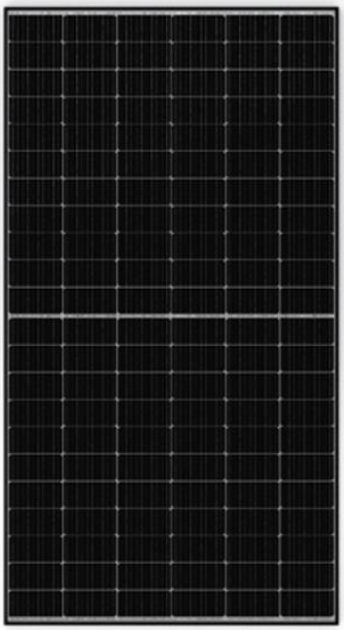
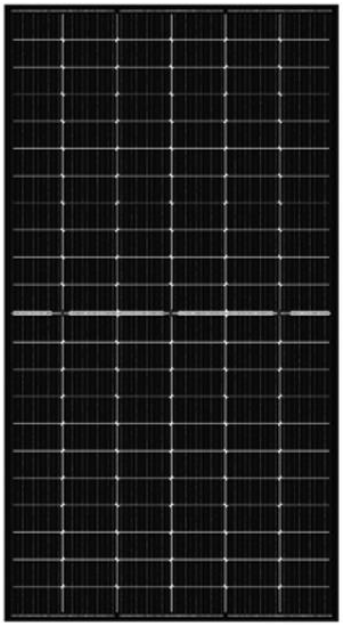
Environmental Product Declaration

In accordance with ISO14025:2006 and EN15804:2012+A2:2019 and with mutual recognition from EDP Italy & EPD International for:

BBO photovoltaic modules Duplex & Bifacial from BISOL Proizvodnja, d.o.o.





Owner of the declaration:
BISOL Proizvodnja, d.o.o.

Product name:
BBO photovoltaic modules: BBO Duplex & BBO Bifacial
Declared unit:
1 m2 of Manufactored photovoltaic module

Product category /PCR:
NPCR Part A for Construction products and services, version2.0 NPCR 029:2022 Part B for photovoltaic modules 1.2

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-7183-6585-EN

Registration number:
NEPD-7183-6585-EN

Issue date: 06.08.2024

Update date: 04.08.2025

Valid to: 06.08.2029

The Norwegian
EPD Foundation

General information

Product:

BBO photovoltaic modules Duplex & Bifacial with ranges from 500 – 525 Wp produced by BISOL Proizvodnja, d.o.o.

Program operator:

The Norwegian EPD Foundation
Post Box 5250 Majorstuen, 0303 Oslo, Norway
Tlf: +47 23 08 80 00
e-mail: post@epd-norge.no

Declaration number:

NEPD-7183-6585-EN

This declaration is based on Product Category Rules:

NPCR Part A for Construction products and services, version2. Issue date: 24.03.2021 valid to: 24.03.2026
NPCR 029:2022 Part B for photovoltaic modules 1.2 issue date: 31.03.2022 valid to: 11.06.2025

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, life cycle assessment data and evidence.

Type of EPD: Cradle-to-grave and module D. This is an average EPD, results depicted are for an average of BISOL BBO Duplex 500 and BISOL BBO Bifacial 500.

Declared unit: 1m^2 of manufactured photovoltaic modules: BBO Duplex 500 & BBO Bifacial 500. 1m^2 corresponds to 223 Wp.

Functional unit: 1Wp of manufactured photovoltaic module, from cradle to grave and module D, for the defined reference service life of 25 years.

Verification: Independent verification of the declaration and data, according to ISO14025:2010

internal ☐ external ■

Afzal khan Peerukhan
Independent verifier approved by EPD Norway

Owner of the declaration:

BISOL Proizvodnja, d.o.o.
Contact person: Marija Završnik,
marija.zavrsnik@bisol.si
Phone: +386 (0)3 703 22 50
e-mail: info@bisol.com

Manufacturer:

BISOL Proizvodnja, d.o.o.,
Latkova vas 59a, 3312 Prebold,
Slovenija
Phone: +386 (0)3 703 22 50
e-mail: info@bisol.com

Place of production:

Latkova vas 59a, 3312 Prebold,
Slovenija, EU

Management system:

ISO 14001, ISO 9001,

ISO 45001

Organization no:

3961958000

Issue date: 06.08.2024

Update date: 04.08.2025

Valid to: 06.08.2029

Year of study:

2024

Comparability:

EPDs from other programs than The Norwegian EPD Foundation may not be comparable.

The EPD has been worked out by: Jaka Jelenc, Greenium poslovno svetovanje, s.p.

