo las etapas definidas anteriormente en el apartado de límites del sistema (A1-A3+C1-C4+D), y considerando todas las categorías de impacto requeridas por la PCR 2019:14 Construction products, versión 1.11.

Los resultados presentados se han obtenido mediante la ponderación de la composición de las diez referencias incluidas en el estudio en función de la producción de cada una de ellas con respecto a la producción total de la familia.

Los resultados de impacto estimados son sólo declaraciones relativas que no indican los puntos finales de las categorías de impacto, la superación de los umbrales valorados, los márgenes de seguridad o los riesgos.

Impactos ambientales potenciales - Indicadores obligatorios de conformidad con la normativa EN 15804

Resultados de impacto ambiental por unidad declarada (1 m2) correspondientes a la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección										
Indicador	**Unidad**	**A1**	**A2**	**A3**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**Módulo D**
GWP-fossil	kg CO_2 eq.	1,58E+00	2,02E-02	1,99E-01	1,80E+00	0	3,11E-03	0	2,38E-03	0
GWP-biogenic	kg CO_2 eq.	4,37E-03	1,08E-06	1,29E-03	5,66E-03	0	1,67E-07	0	1,45E-05	0
GWP-luluc	kg CO_2 eq.	8,94E-04	1,52E-07	5,55E-04	1,45E-03	0	2,35E-08	0	8,51E-07	0
GWP-Total	kg CO_2 eq.	1,59E+00	2,02E-02	2,00E-01	1,81E+00	0	3,11E-03	0	2,39E-03	0
ODP	kg CFC 11 eq.	6,29E-07	4,65E-09	1,91E-08	6,53E-07	0	7,21E-10	0	4,23E-10	0
AP	mol H+ eq.	9,14E-03	6,79E-05	1,09E-03	1,03E-02	0	1,07E-05	0	2,21E-05	0
EP-freshwater	kg P eq.	5,79E-05	1,09E-08	9,84E-06	6,77E-05	0	1,69E-09	0	2,98E-08	0
EP-marine	kg N eq.	1,33E-03	2,15E-05	2,47E-04	1,60E-03	0	3,45E-06	0	9,15E-06	0
EP-terrestrial	mol N eq.	1,31E-02	2,37E-04	2,73E-03	1,61E-02	0	3,80E-05	0	1,00E-04	0
POCP	kg NMVOC eq.	5,72E-03	6,47E-05	9,44E-04	6,73E-03	0	1,04E-05	0	2,77E-05	0
ADP-minerals and metals[1]	kg Sb eq.	8,04E-07	8,50E-10	2,78E-06	3,59E-06	0	1,32E-10	0	9,91E-11	0
ADP-fossil[1]	MJ	2,95E+01	2,84E-01	3,55E+00	3,34E+01	0	4,40E-02	0	3,16E-02	0
WDP[1]	m^3	9,77E-01	-6,02E-05	1,03E-01	1,08E+00	0	-9,33E-06	0	7,68E-05	0
Acrónimos	**GWP-fossil =** Calentamiento global potencial combustibles fósiles; **GWP-biogenic =** Calentamiento global potencial biogénico; **GWP-luluc =** Calentamiento global potencial uso del suelo; **ODP =**Agotamiento potencial de la capa de ozono estratosférico; **AP =** Acidificación potencial ; **EP-freshwater =** Eutrofización potencial, agua dulce ; **EP-marine =** Eutrofización potencial, agua marina; **EP-terrestrial =** Eutrofización potencial terrestre; **POCP =** Formación potencial de ozono troposférico; **ADP-minerals&metals =** Agotamiento potencial de recursos minerales; **ADP-fossil =** Agotamiento potencial de recursos fósiles; **WDP =** Uso de agua									
[1]Los resultados de este indicador de impacto ambiental deben utilizarse con prudencia, ya que las incertidumbres de los resultados son elevadas y la experiencia con este parámetro es limitada.										

Impactos ambientales potenciales - Indicadores adicionales obligatorios y voluntarios

Tal y como requiere la PCR 2019:14, en la tabla adjunta se presenta un indicador adicional para la categoría de impacto de Calentamiento Global (GWP-GHG), con factores de caracterización basados en el IPCC (2013).

