

JA Solar GmbH



ENVIRONMENTAL PRODUCT DECLARATION

**Mono-crystalline Double glass,
N-Type, solar photovoltaic modules**

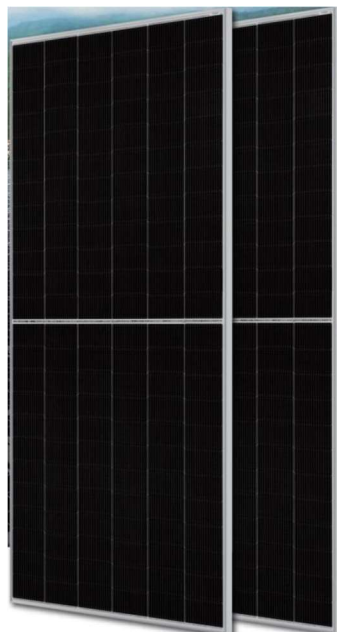
China

in compliance with ISO 14025 and EN15804

| | |
|------------------|------------------------------|
| Program Operator | The Norwegian EPD Foundation |
| Publisher | EPDItaly |

| | |
|---------------------|-------------------|
| Declaration Number | NEPD-4908-4258-EN |
| Registration Number | MR-EPDITALY0072 |

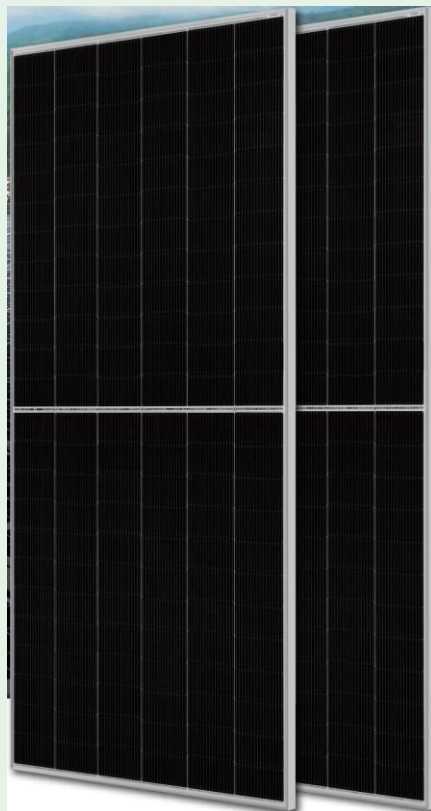
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| Issue Date | 12/09/2023 |
| Valid to | 12/09/2028 |



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www.epditaly.it

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804 +A2



The Norwegian
EPD Foundation

Owner of the declaration:
JA Solar GmbH

Program holder and publisher: The Norwegian EPD foundation

Declaration number:
NEPD-4908-4258-EN

Registration Number:
NEPD-4908-4258-EN

Issue date: 12.09.2023
Valid to: 12.09.2028

Product name

Mono-crystalline Double glass,
N-Type, solar photovoltaic
modules

Manufacturer

JA Solar Technology Co., Ltd.

General information

Product:

Mono-crystalline Double glass, N-Type, solar photovoltaic modules

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-4908-4258-EN

This declaration is based on Product Category Rules:

NPCR 029 2020 Part B for PV modules 1.1

Statements:

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.

Declared unit:

1m² of manufactured photovoltaic module

Declared unit with option:

1m² of manufactured photovoltaic module.

Functional unit:

1 Wp of manufactured photovoltaic module, from cradle-to-grave, with activities needed for a study period for a defined reference service life (≥80% of the labelled power output)

Verification:

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

internal external

Independent verifier approved by EPD Norway



Owner of the declaration:

JA Solar Technology Co., Ltd.

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Manufacturer:

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JA Solar (Xingtai) Co., Ltd.

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Place of production:

China

Management system:

[ISO 14001 fill in]

Organisation no:

DE272082449

Issue date:

12.09.2023

Valid to:

12.09.2028

Year of study:

2023

Comparability:

EPDs from other programmes than [Name of Program operator] may not be comparable.