Approved Manager of EPD Norway

Product

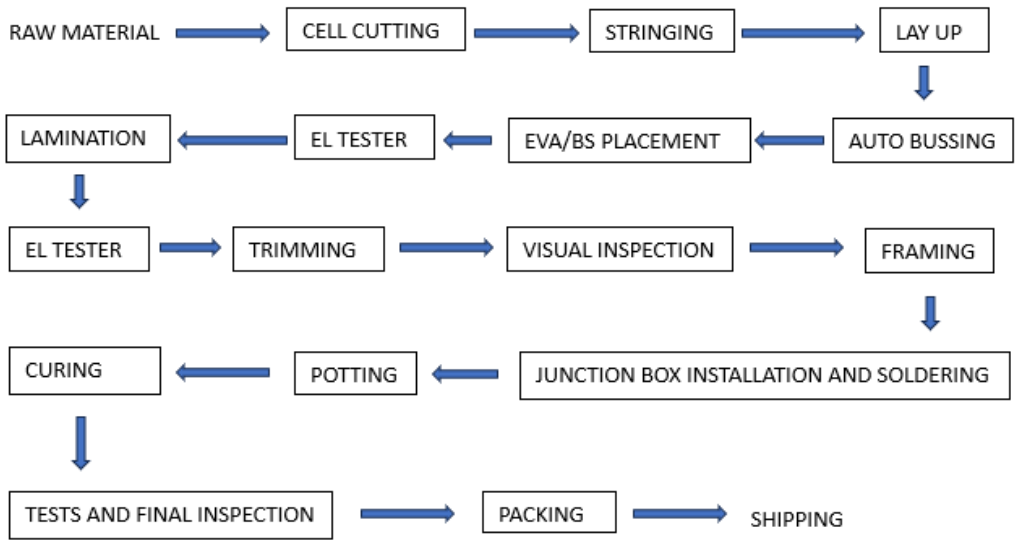
Product description: BISOL photovoltaic modules are available in two sizes. BBO modules are characterized by high performance. These are larger module models; the dimensions of the module with standard frames are 1,975 x 1,134 x 35 mm, and the weight is 23,5 kg. The BBO type of modules is available in power classes between 500 and 525 Wp.

The BISOL Duplex module is considered one of BISOL's best-selling photovoltaic modules, as it offers the best power-to-size ratio and significantly higher cell power and higher conversion efficiency compared to other products on the market. It is suitable for both industrial projects and residential buildings. BISOL Duplex is characterized by a reduced shadowing effect and high efficiency in low-light conditions. It is available in two versions, namely the larger BBO version and the smaller BDO version. The BBO type of the BISOL Duplex module has 108 series-connected half-cells in power classes between 500 and 525 Wp. It is available in three color versions, namely silver-white, black-white, and black.

The BISOL Bifacial module is a photovoltaic module with a standard number of double-sided cells with a transparent back film, which also produces power on the back of the module, allowing up to 60% additional yield from the back of the module, depending on the color shades of the surface, the amount of diffuse sunlight, reflected diffuse sunlight, and reflected direct sunlight. It is suitable for floor installations and flat roofs and is considered the ideal solution for projects where strength is more important than light transmission. It is available in two versions, namely the larger BBO version and the smaller BDO version. BBO module type BISOL Bifacial performs between 500 and 525 Wp. It is only available in black, with the color of the back film being transparent.

This is an EPD that covers multiple products for the BBO photovoltaic modules: BBO Duplex & BBO Bifacial. All the BBO modules have the same structure per m2 (same weights), the difference is in the Wp of produced electricity. All of the environmental indicators for all the modules covered by this EPD are within +/- 10%.

The production is located in Latkova vas 59a, 3312 Prebold, Slovenija (European Union) and has the following production steps:



Step 1: Raw material
Entrance and check of the raw material for module production.
Step 2: Cell cutting
Cells are cut into two halfs to reduce current losses and boost efficiency of the modules.
Step 3: Stringing
Stringing is a soldering process of solar cells. The cells are electrically connected using tinned copper ribbon. This connection forms a string of cells.
Step 4: Lay up
The strings of photovoltaic cells are positioned on the top of tempered solar glass, covered with the encapsulant.
Step 5: Auto bussing
A machine uses vacuum to pick up the solar cells and position them precisely, ensuring accurate placement of the ribbons. The ribbons are then soldered onto the cells with induction soldering.
Step 6: EVA/BS placement
Special automatic cutters cut foil to exact size and automatically place it on the glass with cells.
Step 7: EL tester
EL test conducts appearance and electroluminescent imaging inspection on the PV modules before lamination. EL defect tester is used to identify and analyze defects and irregularities in solar cells.
Step 7: Lamination
During lamination, the encapsulant is cross-linked under temperature and vacuum. At this phase all sandwich components are laminated into a semi-finished product.
Step 8: EL tester
EL test conducts appearance and electroluminescent imaging inspection on the PV modules after lamination. EL defect tester is used to identify defects and irregularities in solar cells and modules that might affect their efficiency and longevity.
Step 9: Trimming
The edge trimming process removes excess encapsulant and back cover film from the module laminate edges and disposes of the excess material.
Step 10: Visual inspection
Visual inspection of solar panels is intended to identify and prevent a serial defect (bubbles…).
Step 11: Framing
Framing is a process of attaching protective and strengthening frames to the PV laminates of a solar panel.
Step 12: Junction box installation and soldering
The junction box is mounted on the ribbons extending from the back plate of the module. The junction box is attached to the module by using sealant and soldering process.
Step 13: Potting
Potting is the process of encapsulating the junction box with a protective material called potting compound. The potting compound is injected into the junction box to protect the electrical connections and components from external elements such as moisture, dust and extreme temperatures.
Step 14: Curing
It is automated process. The modules are moved automatically towards measurements ensuring enough time for silicon to cure.
Step 15: Tests and final inspection
Final inspection and tests include visual inspection, IV measurement, hi pot test.
Step 16: Packing
Separators are placed between each module and extra protections are added to the four corners of each module stack. Solar modules are packed horizontally on the pallet, which is then wrapped in a plastic film and prepared for the transportation.
Step 17: Shipping
Transport to the customer.