Resultados de impacto ambiental por unidad declarada (1 m2) correspondientes a la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección										
Indicador	**Unidad**	**A1**	**A2**	**A3**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**Módulo D**
GWP-GHG*	kg CO_2 eq.	1,54E+00	2,01E-02	1,96E-01	1,75E+00	0	3,09E-03	0	2,35E-03	0
PM	disease inc.	6,91E-08	1,15E-09	1,35E-08	8,37E-08	0	2,02E-10	0	5,47E-10	0
IRP[2]	kBq U-235 eq	4,83E-02	1,25E-03	1,04E-02	6,00E-02	0	1,94E-04	0	1,37E-04	0
ETP-fw[1]	CTUe	6,76E+01	1,10E-01	3,96E+00	7,17E+01	0	1,75E-02	0	1,87E-02	0
HTP-c[1]	CTUh	4,06E-09	1,53E-12	2,05E-09	6,11E-09	0	2,51E-13	0	2,33E-13	0
HTP-nc[1]	CTUh	3,47E-08	1,67E-10	3,53E-09	3,84E-08	0	2,92E-11	0	1,97E-11	0
SQP[1]	Pt	2,04E+00	9,04E-04	3,92E+01	4,13E+01	0	1,40E-04	0	7,88E-02	0
Acrónimos	**GWP-GHG =** Calentamiento global potencial - Gases de efecto invernadero; **PM =** Materia particulada; **IRP =** Radiación ionizante, salud humana; **ETP-fw =** Ecotoxicidad agua dulce - orgánica ; **HTP-c =** Salud humana, efectos cancerígenos; **HTP-nc =** Salud humana, efectos no cancerígenos; **SQP =** Uso del suelo									
*El indicador incluye todos los gases de efecto invernadero recogidos en GWP-total, pero excluye la captura del dióxido de carbono biogénico, sus emisiones, así como también el carbono biogénico almacenado en el producto. Por lo tanto, este indicador equivale al GWP original definido en la normativa EN 15804:2012+A1:2013.										
[1]Los resultados de este indicador de impacto ambiental deben utilizarse con prudencia, ya que las incertidumbres de los resultados son elevadas y la experiencia con este parámetro es limitada.										
[2]Esta categoría de impacto trata principalmente con los impactos eventuales de las dosis bajas de las radiaciones ionizantes sobre la salud humana del ciclo del combustible nuclear. No considera los efectos debidos a posibles accidentes nucleares ni la exposición ocupacional debida a la eliminación de residuos radioactivos en las instalaciones subterráneas. El potencial de radiación ionizante del suelo, debida al radón o de algunos materiales de construcción no se mide tampoco con este parámetro.										

Uso de recursos

Uso de recursos por unidad declarada (1 m2) correspondiente a la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección										
Indicador	Unidad	A1	A2	A3	A1-A3	C1	C2	C3	C4	Módulo D
PERE	MJ	1,15E+00	4,18E-04	7,18E+00	8,34E+00	0	6,47E-05	0	7,30E-04	0
PERM	MJ	0	0	3,27E-01	3,27E-01	0	0	0	0	0
PERT	MJ	1,15E+00	4,18E-04	7,51E+00	8,66E+00	0	6,47E-05	0	7,30E-04	0
PENRE	MJ	1,91E+01	3,02E-01	3,26E+00	2,26E+01	0	4,67E-02	0	3,36E-02	0
PENRM	MJ	1,26E+01	0	5,34E-01	1,31E+01	0	0	0	0	0
PENRT	MJ	3,16E+01	3,02E-01	3,80E+00	3,57E+01	0	4,67E-02	0	3,36E-02	0
SM	kg	1,07E-02	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0
FW	m³	2,52E-02	4,78E-07	3,01E-03	2,82E-02	0	7,41E-08	0	3,79E-06	0
Acrónimos	**PERE** = Uso de recursos energéticos renovables excluyendo materias primas; **PERM** = Uso de recursos energéticos renovables como materia prima; **PERT** = Uso total de recursos energéticos renovables; **PENRE** = Uso de recursos energéticos no renovables excluyendo materias primas; **PENRM** = Uso de recursos energéticos no renovables como materia prima ; **PENRT** = Uso total de recursos energéticos no renovables ; **SM** = Uso de materiales secundarios; **RSF** = Uso de combustibles secundarios renovables; **NRSF** = Uso de combustibles secundarios no renovables; **FW** = Huella hídrica									