The EPD has been worked out by:

Laurène MEJEAN - Kasptan



Approved (Manager of EPD Norway)

Product

Product description:

Mono-crystalline solar photovoltaic modules are designed to be installed on roofs or as stand-alone systems for local power production. All the modules included in this EPD are double glass and the solar cells are produced with TOPCON process. Solar cells are assembled together with the EVA, glass, frame and electrical connections to produce the finished solar module in the production factories Hefei and Xingtai in China.

This EPD represents multiples modules with small variations over the size, the number of cells, power... (see table of module characteristics in “Technical details”). The results are calculated based on the maximum inventory amongst the modules. The variation between each module results is lower than 10 %.

Product specification:

The packaging consists of LDPE, PP, paper and a cardboard box, and the panels are delivered on a wooden pallet.

| Materials | KG/DU | % |
|---------------------|----------------|-----|
| Cells | 2.8E-01 | 2% |
| Glass | 1.0E+01 | 76% |
| EVA | 9.5E-01 | 7% |
| Aluminium frame | 1.0E+00 | 8% |
| Junction box | 5.9E-02 | 0% |
| String connector | 2.7E-02 | 0% |
| Cell connector | 8.5E-02 | 1% |
| JB potting silicone | 1.4E-01 | 1% |
| Soldering flux | 7.0E-03 | 0% |
| Packaging | KG/DU | % |
| Wooden pallet | 4.8E-01 | 4% |
| Cardboard | 1.5E-01 | 1% |
| Low density PE | 6.8E-03 | 0% |
| PP | 1.9E-02 | 0% |
| Paper | 1.4E-06 | 0% |

Technical data:

This EPD is valid for the following module types:

- JAM78D40/MB
- JAM72D40/MB
- JAM54D40/MB
- JAM72D42/LB
- JAM66D45/LB

- JAM72D40/GB
- JAM54D40/GB
- JAM54D41/GB
- JAM72D40/LB
- JAM54D40/LB
- JAM54D41/LB

| Characteristics | Unit | JAM78D40/MB | JAM72D40/MB | JAM54D40/MB | JAM72D42/LB | JAM66D45/LB | JAM72D40/GB | JAM54D40/GB | JAM72D40/LB | JAM54D40/LB | JAM54D41/LB | JAM54D41/GB |
|------------------------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Height [m] | m | 2.465 | 2.278 | 1.722 | 2.465 | 2.384 | 2.278 | 1.722 | 2.333 | 1.762 | 1.762 | 1.722 |
| Width [m] | m | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 | 1.134 |
| Area [m ²] | m ² | 2.79531 | 2.583252 | 1.952748 | 2.79531 | 2.703456 | 2.583252 | 1.952748 | 2.645622 | 1.998108 | 1.998108 | 1.952748 |
| Wafer size | mm | 182*182 | 182*182 | 182*182 | 182*199 | 182*210 | 182*185.3 | 182*185.3 | 182*188 | 182*188 | 182*188 | 182*185.3 |
| Power [Wp] | Wp | 600-625 | 555-580 | 410-435 | 605-630 | 585-610 | 565 | 410-435 | 575-600 | 430-455 | 430-455 | 410-435 |
| Bifacial | Y/N | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial | Bifacial |
| Lifetime [year] | Year | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Yearly degradation | % | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| Nb. of cells [pcs] | pcs | 78 | 72 | 54 | 72 | 66 | 72 | 54 | 72 | 54 | 54 | 54 |

This study has been conducted according to the requirements of:

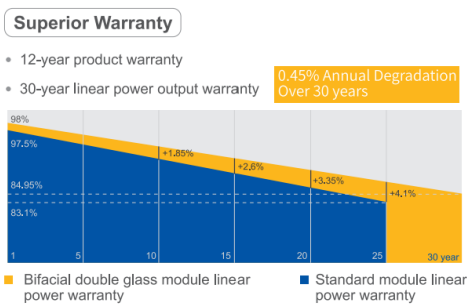
- ISO 14044;
- ISO 14025;
- EN15804+A2:2019;
- NPCR part A “Construction products and services” version 2.0;
- NPCR part B “for photovoltaic modules used in the building and construction industry, including production of cell, wafer, ingot block, solar grade silicon, solar substrates, solar superstrates and other solar grade semiconductor materials” version 1.1.