Market:

The photovoltaic modules are made in EU, in terms of transport to costumer and EOL EU scenarios are applied.

Application and technical function of product:

Photovoltaic modules are used to power homes, businesses and industrial facilities. They capture solar power to transform it into sustainable energy. It is a cost-effective solution for reducing costs and providing clean energy.

Product specification:

Average product

Materials	Value [kg/DU]	%
Glass	7,83E+00	73,87%
Frame	1,04E+00	9,81%
Ribbon	8,01E-02	0,76%
Junction box	1,10E-01	1,04%
Photocell	2,05E-01	1,93%
Back foil	4,91E-01	4,63%
EVA/POE	7,28E-01	6,87%
Silicon	1,04E-01	0,98%
Flux	1,02E-02	0,10%
Labels	7,68E-04	0,01%
Packaging	**Value [kg/DU]**	**%**
Pallet	4,07E-01	3,67%
Cardboard	4,49E-02	0,41%
Packaging plastic	3,96E-02	0,36%

In the above table average product specifications are presented

Technical data (same for all modules within a group, covered in this EPD):

Caracteristics	Unit	BBO Duplex	BBO Bifacial
Height	m	1,975	1,975
Width	m	1,134	1,134
Area	m2	2,23965	2,23965
Weight	kg	23,5	23,5
Wafer size	mm	182,25*210	182,25*210
Power	Wp	500-525	500-525
Bifacial	Y/N	Monofacial	Bifacial
Lifetime	Year	25	25
Yearly degradation	%	0,5	0,5
No. of cells	pcs	54	54

The modules are produced according to IEC standards: IEC 61215:2021, IEC 61730:2023 IEC 61701:2020, IEC 62716:2013, IEC TS 63342:2022 & IEC TS 62804-1:2015

An average of 500Wp BBO Duplex and BBO Bifacial is considered in the study and a conversion factor is shown below. This EPD is valid for the following modules:

BBO Duplex	Maximum power output range (Wp)	Conversion factor for FU
BBO 500	500	1,00
BBO 505	505	0,99
BBO 510	510	0,98
BBO 515	515	0,97
BBO 520	520	0,96
BBO 525	525	0,95

BBO Bifacial	Maximum power output range (Wp)	Conversion factor
BBO 500	500	1,00
BBO 505	505	0,99
BBO 510	510	0,98
BBO 515	515	0,97
BBO 520	520	0,96
BBO 525	525	0,95

Reference service life, product: 25 years

Additional technical info: None

LCA: Calculation rules

Declared unit: 1m^2 of manufactured photovoltaic modules: BBO Duplex & BBO Bifacial, 1m^2 corresponds to 223 Wp.

Functional unit: 1Wp of manufactured photovoltaic module, from cradle to grave and module D, for the defined reference service life.

Cut-off criteria: Due to their low mass, flux and labels were cut off from the study, the impact is below the cut of criteria .

Allocation: The energy consumption and waste production during the assembly stage of the PV module was allocated by PV m^2. The transport of raw materials is allocated by weight ratio. The waste produced on site that is recycled is to be considered as materials that have reached a so-called "end-of-waste" state, the coverage of the waste processing is thus terminated. Any inputs/flows related to refine gross recycled materials for actual applications are beyond the product system boundary and is accounted in Module D.