Producción de residuos y otros flujos de salida

Producción de residuos

Producción de residuos por unidad declarada (1 m2) correspondiente a la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección										
Indicador	Unidad	A1	A2	A3	A1-A3	C1	C2	C3	C4	Módulo D
Residuos peligrosos	kg	1,24E-05	7,53E-07	1,22E-05	2,54E-05	0	1,17E-07	0	6,74E-08	0
Residuos no peligrosos	kg	1,70E-01	1,50E-05	9,24E-02	2,62E-01	0	2,32E-06	0	4,50E-01	0
Residuos radioactivos	kg	4,54E-05	2,06E-06	1,07E-05	5,82E-05	0	3,19E-07	0	2,00E-07	0

Otros flujos de salida

Otros flujos de salida por unidad declarada (1 m2) correspondientes a la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección										
Indicador	Unidad	A1	A2	A3	A1-A3	C1	C2	C3	C4	Módulo D
Componentes para reutilización	kg	0	0	0	0	0	0	0	0	0
Material para reciclaje	kg	0	0	4,65E-05	4,65E-05	0	0	0	0	0
Materiales para valorización energética	kg	0	0	4,46E-06	4,46E-06	0	0	0	0	0
Energía eléctrica exportada	MJ	0	0	0	0	0	0	0	0	0
Energía térmica exportada	MJ	0	0	0	0	0	0	0	0	0

Interpretación de resultados

A continuación, se muestra cómo se distribuyen los impactos ambientales relativos al producto promedio representativo de la familia de Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección a lo largo de su ciclo de vida (Etapa de Producto y Etapa de Fin de vida). Para facilitar la interpretación de resultados, se representan únicamente las categorías de impacto más representativas a nivel de comunicación ambiental.

Como se puede observar en la figura adjunta (ver tablas superiores para interpretar los acrónimos), el módulo A1 Extracción y procesado de materias primas es el que presenta una mayor contribución sobre los impactos totales del ciclo de vida del producto, siendo el mayoritario en siete de los diez indicadores evaluados, con un valor máximo del 96% (Agotamiento de la capa de ozono estratosférico).

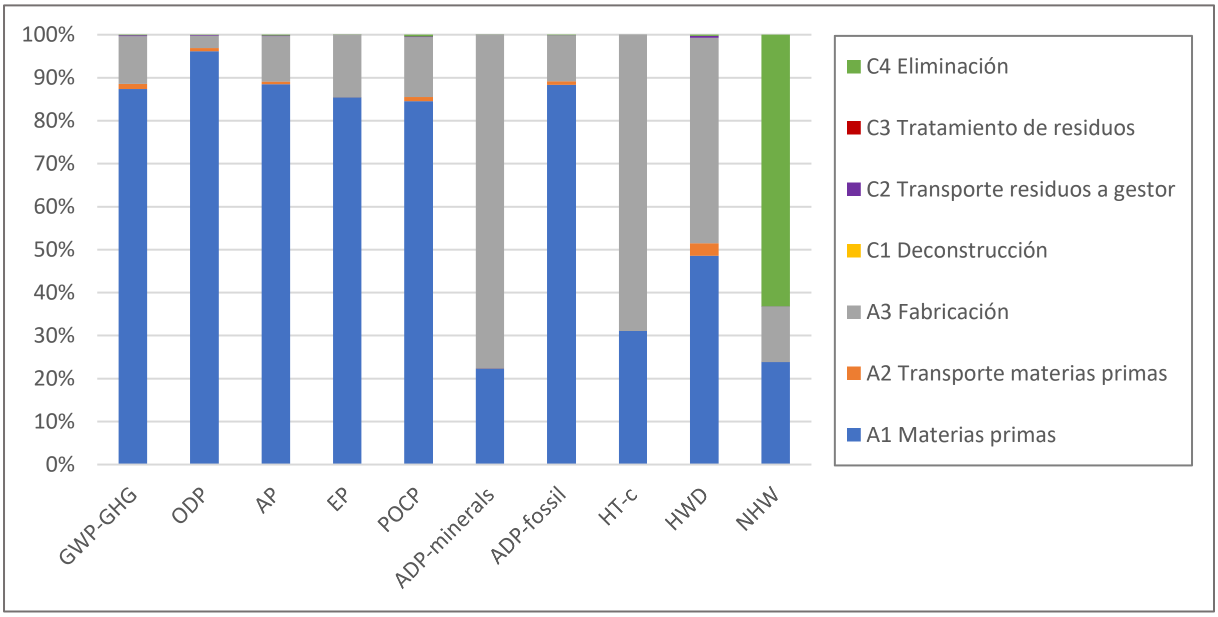
Respecto al módulo A2, Transporte de materias primas a la planta de producción, éste presenta una contribución mayoritariamente despreciable, ya que la mayoría de los valores se sitúan por debajo del 1%.