Market:

World

Reference service life, product:

30 years



LCA: Calculation rules

Declared unit:

1m² of manufactured photovoltaic module

Data quality:

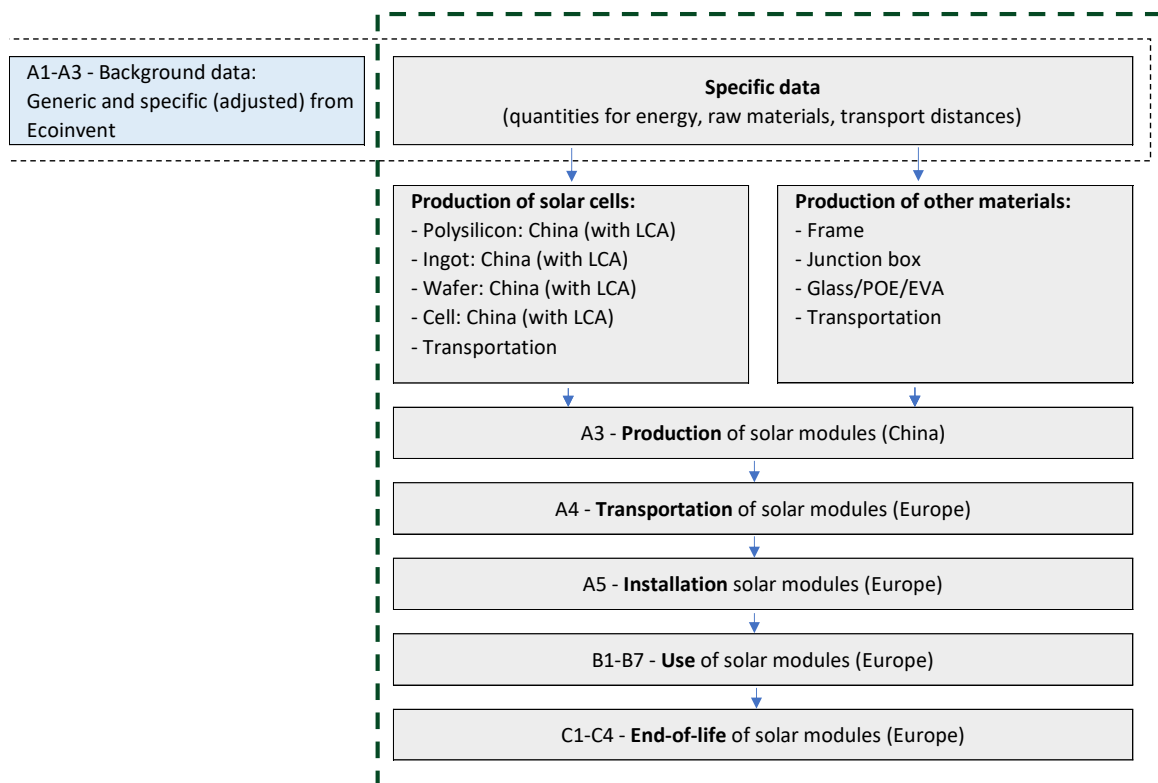
Specific data comes from actual consumption of the module assembly factory (July 2020 – June 2021). This data has been collected by the manufacturer and checked by the LCA practitioner. Generic data is from Ecoinvent v3.6 and SimaPro v9. Characterization factors from EN15804:2012 + A2: 2019. Generic data <10 years old.