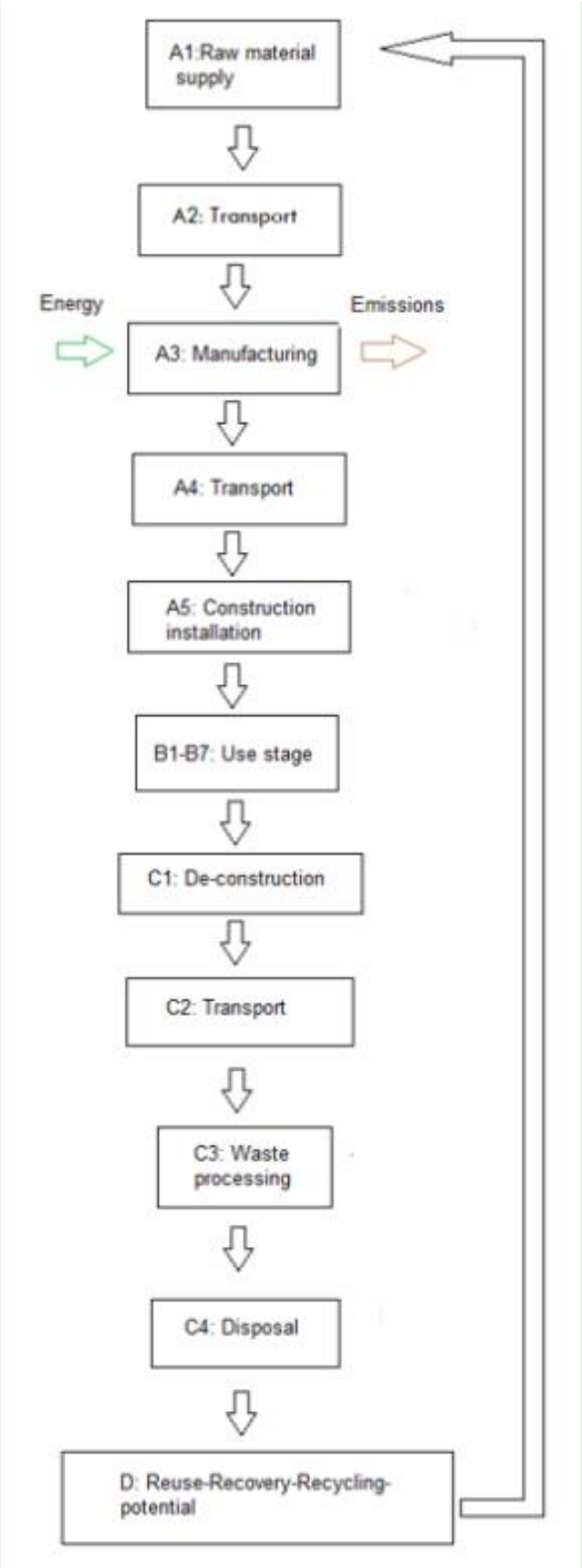
Key assumptions: The GWPT data for the photovoltaic cell was obtained from the manufacturer Chuzhou JieTai New Energy Technology Co., Ltd, product: 1 piece of N-Type TOPCon high efficiency monocrystalline solar cell. GWPT for the photovoltaic cell equals 42,75 kgCO2eq/m^2 of cell.

Data quality: Specific data comes from actual consumption data from assembly location, gathered in year 2022. Primary data for the photovoltaic cell was provided by HUAIAN Jietai New Energy Technology Co., Ltd. The data was collected and provided by the manufacturer. Generic data is taken from LCA for Experts version 10.9.1.17, Sphera My professional database EN version 2025.1, the generic data is less than 5 years old.

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

Product stage			Assembly stage		Use stage							End of life stage				Benefits & loads beyond system boundary
Rawmaterials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operationalenergyuse	Operationalwateruse	De-constructiondemolition	Transport	Wasteprocessing	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	X

System boundary: For this EPD Cradle to grave system boundaries are applied.



LCA: Scenarios and additional technical information

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

Production (A1-A3)

A1-A3: includes the production of raw materials and their transport along with the operations needed to assemble the photovoltaic module. For the transport of non-electrical components 100km by truck was assumed (representing SLO/EU), for photovoltaic cell and other electrical components 500km by truck and 20000 km by container ship was applied (representing SLO/CN). The Slovenian residual grid mix was used for electricity consumption for the assembly stage. Production data was obtained for the year 2022. The product is made in Slovenia/European Union.

Transport from production place to assembly/user (A4)

Transport from production place to assembly/user (A4)	Capacity utilisation (incl. return) %	Distance (km)	Fuel/Energy consumption
Truck (GLO: Truck, Euro 0 -6 mix, 20 -26 t gross weight)	55 %	1.800	Diesel 0,51L
Boat (GLO: Average ship, 3500 t payload capacity)	70 %	200	HFO 0,03L

Assembly (A5)

A5: hand tools are used for installation and their energy consumption is negligible but to mount the PV module to the roof, 4 clamps and 4 screws are used (mass 0,5 kg, material Stainless steel). Waste recovery of packaging is considered in phase A5 as well.

Assembly materials (A5)	Quantity (piece)	Mass (kg)
Cramps and screws	4x4	0,5

Use (B1-B7)

B1-B7: Over the applied RSL, the impacts from LCA stages B1, B3, B4, B5, B6 & B7 are negligible and are assumed to be zero.

For maintenance (B2) it is assumed that 0,5 l of water is used for cleaning a module per year for the declared RSL of 25 years. No energy produced is included. LCA stage B2 is declared in this EPD.

To calculate expected energy production over the RSL, the following formulas may be used:

E1 = S_{rad} * A * y * PR *)1 – deg), where:

- E1 is the energy produced in 1st year of operation,
- Srad is site specific annual average solar radiation on module (shadings not included), kWh/KWp/year- The annual radiation must take into consideration the specific inclination and orientation,
- A is the area of the module, form functional unit, m^2
- Y is the module yield, kWp for standard test conditions of the module divided by the area of the module (STC is the ratio given for standard test conditions: irradiance 100W/m2, cell T 25 ^oC, wind speed 1m/s. AM 1,5.
- PR is the performance ratio, coefficient for losses. Site specific performance ratio can be modelled with PV simulation software
- Deg is yearly degradation rate

Energy production over the RSL of the module, assuming linear annual degradation can be calculated using the following equation: $E_{RSL} = E1 * (1+ \sum_{n=1}^{RSL-1} 1 - \deg)^n)$