El módulo A3 Fabricación, presenta una contribución ambiental media o baja según el indicador considerado, excepto para las categorías de impacto de Producción de residuos peligrosos (48%), Toxicidad humana cancerígena (69%) y, especialmente, el indicador de Agotamiento de recursos minerales (78%), el cual concentra la mayoría de los impactos ambientales del módulo.

Por último, la Etapa de Fin de vida en su conjunto presenta valores de impacto despreciables, excepto el módulo C4 Eliminación para la categoría de impacto de Producción de residuos no peligrosos (63%), cuya elevada contribución está directamente relacionada con los impactos ambientales derivados de la deposición final de los residuos del producto en vertedero.

La aplicación de 1 m2 del producto promedio representativo de la familia Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección, presenta un impacto de 1,76 kg de CO2 eq/UD para la categoría de impacto Calentamiento Global (IPCC 2013) y de 33,4 MJ/UD para la categoría de impacto de Agotamiento de Recursos Fósiles.

Contribución ambiental de los módulos del producto promedio representativo sobre su ciclo de vida



Los productos analizados no contienen carbono biogénico, salvo el embalaje secundario (palés de madera y láminas de cartón). Debido a que su peso no supera el umbral del 5% respecto a la masa total del producto, no se requiere declarar el carbono biogénico, tal y como indica la EN 15804:2012+A2.

Información adicional

Como información adicional, a continuación, se incluye la desviación existente entre las referencias que componen la familia Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección respecto a su producto promedio representativo sobre el indicador de GWP-GHG (Calentamiento Global Potencial – Gases de efecto invernadero).

Los resultados se encuentran expresados por unidad declarada (1 m2) y cubren todos los módulos incluidos en la Etapa de Producto A1-A3.

Desviación de las referencias analizadas respecto a su promedio sobre el indicador GWP-GHG

Desviación porcentual de las referencias incluidas en la familia Resinas en base acrílica, epoxi y poliuretano para impermeabilización y protección respecto al promedio para el indicador GWP-GHG (A1-A3)												
Parámetros	Unidad	Promedio Familia	MAXSHEEN	MAXSHEEN ELASTIC	MAXELASTIC - TH	MAXEPOX PRIMER -W	MAXURETHANE FLEX	MAXEPOX FLEX	MAXURETHANE 2C	MAXURETHANE 2C -W	MAXFLOOR	MAXELASTIC PUR THERMOCOAT
Resultados A1-A3 en valor absoluto	kg CO_2 eq.	1,75E+00	8,09E-01	9,67E-01	2,54E+00	1,49E+00	4,21E+00	1,89E+00	1,87E+00	1,73E+00	2,22E+00	3,44E+00
Desviación porcentual	(%)	0,00%	-53,82%	-44,79%	45,09%	-15,11%	140,62%	8,10%	6,71%	-1,06%	27,02%	96,22%

English Summary

DRIZORO S.A.U.

DRIZORO, S.A.U. was established in 1977. Beginning its activity as a manufacturer of chemical products for the construction industry, it focused on supplying specialty mortars designed for waterproofing, concrete repair, flooring and decorative finishes.

Our Headquarters and Production Plant is based in Torrejon de Ardoz (Madrid), Spain. This is also the base for our Research and Development, Laboratory, Technical, Sales, Marketing and Administration.

DRIZORO S.A.U. has an International Division, providing a permanent contact and Technical assistance to our customers in more than thirty countries.

Our commitment to continually improving our products and processes, incorporating the latest technologies, led us to establish an Integral Quality and Environmental System, based on ISO 9001:2000 and ISO 14001:2004. These standards give DRIZORO S.A.U. the professional approach required to meet the challenges of today and those in the future.

Our projected achievements, but in permanent evolution and modernisation, have allowed us the better development of national and international markets by implanting the DRIZORO Products.