Allocation:

The allocation is made in accordance with the provisions of ISO 14025. Incoming energy and water and waste production in-house is allocated equally among all products through mass allocation. Effects of primary production of recycled materials allocated to the main product in which the material was used. The recycling process and transportation of the material is allocated to this analysis

System boundary:

The study is based on a cradle to grave analysis i.e., from raw material extraction to the disposal of waste. A summary of what is included and excluded is shown below:



The PolySi, ingots, wafers, cells and modules are manufactured in China. The supply chain is shown below:

| Production | Site |
|-----------------|------------------|
| Virgin Polysi | Yongxiang, China |
| Ingot/brick | Qujing, China |
| Wafer | Qujing, China |
| Recycled Polysi | Qujing, China |
| Cells | Ningjin, China |

| | |
|---------|--------------------------------|
| Modules | Hefei, China Xingtai, China |
|---------|--------------------------------|

Cut-off criteria:

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

LCA: Scenarios and additional technical information

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

Transport from production place to assembly/user (A4) per declared unit

The transport step A4 covers the transport from the factories in China to the installation site in Europe by sea and road.

| Type | Capacity utilisation (incl. return) % | Type of vehicle | Distance KM | value (tkm) |
|-------|---------------------------------------|-----------------|-------------|-------------|
| Truck | 50% | Lorry, in China | 1000 | 12.63 |
| Boat | 50% | Container ship | 19000 | 240.00 |
| Truck | 50% | Lorry, Europe | 1000 | 12.63 |

Assembly (A5) per declared unit

The modules are installed by hand. The screwdriver electricity consumption is neglected. As in PCR part B, the fasteners (screws) are not included in the LCA. The only impact is the packaging waste given in the table below:

| | Unit | Value |
|---|------|----------|
| Wooden pallet | Kg | 4.80E-01 |
| Cardboard | Kg | 1.50E-01 |
| Low density PE | Kg | 6.79E-03 |
| PP | Kg | 1.91E-02 |
| Paper | Kg | 1.42E-06 |
| Transportation in lorry (Capacity utilisation incl. return : 50%) | Tkm | 6.57E-01 |

Use (B1-B5)

The modules are considered as self-cleaning materials. No maintenance, repair, replacement or refurbishment is required during the module lifetime.

Operational energy (B6) and water consumption (B7)

The modules are producing electricity from sunlight. The energy production during the buildings lifetime is not included in the results. However, the electricity production can be calculated as below:

$$E_{year\ i} = I_{sun} \times S_{1kWp} \times Eff_{panel} \times PR \times D_{panel} \times (1 + b)$$

Where:

- I_{sun} is the sun irradiation received by the module in kWh. m⁻².year⁻¹, which depends on the site location (Norway : 1000 kWh. m⁻².year⁻¹, source : Globas Solar Atlas)

- PR, or Performance Ratio, is the ratio between the energy produced by the panel and the final energy at the output of the photovoltaic system in order to take into account the various losses (Theoretical PR for JA Solar bifacial panels on a PV power plant built in 2023: 85%).
- Eff_{panel} , or panel efficiency, is the ratio between the energy produced and the solar radiation received.
- b is the bifacial gain (5% if bifacial and 0% if monofacial)
- S_{1kWp} is the surface area to get 1 kWp.
- D_{panel} corresponds to the degradation of the panel in year i. This degradation is 2% the first year and then 0.25% per year. $D_{panel} = 0.98 \times (1 - 0.25\%)^{i-1}$

Module production does not require water consumption.

End of Life (C1, C3, C4) per declared unit

The modules are considered as removed by hand. The recycling rates assumed for the LCA are:

- The cells and glass is shredded and recycled at 95%
- The frame is removed and recycled at 100%
- The cable and junction box are recycled at 100%

| | Unit | Value |
|-----------------------------------|------|----------|
| Solid waste, incinerated | Kg | 1.08E+00 |
| Recycling (sorting and shredding) | Kg | 2.34E+01 |

Transport to waste processing (C2) per declared unit

It has been assumed that the modules are collected by truck.

| Type | Capacity utilisation (incl. return) % | Type of vehicle | Distance KM | value (tkm) |
|-------|---------------------------------------|-----------------|-------------|-------------|
| Truck | 50% | Lorry in Europe | 1000 | 12.40 |

LCA: Results

The LCA results show the environmental impacts and resource input and output flows calculated according to ISO 14025 and EN 15804 +A2. The results are shown per functional unit, which for this declaration is 1Wp, as well as per declared unit, which for this declaration is 1 m². The LCA results have been calculated using the LCA software SimaPro 9.