BBO Duplex	Maximum power output range (Wp)	E1/kWp	deg-first year	deg-after first year	ERSL/kWp
BBO 500	500	1115	3%	0,5%	26276
BBO 505	505	1115	3%	0,5%	26276
BBO 510	510	1115	3%	0,5%	26276
BBO 515	515	1115	3%	0,5%	26276
BBO 520	520	1115	3%	0,5%	26276
BBO 525	525	1115	3%	0,5%	26276
BBO Bifacial	Maximum power output range (Wp)	E1/kWp	deg-first year	deg-after first year	ERSL/kWp
BBO 500	500	1115	3%	0,5%	26276
BBO 505	505	1115	3%	0,5%	26276
BBO 510	510	1115	3%	0,5%	26276
BBO 515	515	1115	3%	0,5%	26276
BBO 520	520	1115	3%	0,5%	26276
BBO 525	525	1115	3%	0,5%	26276

Maintenance (B2)

Maintenance (B2)	Unit	Value
Water consumption	m3	1,25E-02

End of Life (C1, C3, C4)

C1: Final product is assumed to be de-installed by hand and the impacts are assumed to be zero.

C3: Waste processing: For the recovery of the product after use, 80% of the product is assumed to be recycled and 5 % of the final product is assumed to be incinerated with efficiency 60%. The recovery takes place in EU.

C4: Waste disposal: 15% of the final product is assumed to be disposed of in a landfill.

Due to the reference service life of 25 years, this is assumed to be a conservative scenario. The end-of-life scenario is assumed to be in Europe.

Transport to waste processing (C2)

Transport from production place to assembly/user (C2)	Capacity utilization (incl. return) %	Distance (km)	Fuel/Energy consumption
Truck (GLO: Truck, Euro 0 -6 mix, 20 -26 t gross weight)	55 %	50	Diesel 0,025L

Benefits and loads beyond the system boundaries (D)

In Module D, benefits are credited from the recovery of 80% of the recycled material, as well as from the energy recovered through the incineration of 5% of the material.

Benefits and loads beyond the system boundaries (D)	Unit	Value
Substitution of electricity, in Norway	MJ/ m^2	2,12E+00
Substitution of thermal energy, district heating, in Norway	MJ / m^2	7,53E+00
Benefits from recycling (material)	KG/ m^2	8,48E+00

LCA: Results

The results are shown for the average product BISOL BBO Duplex and Bifacial 500Wp, the results are shown per functional unit which is 1 Wp and for the declared unit which is 1m^2. These results are valid for all the products covered by this EPD as mentioned in the product description.

Core environmental impact indicators (per functional unit - Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP - total	kg CO2 eq	3,89E-01	9,89E-03	1,11E-02	0,00E+00	4,88E-06	0,00E+00	4,62E-06	0,00E+00	0,00E+00	0,00E+00	5,70E-05	2,50E-04	1,84E-02	8,16E-04	-8,34E-02
GWP - fossil	kg CO2 eq	3,92E-01	9,79E-03	7,89E-03	0,00E+00	4,88E-06	0,00E+00	4,61E-06	0,00E+00	0,00E+00	0,00E+00	5,70E-05	2,47E-04	1,84E-02	8,16E-04	-8,33E-02
GWP - biogenic	kg CO2 eq	-3,20E-03	0,00E+00	3,20E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWP - luluc	kg CO2 eq	4,96E-04	1,01E-04	9,61E-06	0,00E+00	5,68E-09	0,00E+00	5,37E-09	0,00E+00	0,00E+00	0,00E+00	4,66E-08	2,54E-06	2,18E-05	5,44E-07	-6,97E-05
ODP	kg CFC11 eq	6,34E-05	1,62E-15	5,75E-14	0,00E+00	2,72E-17	0,00E+00	2,57E-17	0,00E+00	0,00E+00	0,00E+00	1,57E-15	4,10E-17	1,47E-13	7,77E-16	-3,17E-13
AP	molc H+ eq	2,34E-03	2,29E-05	6,31E-05	0,00E+00	8,24E-09	0,00E+00	7,80E-09	0,00E+00	0,00E+00	0,00E+00	9,82E-08	4,91E-07	1,77E-05	1,96E-06	-5,41E-04
EP- freshwater	kg P eq	1,39E-04	2,64E-08	2,39E-08	0,00E+00	6,83E-10	0,00E+00	6,46E-10	0,00E+00	0,00E+00	0,00E+00	1,66E-10	6,66E-10	9,22E-08	1,49E-07	-9,89E-08
EP -marine	kg N eq	5,53E-04	1,02E-05	5,42E-06	0,00E+00	4,97E-09	0,00E+00	4,70E-09	0,00E+00	0,00E+00	0,00E+00	3,03E-08	2,13E-07	4,40E-06	1,70E-06	-6,01E-05
EP - terrestrial	molc N eq	5,54E-03	1,10E-04	5,79E-05	0,00E+00	2,55E-08	0,00E+00	2,41E-08	0,00E+00	0,00E+00	0,00E+00	3,35E-07	2,28E-06	5,23E-05	7,17E-06	-6,67E-04
POCP	kg NMVOC eq	1,68E-03	2,30E-05	1,80E-05	0,00E+00	7,16E-09	0,00E+00	6,77E-09	0,00E+00	0,00E+00	0,00E+00	6,77E-08	4,44E-07	1,12E-05	4,06E-06	-2,25E-04
ADP-M&M[2]	kg Sb-Eq	2,28E-05	6,50E-10	2,96E-07	0,00E+00	3,11E-13	0,00E+00	2,95E-13	0,00E+00	0,00E+00	0,00E+00	1,18E-11	1,64E-11	2,60E-09	1,68E-11	-1,61E-06
ADP-fossil[2]	MJ	5,46E+00	1,25E-01	9,50E-02	0,00E+00	7,18E-05	0,00E+00	6,79E-05	0,00E+00	0,00E+00	0,00E+00	7,67E-04	3,17E-03	1,51E-01	5,67E-03	-1,01E+00
WDP[2]	m^3	3,30E-01	4,47E-05	1,32E-03	0,00E+00	2,55E-03	0,00E+00	2,41E-03	0,00E+00	0,00E+00	0,00E+00	1,45E-06	1,13E-06	2,69E-03	2,63E-05	-1,93E-02