The products: Waterproofing acrylic, epoxy and polyurethane based coatings

The assessed products are coatings composed by acrylic and polyurethane resins for the waterproofing of hydraulic works, roofs and façades, as well as for pavement protection.

Declared Unit

1m2 of surface covered with synthetic resin (0,45 kg).

System Boundaries

From cradle to gate with modules C1-C4 and module D.

The scope of this EPD covers the entire Product Stage (modules A1, A2 and A3):
Extraction and processing of raw materials, its transport to the production plant and the resins manufacturing process.

It also covers the End of Life Stage of the product (modules C1, C2, C3 and C4):
Deconstruction, transport of waste to manager, waste treatment and the final disposal of the product.

Module D, Benefits and loads beyond the system boundary, related to the reuse or recycling potential of the product waste has been included.

Construction Stage (modules A4 and A5) and Use Stage (modules B1-B7) have been excluded from the LCA.

Additional Information

For further information, please contact to the next email address: info@drizoro.com

Environmental impact results

Environmental impact results per declared unit (1 m2) for Waterproofing acrylic, epoxy and polyurethane based coatings family										
Impact category	**Unit**	**A1**	**A2**	**A3**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**Module D**
GWP-fossil	kg CO_2 eq.	1,58E+00	2,02E-02	1,99E-01	1,80E+00	0	3,11E-03	0	2,38E-03	0
GWP-biogenic	kg CO_2 eq.	4,37E-03	1,08E-06	1,29E-03	5,66E-03	0	1,67E-07	0	1,45E-05	0
GWP-luluc	kg CO_2 eq.	8,94E-04	1,52E-07	5,55E-04	1,45E-03	0	2,35E-08	0	8,51E-07	0
GWP-Total	kg CO_2 eq.	1,59E+00	2,02E-02	2,00E-01	1,81E+00	0	3,11E-03	0	2,39E-03	0
ODP	kg CFC 11 eq.	6,29E-07	4,65E-09	1,91E-08	6,53E-07	0	7,21E-10	0	4,23E-10	0
AP	mol H+ eq.	9,14E-03	6,79E-05	1,09E-03	1,03E-02	0	1,07E-05	0	2,21E-05	0
EP-freshwater	kg P eq.	5,79E-05	1,09E-08	9,84E-06	6,77E-05	0	1,69E-09	0	2,98E-08	0
EP-marine	kg N eq.	1,33E-03	2,15E-05	2,47E-04	1,60E-03	0	3,45E-06	0	9,15E-06	0
EP-terrestrial	mol N eq.	1,31E-02	2,37E-04	2,73E-03	1,61E-02	0	3,80E-05	0	1,00E-04	0
POCP	kg NMVOC eq.	5,72E-03	6,47E-05	9,44E-04	6,73E-03	0	1,04E-05	0	2,77E-05	0
ADP-minerals and metals[1]	kg Sb eq.	8,04E-07	8,50E-10	2,78E-06	3,59E-06	0	1,32E-10	0	9,91E-11	0
ADP-fossil[1]	MJ	2,95E+01	2,84E-01	3,55E+00	3,34E+01	0	4,40E-02	0	3,16E-02	0
WDP[1]	m^3	9,77E-01	-6,02E-05	1,03E-01	1,08E+00	0	-9,33E-06	0	7,68E-05	0
Acronyms	**GWP-fossil** = Global Warming Potential fossil fuels; **GWP-biogenic** = Global Warming Potential biogenic; **GWP-luluc** = Global Warming Potential land use and land use change; **ODP** = Depletion potential of the stratospheric ozone layer; **AP** = Acidification potential, Accumulated Exceedance; **EP-freshwater** = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; **EP-marine** = Eutrophication potential, fraction of nutrients reaching marine end compartment; **EP-terrestrial** = Eutrophication potential, Accumulated Exceedance; **POCP** = Formation potential of tropospheric ozone; **ADP-minerals&metals** = Abiotic depletion potential for non-fossil resources; **ADP-fossil** = Abiotic depletion for fossil resources potential; **WDP** = Water (user) deprivation potential, deprivation-weighted water consumption									
[1]Environmental impact results shall be managed with caution since the uncertainty of the results are high and the experience with this parameter is limited.										

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PCR 2019:14. Construction products. 1.11

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ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures.