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 | |
|---------------|-----------|---------------|----------------|----------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|----------------------------|-----------|------------------|---|------------------------------------|
| 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 | X | X | X | X | X | X | X | X | X | X | X | X | MNR |

Classification of disclaimers to the declaration of core and additional environmental impact indicators

| ILCD classification | Indicator | Disclaimer |
|---|---|------------|
| ILCD type / level 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 |
| | Acidification potential, Accumulated Exceedance (AP) | None |
| | Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater) | None |
| ILCD type / level 2 | 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 |
| ILCD type / level 3 | Potential Human exposure efficiency relative to U235 (IRP) | 1 |
| | 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 |
| <p>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.</p> <p>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</p> | |

Results presented per functional unit

Core environmental impact indicators (per functional unit - Wp)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|----------------|------------------------|----------|----------|------------------|-------------------|-----------|-------------------|
| GWP-total | kg CO2 eq. | 4.49E-01 | 3.87E-01 | 2.51E-02 | 4.66E-03 | 0.00E+00 | 3.25E-02 |
| GWP-fossil | kg CO2 eq. | 4.44E-01 | 3.85E-01 | 2.51E-02 | 1.71E-03 | 0.00E+00 | 3.24E-02 |
| GWP-biogenic | kg CO2 eq. | 4.84E-03 | 1.81E-03 | 8.82E-06 | 2.95E-03 | 0.00E+00 | 7.67E-05 |
| GWP-LULUC | kg CO2 eq. | 2.87E-04 | 2.57E-04 | 1.36E-05 | 2.87E-07 | 0.00E+00 | 1.68E-05 |
| ODP | kg CFC11 eq. | 2.35E-08 | 1.57E-08 | 5.43E-09 | 1.19E-10 | 0.00E+00 | 2.22E-09 |
| AP | mol H ⁺ eq. | 3.48E-03 | 2.88E-03 | 4.10E-04 | 3.65E-06 | 0.00E+00 | 1.81E-04 |
| EP-freshwater | kg P eq. | 1.51E-05 | 1.43E-05 | 1.58E-07 | 2.58E-08 | 0.00E+00 | 6.51E-07 |
| EP-marine | kg N eq. | 6.13E-04 | 4.66E-04 | 1.10E-04 | 5.74E-06 | 0.00E+00 | 3.17E-05 |
| EP-terrestrial | mol N eq. | 6.89E-03 | 5.30E-03 | 1.22E-03 | 1.40E-05 | 0.00E+00 | 3.59E-04 |
| POCP | kg NMVOC eq. | 2.64E-03 | 2.21E-03 | 3.25E-04 | 4.72E-06 | 0.00E+00 | 9.92E-05 |
| ADP-M&M | kg Sb eq. | 2.89E-05 | 2.64E-05 | 6.44E-08 | 1.90E-09 | 0.00E+00 | 2.45E-06 |
| ADP-fossil | MJ | 4.57E+00 | 3.94E+00 | 3.58E-01 | 8.35E-03 | 0.00E+00 | 2.58E-01 |
| WDP | m ³ | 2.23E-01 | 2.13E-01 | 9.83E-04 | 2.02E-04 | 0.00E+00 | 8.62E-03 |

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

Additional environmental impact indicators (per functional unit - Wp)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|-------------------|----------|----------|------------------|-------------------|-----------|-------------------|
| PM | Disease incidence | 3.59E-08 | 3.27E-08 | 1.64E-09 | 5.21E-11 | 0.00E+00 | 1.53E-09 |
| IRP | kBq U235 eq. | 9.06E-03 | 6.37E-03 | 1.52E-03 | 3.49E-05 | 0.00E+00 | 1.14E-03 |
| ETP-fw | CTUe | 1.83E+01 | 1.70E+01 | 2.70E-01 | 4.01E-02 | 0.00E+00 | 1.00E+00 |
| HTP-c | CTUh | 4.53E-10 | 4.09E-10 | 1.32E-11 | 7.06E-13 | 0.00E+00 | 3.01E-11 |
| HTP-nc | CTUh | 3.13E-08 | 2.93E-08 | 2.61E-10 | 2.32E-11 | 0.00E+00 | 1.67E-09 |
| SQP | Dimensionless | 3.34E+00 | 2.76E+00 | 3.00E-01 | 1.23E-02 | 0.00E+00 | 2.73E-01 |