Core environmental impact indicators (per declared unit - m^2)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP - total	kg CO2 eq	8,67E+01	2,21E+00	2,47E+00	0,00E+00	1,03E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,27E-02	5,57E-02	4,10E+00	1,82E-01	-1,86E+01
GWP - fossil	kg CO2 eq	8,73E+01	2,18E+00	1,76E+00	0,00E+00	1,03E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,27E-02	5,51E-02	4,10E+00	1,82E-01	-1,86E+01
GWP - biogenic	kg CO2 eq	-7,12E-01	0,00E+00	7,12E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWP - luluc	kg CO2 eq	1,11E-01	2,24E-02	2,14E-03	0,00E+00	1,20E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,04E-05	5,67E-04	4,87E-03	1,21E-04	-1,55E-02
ODP	kg CFC11 eq	1,41E-02	3,62E-13	1,28E-11	0,00E+00	5,73E-15	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,51E-13	9,14E-15	3,28E-11	1,73E-13	-7,06E-11
AP	molc H+ eq	5,21E-01	5,10E-03	1,41E-02	0,00E+00	1,74E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,19E-05	1,10E-04	3,96E-03	4,37E-04	-1,21E-01
EP-freshwater	kg P eq	3,10E-02	5,88E-06	5,34E-06	0,00E+00	1,44E-07	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,71E-08	1,49E-07	2,05E-05	3,33E-05	-2,21E-05
EP -marine	kg N eq	1,23E-01	2,28E-03	1,21E-03	0,00E+00	1,05E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,76E-06	4,74E-05	9,82E-04	3,79E-04	-1,34E-02
EP - terrestrial	molc N eq	1,24E+00	2,45E-02	1,29E-02	0,00E+00	5,38E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,48E-05	5,09E-04	1,17E-02	1,60E-03	-1,49E-01
POCP	kg NMVOC eq	3,75E-01	5,13E-03	4,01E-03	0,00E+00	1,51E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,51E-05	9,89E-05	2,50E-03	9,06E-04	-5,02E-02
ADP-M&M[2]	kg Sb-Eq	5,09E-03	1,45E-07	6,61E-05	0,00E+00	6,57E-11	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,64E-09	3,66E-09	5,79E-07	3,74E-09	-3,59E-04
ADP-fossil[2]	MJ	1,22E+03	2,79E+01	2,12E+01	0,00E+00	1,51E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,71E-01	7,06E-01	3,37E+01	1,26E+00	-2,25E+02
WDP[2]	m^3	7,37E+01	9,97E-03	2,94E-01	0,00E+00	5,38E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,23E-04	2,52E-04	6,01E-01	5,87E-03	-4,31E+00

GWP-total: Global Warming Potential; 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; See "additional Norwegian requirements" for indicator given as PO4 eq. EP-marine: Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-terrestrial: Eutrophication potential, Accumulated Exceedance; POCP: Formation potential of tropospheric ozone; ADP-M&M: Abiotic depletion potential for non-fossil resources (minerals and metals); ADP-fossil: Abiotic depletion potential for fossil resources; WDP: Water deprivation potential, deprivation weighted water consumption

Reading example: 9,0 E-03 = 9,0*10-3 = 0,009

Carbon footprint

The GWP total results presented in this EPD document represent the carbon footprint of the products studied & included in this EPD. The GWPT value for A1-C4 is 4,29E-01 kgCO2eq/Wp & 9,58E+01kgCO2eq/m^2.

Additional environmental impact indicators (per functional unit -Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	Disease incidence	2,61E-08	2,85E-10	9,14E-10	0,00E+00	1,61E-13	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,67E-13	3,99E-12	1,47E-10	1,97E-11	-4,80E-09
IRP[1]	kBq U235 eq.	2,73E-02	3,40E-05	3,23E-04	0,00E+00	3,08E-07	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,00E-06	8,58E-07	3,39E-03	1,03E-05	-4,04E-03
ETP-fw[2]	CTUe	3,91E+00	1,63E-01	6,88E-02	0,00E+00	4,74E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,13E-04	4,12E-03	3,14E-02	7,25E-03	-2,29E-01
HTP-c[2]	CTUh	2,40E-10	2,20E-12	7,63E-12	0,00E+00	3,42E-15	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,66E-14	5,55E-14	2,39E-12	1,50E-13	-2,63E-11
HTP-nc[2]	CTUh	7,30E-09	1,23E-10	6,28E-11	0,00E+00	2,65E-13	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,03E-13	3,10E-12	5,68E-11	9,62E-12	-5,18E-10
SQP[2]	Dimensionless	1,27E+00	5,54E-02	1,95E-02	0,00E+00	8,29E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,43E-04	1,40E-03	5,38E-02	5,44E-04	-2,16E+00