UNE-EN ISO 14044:2006 – Environmental management – Life Cycle Assessment – Requirements

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https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

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http://www.drizoro.com/

VERIFICATION STATEMENT CERTIFICATE

CERTIFICADO DE DECLARACIÓN DE VERIFICACIÓN

Certificate No. / Certificado nº: EPD07002

TECNALIA R&I CERTIFICACION S.L., confirms that independent third-party verification has been conducted of the Environmental Product Declaration (EPD) on behalf of:
TECNALIA *R&I CERTIFICACION S.L., confirma que se ha realizado verificación de tercera parte independiente de la Declaración Ambiental de Producto (DAP) en nombre de:*

DRIZORO, S.A.U.
Calle Primavera 50-52, Polígono Industrial Las Monjas
28850 TORREJÓN DE ARDOZ (Madrid) SPAIN

for the following product(s):
para el siguiente(s) producto(s):

WATERPROOFING ACRYLIC, EPOXY AND POLYURETHANE BASED COATINGS
RESINAS EN BASE ACRÍLICA, EPOXI Y POLIURETANO PARA IMPERMEABILIZACIÓN Y PROTECCIÓN

with registration number **S-P-06118** in the International EPD® System *(www.environdec.com).*
con *número de registro **S-P-06118** en el Sistema International EPD® (www.environdec.com).*

it´s in conformity with:
es conforme con:

- **ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations.**
- **General Programme Instructions for the International EPD® System v.3.01.**
- **PCR 2019:14 Construction products (EN 15804:A2) v.1.11.**
- **UN CPC: NA.**

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CERTIFICACION tecnalia CERTIFICATION

Carlos Nazabal Alsua
Manager

ENAC CERTIFICACIÓN ISO 17065 Nº125 / C-PR283

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APPENDIX C CIRCULAR DESIGN FRAMEWORK FOR BRIDGES

Version 0.1: 23.10.2022

Circular Design Framework

Bridges

Key focus point	CE Design Strategies 1-10	Description		Design Actions	#	Suggested follow-up
Build Nothing	01. Refuse unnecessary new construction	Early decisions on design and program of a project yield massive impact on the following construction, operation, refurbishment and second life reuse phases. Consideration of environmental, social and economic value at project outset against the clients strategic objectives is a key task. It should be determined if new construction presents the most efficient solutions to meet the client need. This strategy aims at rethinking the need for new transport, energy and water assets by reassessing the **necessity of new construction** for the envisioned objectives. Potentially other measures can be taken to fullfil or reduce the client need. If not, then assess if an existing asset can be used instead of new build.	1.1	Establish a modal shift in the mobility need so that lesser roads are needed to meet the demand for mobility.	3	Not for bridge designers specifically but the brief can be influenced
			1.2	Reuse, renovate or repurpose existing assets instead of building new. Doing more with what we already have.	3	
			1.3	Link requirement for new infrastructure to areal plannning strategies for transport and traffic that are based on optimisation of environmental, social and economic performance	3	
Efficiently used assets	02. Increase intensity of use	Maximising the **intensity of use** of assets is fundamental to minimise overall resource consumption. Increasing utilisation of infrastructure assets is a fundamental principle and the accomodation of various functions of an asset must be included into the construction programme early on. Existing assets can be adapted to increase their utility. For roads and streets bus lanes can be used to replace car capacity and space can be created to include active mobility. This strategy aims at the reduction of upfront resource consumption by maximizing the intensity of use of transport, water and energy assets. Optimized utilization can be achieved through the exploration of the "Space sharing" and "multi-use" concepts The future utilization potential is explored under "Design for Adaptability".	2.1	Increase the multi-use mobility potential of bridges. Allowing for other future use than what the original design is intended for. For example include different loading schemes into the design.	1	**Include in a circular design strategy checklist, checklist to be drafted in follow-up to the Bridges in a circular economy research**
			2.2	Create the general physical conditions to enable multi-use mobility. For example create an obstacle free road surface to accomodate various mobility functions (closely linked with 04 Design for Adaptability).	1	
Long-term value	03. Design for Longevity	This strategy aims at maximizing the value of the asset and it's component over time, optimising **value retention and value recovery potential**. At asset level, it aims at delivering the required function, as well as designing and selecting durable products that can stand the test of time. Durable products and components can be adapted to changing needs over time and extend the service life of an asset and reduce cost. At end of functional asset life durable products and components will have residual value and can be reused in the future. A long life cycle of products and components is directly linked to its design, as the design sets the baseline for an element's quality, maintenance need, necessity for repair, adaptability and residual value when removed.	3.1	Design beautiful and social. Design for timeless architecture that local communities will love and care for a long time.	2	Bridge engineers to advocate inclusion of architects in prominent projects
			3.2	Design for future climate adaptability so that it retains its functionality, performance and value, despite more extreme climate conditions.	2	Include in design checklist, and CEEQUAL certification of larger projects
			3.3	Use fewer unique and project-specific bridge elements.	1	**Include in a checklist**
			3.4	Investigate Product As-a-Service or Leasing schemes for components expected to have a short or medium service life in the project. Within these schemes the durability of the product is generally higher than when you only buy the product. Linked to LCC.	2	Influence the brief to increase awareness of such scheme in procurement
			3.5	Select durable and low maintenance materials for the load bearing structure.	1	**Include in a checklist**
			3.6	Select easy to replace alternatives for components with low service life (compared to main structure) like joints, bearings and parapets.	1	**Include in a checklist**
			3.7	Make use of Life-Cycle Cost Assessment (LCCA) as design assessment tool, and make this a requirement in all bridge design processes.	1	**Support IRCA in defining methodology for LCCA and set the mandate**
			3.8	Select durable and low maintenance materials for non-load bearing components such as parapets, bearings, utilities and joints	1	**Include in a checklist**
	04. Design for Adaptability	This strategy aims at enabling the **adaptability potential** during the use stage. Functional requirements change and it is important that assets have the ability to adapt to new functions to retain their value. It considers three design principles for adaptability: versatility, convertibility and expandability, which are in turn related to the required level of system changes adaptations.	4.1	Increase expandability: Allow for substantial changes by preparing for modifications to the load bearing structure. Include analysis of possible future bridge widening or lengthening and configure the structure such that this can be accommodated without extensive demolition. Applies to 4.2 and 4.3 also.	2	Identify which bridge/project types would benefit from this additional analysis and include in checklists accordingly
			4.2	Increase convertibility: Allow for substantial changes in use by preparing for modifications to the surface layout.	2	
			4.3	Increase versatility: Allow minor changes to the exterior of bridges like railings and edge details	2	
			4.4	Increase access to services, enabling easy repair and replacement.	2	
			4.5	Develop and issue a Manual for adaption with sufficient asset information (e.g. digital twin and Material Passports)	1	**Include in as-built BIM models that are used by owners in-service**
	05. Design for Disassembly	This strategy aims at enabling the **disassembly potential** at end of service life. The design life of some components in assets outlast the service life. It is of importance to design upfront for the disassembly of components in order to recover residual value at end of service life. Seven design principles for disassembly are considered. Following ISO 20887 these principles are; ease of access, independence, avoidance of unnecessary treatments and finishes, supporting re-use (circular economy) business models, simplicity, standardization and safety of disassembly.	5.1	Develop reversible connections between layers of different life span	2	Draw on international experience and with IRCA identify an opportunity to build a reversible bridge in Iceland