Additional environmental impact indicators (per declared unit - m^2)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	Disease incidence	5,82E-06	6,35E-08	2,04E-07	0,00E+00	3,59E-11	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,71E-10	8,91E-10	3,28E-08	4,40E-09	-1,07E-06
IRP[1]	kBq U235 eq.	6,08E+00	7,57E-03	7,20E-02	0,00E+00	6,88E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,56E-03	1,91E-04	7,56E-01	2,30E-03	-9,01E-01
ETP-fw[2]	CTUe	8,72E+02	3,63E+01	1,53E+01	0,00E+00	1,06E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,74E-02	9,18E-01	7,00E+00	1,62E+00	-5,10E+01
HTP-c[2]	CTUh	5,35E-08	4,90E-10	1,70E-09	0,00E+00	7,63E-13	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,04E-11	1,24E-11	5,34E-10	3,34E-11	-5,88E-09
HTP-nc[2]	CTUh	1,63E-06	2,74E-08	1,40E-08	0,00E+00	5,91E-11	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,98E-11	6,92E-10	1,27E-08	2,15E-09	-1,15E-07
SQP[2]	Dimensionless	2,82E+02	1,24E+01	4,36E+00	0,00E+00	1,85E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,87E-02	3,12E-01	1,20E+01	1,21E-01	-4,81E+02

PM: Particulate matter emissions; IRP: Ionizing radiation, human health; ETP-fw: Ecotoxicity (freshwater); ETP-c: Human toxicity, cancer effects; HTP-nc: Human toxicity, non-cancer effects; SQP: Land use related impacts / soil quality

[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.

[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

Resource use (per functional unit -Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPEM	MJ	3,44E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRPM	MJ	1,56E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RPEE	MJ	8,62E-01	9,45E-03	2,58E-02	0,00E+00	1,29E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,57E-06	2,39E-04	8,98E-02	6,15E-04	-5,42E-01
TPE	MJ	8,96E-01	9,45E-03	2,58E-02	0,00E+00	1,29E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,57E-06	2,39E-04	8,98E-02	6,15E-04	-5,42E-01
NRPE	MJ	5,46E+00	1,25E-01	9,50E-02	0,00E+00	6,79E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,07E-06	3,17E-03	1,51E-01	5,67E-03	-1,01E+00
TRPE	MJ	5,61E+00	1,25E-01	9,50E-02	0,00E+00	6,79E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,07E-06	3,17E-03	1,51E-01	5,67E-03	-1,01E+00
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m^3	7,80E-03	4,67E-06	3,80E-05	0,00E+00	5,61E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,62E-09	1,18E-07	9,50E-05	7,86E-07	-5,95E-04

Resource use (per declared unit - m^2)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPEM	MJ	7,68E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRPM	MJ	3,49E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RPEE	MJ	1,92E+02	2,11E+00	5,74E+00	0,00E+00	2,88E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,02E-03	5,32E-02	2,00E+01	1,37E-01	-1,21E+02
TPE	MJ	2,00E+02	2,11E+00	5,74E+00	0,00E+00	2,88E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,02E-03	5,32E-02	2,00E+01	1,37E-01	-1,21E+02
NRPE	MJ	1,22E+03	2,79E+01	2,12E+01	0,00E+00	1,51E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,13E-03	7,06E-01	3,37E+01	1,26E+00	-2,25E+02
TRPE	MJ	1,25E+03	2,79E+01	2,12E+01	0,00E+00	1,51E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,13E-03	7,06E-01	3,37E+01	1,26E+00	-2,25E+02
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m^3	1,74E+00	1,04E-03	8,46E-03	0,00E+00	1,25E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,62E-07	2,63E-05	2,12E-02	1,75E-04	-1,33E-01

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 Nonrenewable primary energy resources used as energy carrier; NRPM Nonrenewable 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 (per functional unit -Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HW	kg	5,94E-10	5,03E-12	4,57E-11	0,00E+00	2,70E-14	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,50E-12	1,27E-13	4,59E-09	9,03E-13	-3,03E-09
NHW	kg	2,33E-02	1,75E-05	2,36E-03	0,00E+00	1,60E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,82E-07	4,42E-07	4,05E-03	5,74E-03	-1,22E-02
RW	kg	3,52E-05	2,37E-07	2,80E-06	0,00E+00	2,13E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,00E-08	5,98E-09	2,06E-05	6,98E-08	-3,45E-05

End of life – Waste (per declared unit - m^2)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HW	kg	1,33E-07	1,12E-09	1,02E-08	0,00E+00	6,02E-12	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,34E-10	2,83E-11	1,02E-06	2,01E-10	-6,76E-07
NHW	kg	5,20E+00	3,90E-03	5,27E-01	0,00E+00	3,57E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,52E-04	9,86E-05	9,04E-01	1,28E+00	-2,72E+00
RW	kg	7,85E-03	5,27E-05	6,25E-04	0,00E+00	4,75E-07	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,56E-05	1,33E-06	4,59E-03	1,56E-05	-7,68E-03

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

End of life – output flow (per functional unit -Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,80E-02	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,38E-03	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,53E-03	0,00E+00	0,00E+00
ETE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,38E-02	0,00E+00	0,00E+00

End of life – output flow (per declared unit - m^2)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,48E+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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,30E-01	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,12E+00	0,00E+00	0,00E+00
ETE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,53E+00	0,00E+00	0,00E+00

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

Information describing the biogenic carbon content at the factory gate

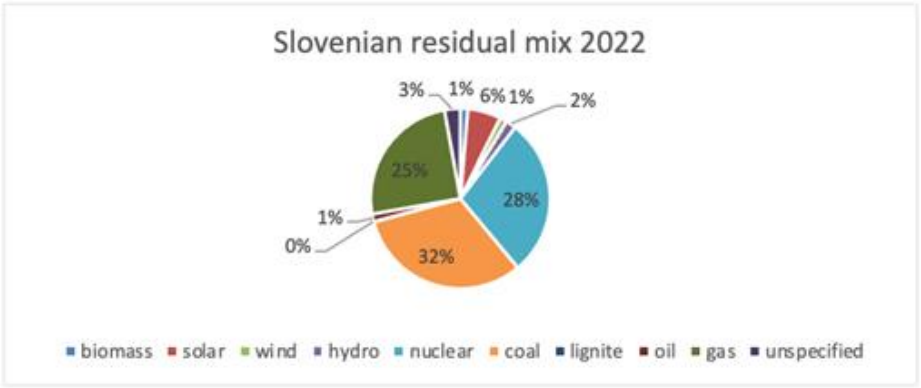
Biogenic carbon content	Unit	Value
Biogenic carbon content in product	kg C /m^2	0,00E-00
Biogenic carbon content in product	kg C /Wp	0,00E-00
Biogenic carbon content in the accompanying packaging	kg C/m^2	1,94E-01
Biogenic carbon content in the accompanying packaging	kg C /Wp	8,70E-04

Additional requirements

Location based electricity mix from the use of electricity in manufacturing

For this EPD the residual Slovenian national mix was used. The model is based on: https://www.aib-net.org/sites/default/files/assets/facts/residual-mix/2022/AIB_2022_Residual_Mix_Results_.pdf

National electricity grid	Data source	GWP_{total} [kg CO2 eq/kWh]
Residual mix Si	LCA for Experts & AIB	5,90E-01



Additional environmental impact indicators required for construction products

To increase the transparency of biogenic carbon contribution to climate impact, the indicator GWP-IOBC is required as it declares climate impacts calculated according to the principle of instantaneous oxidation. GWP-IOBC is also referred to as GWP-GHG in context to Swedish public procurement legislation.

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-IOBC	Kg/Wp	3,92E-01	9,89E-03	7,90E-03	0,00E+00	4,62E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,70E-05	2,50E-04	1,84E-02	8,16E-04	-8,34E-02
GWP-IOBC	Kg/m2	8,74E+01	2,21E+00	1,76E+00	0,00E+00	1,03E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,27E-02	5,57E-02	4,10E+00	1,82E-01	-1,86E+01

GWP-IOBC Global warming potential calculated according to the principle of instantaneous oxidation.

Hazardous substances

The declaration is based upon reference to threshold values and/or test results and/or material safety data sheets provided to EPD verifiers. Documentation available upon request to EPD owner.

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

Indoor environment

No tests were performed

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+A2:2019	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
NPCR 029 version 1.1 PCR – Part B	For photovoltaic modules used in the building and construction industry, including production of cell, wafer, ingot block, solar grade silicon, solar substrates, solar superstrates and other solar grade semiconductor materials.
NPCR PART A Version: 2.0 construction products and services March 2021	Construction products and services
LCA Report	Manufacture of BBO Duplex, BBO Bifacial, BDO Duplex, BDO Bifacial, BDO Supreme, BDO Spectrum (Orange and Red) and BIPV photovoltaic modules

epd-norway	Program Operator	tlf	+47 23 08 80 00
	The Norwegian EPD Foundation		
	Post Box 5250 Majorstuen, 0303 Oslo	e-post:	post@epd-norge.no
	Norway	web	www.epd-norge.no
epd-norway	Publisher	tlf	+47 23 08 80 00
	The Norwegian EPD Foundation		
	Post Box 5250 Majorstuen, 0303 Oslo	e-post:	post@epd-norge.no
	Norway	web	www.epd-norge.no
ECO PLATFORM EPD VERIFIED	ECO Platform ECO Portal	web web	www.eco-platform.org ECO Portal
BISOL	Owner of the declaration	tlf	+386 (0)3 703 22 50
	BISOL Proizvodnja, d.o.o.		
	Latkova vas 59a, 3312 Prebold	e-post:	info@bisol.com
	Slovenija	web	https://www.bisol.com/
Gr GREENIUM Sustainability & Management System Consulting	Greenium, poslovno svetovanje Jaka Jelenc, s.p.	tlf	+386 31 577 680
	Greenium, poslovno svetovanje Jaka Jelenc, s.p.		
	Pečinska ulica 22, Ljubljana	e-post:	greeniumconsulting@gmail.com
	Slovenija	web	www.grenium.si