			5.2	Allow good access to reversible connections	2	
			5.3	Develop reversible connections between components with different functionality. Dutch circular bridge example, funded by Rijkswaterstaat.	2	
			5.4	Develop and issue a Manual for disassembly Document with sufficient asset information (e.g. Digital twin and Material Passports)	1	**Include in as-built BIM models that are used by owners in-service**
Efficient use of materials	06. Refuse unnecessary components	This strategy aims at meeting the project requirements with **minimal material consumption**. At all levels, it fosters simple design approaches, thoughtfully considering the real need of components and materials. It aims at questioning if certain components can be refused without compromising the ability for the project to function at the desired performance level.	6.1	Refuse redundancy in clearance envelope and overestimated user growth predictions	1	**Include in a checklist**
			6.2	Refuse the use of solely aesthetical design elements like edge elements	1	**Include in a checklist**
			6.3	Avoid components where at all possible, for example integral bridges reducing the need of joints and bearings where justifiable.	1	**Include in a checklist**
	07. Increase material efficiency	This strategy aims at meeting the project requirements with minimal material consumption. At all levels, it aims for an **efficient use of materials** at a maximum level of performance. It looks at avoiding inefficient designs (unbalanced cut and fill) and selecting efficient systems and forms. It also looks at the use of high-performance products and materials and advance engineering methodologies.	7.1	Select material efficient structural forms and techniques that suit the span and function.	1	**Include in a checklist**
			7.2	Reduce dimensions of the bridge structure components through selection of high strength materials	1	**Include in a checklist**
			7.3	Use advanced engineering practices to improve material efficiency of the bridge structure. Optimise all components of new structure to a utilisation close to 1.0 over the length and width of the bridge	1	**Include in a checklist**
			7.4	Reduce material waste at production and construction through off-site prefabrication of the bridge structure.	2	Work with other stakeholders and researchers in introducing pre-fab to bridge design where appropriate
	08. Reduce the use of virgin materials	This strategy aims at the prevention of **virgin abiotic material** consumption and promotion of secondary products and materials. At all levels, it aims to promote the use of reused products and recycled materials as well as promoting the use of renewable and biobased materials. And the prevention of virgin construction materials and critical raw materials in transport, water and energy. This strategy helps to mitigates potential risks imposed by scarce materials and material dependency.	8.1	Use reused components in the main structure. To enable this develop an open-source database of available components based on material passports sourced from digital twins	2	Work with the industry to set-up a register of useable components from decommissioned bridges
			8.2	Use concrete and steel with high recycled content	1	**Legislate and work with CO_2 targets**
			8.3	Use timber (or other biobased products)instead of traditional non-renewable structural materials. See here an example https://www.nordic.ca/en/projects/structures/mistissini-bridge	2	Monitor experience of recent timber bridges in Iceland
			8.4	Increase re-use of components for the railing and barriers	2	Work with the industry to set-up a register of useable components from decommissioned bridges
			8.5	Reduce the use of critical raw materials. See more info here https://www.crmalliance.eu/critical-raw-materials	2	Include in a checklist
The right materials	09. Reduce the use of carbon intensive materials	In the construction industry, embodied carbon (upfront carbon) has a significant impact on the climate crisis. As upfront carbon immediately cuts into our remaining carbon budget to stay below the globally agreed 2°C temperature rise by 2050. Other strategies already look at reducing material demand, now and in the future. This strategy aims at reducing the use of **carbon intense materials**. It prioritizes products and components which use reused products, recycled materials, renewable and biobased materials and suppliers that use clean energy in their manufacturing processes.	9.1	Keep track of the embodied carbon footprint of superstructure and substructure and set a target which is below the regionally recommended thresholds	1	**Legislate and work with CO_2 targets**
			9.2	Use concrete products with cement replacers, instead of traditional concrete	1	
			9.3	Use Engineered timber (or other biobased) products, instead of traditional carbon intensive materials like concrete and steel	2	Monitor experience of recent timber bridges in Iceland
			9.4	Alway consider use of reinforced soil solutions to retain soil in vertical walls instead of traditional carbon intensive materials	1	**Include in a checklist**
			9.5	Design for digital information management and provide sufficient information for LCA	1	**Include in as-built BIM models that are used by owners in-service**
	10. Design out hazardous/pollutant materials	This strategy aims at preventing the use of materials that have a negative impact on the **planetary boundaries** other than the Global Warming Potential that is covered by strategy 09. It focusses on the environmental impact categories covered in international LCA guidelines. Additionally, this strategy aims at preventing the use of materials that have a negative impact on the health and wellbeing of local communities and users. Materials which pose a potential risk to human health are likely to prevent the reusability of materials and components in the future, thus impeding on the value retention potential.	10.1	Make sure that materials and products are not on the 'Living Building Challenge (LBC) Red List'. See more info here https://living-future.org/lbc/red-list/	2	Include in a checklist
			10.2	Use on-site electric equipment to reduce the use of fossil fuel driven machines on site, so in turn this reduces the impact of nitrogen, smog and particulate matter emissions in the area.	2	Include in LCA
			10.3	Keep track of all environmental impacts during design through detailed LCA and set an ambitious target for the overall project (all layers, including realistic functional and service lives of components)	1	**IRCA to make LCA a mandatory requirement in bridge design**

Categorisation of Design Actions:

1: Actions that should be prioritised now in Iceland

2: Actions that decision makers should bring up the agenda in next 5 years, and need to be underpinned now

3: Actions that lie outside the scope of bridge design projects