PM: Particulate matter emissions; **IRP:** Ionising 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

Resource use

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|----------------|----------|----------|------------------|-------------------|-----------|-------------------|
| RPEE | MJ | 1.06E+00 | 8.76E-01 | 3.89E-03 | 4.31E-04 | 0.00E+00 | 1.79E-01 |
| RPEM | MJ | 4.44E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 4.44E-02 |
| TPE | MJ | 1.10E+00 | 8.76E-01 | 3.89E-03 | 4.31E-04 | 0.00E+00 | 2.24E-01 |
| NRPE | MJ | 4.40E+00 | 3.94E+00 | 3.58E-01 | 8.35E-03 | 0.00E+00 | 8.97E-02 |
| NRPM | MJ | 1.68E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.68E-01 |
| TRPE | MJ | 4.56E+00 | 3.94E+00 | 3.58E-01 | 8.35E-03 | 0.00E+00 | 2.57E-01 |
| SM | kg | 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 |
| NRSF | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| W | m ³ | 6.57E-03 | 5.08E-03 | 2.95E-05 | 5.99E-06 | 0.00E+00 | 1.45E-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 (per functional unit - Wp)

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|------|----------|----------|------------------|-------------------|-----------|-------------------|
| HW | KG | 3.05E-02 | 2.76E-02 | 3.26E-04 | 5.58E-04 | 0.00E+00 | 1.95E-03 |
| NHW | KG | 6.14E-01 | 5.43E-01 | 1.76E-02 | 4.10E-03 | 0.00E+00 | 4.96E-02 |
| RW | KG | 1.01E-05 | 6.45E-06 | 2.41E-06 | 5.21E-08 | 0.00E+00 | 1.18E-06 |

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

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

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|------|----------|----------|------------------|-------------------|-----------|-------------------|
| CR | kg | 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 |
| MER | kg | 2.23E-03 | 0.00E+00 | 0.00E+00 | 2.23E-03 | 0.00E+00 | 0.00E+00 |
| EEE | MJ | 8.72E+01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 8.72E+01 | 0.00E+00 |
| ETE | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+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

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

Information describing the biogenic carbon content at the factory gate (per functional unit - Wp)

| Biogenic carbon content | Unit | Value |
|---|------|----------|
| Biogenic carbon content in product | kg C | 0 |
| Biogenic carbon content in the accompanying packaging | kg C | 1.07E-03 |

Results presented per declared unit

Core environmental impact indicators (per declared unit - m2)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|----------------|------------------------|----------|----------|------------------|-------------------|-----------|-------------------|
| GWP-total | kg CO2 eq. | 1.01E+02 | 8.72E+01 | 5.67E+00 | 1.05E+00 | 0.00E+00 | 7.33E+00 |
| GWP-fossil | kg CO2 eq. | 1.00E+02 | 8.67E+01 | 5.66E+00 | 3.86E-01 | 0.00E+00 | 7.31E+00 |
| GWP-biogenic | kg CO2 eq. | 1.09E+00 | 4.07E-01 | 1.99E-03 | 6.65E-01 | 0.00E+00 | 1.73E-02 |
| GWP-LULUC | kg CO2 eq. | 6.48E-02 | 5.78E-02 | 3.07E-03 | 6.48E-05 | 0.00E+00 | 3.79E-03 |
| ODP | kg CFC11 eq. | 5.30E-06 | 3.55E-06 | 1.22E-06 | 2.68E-08 | 0.00E+00 | 5.00E-07 |
| AP | mol H ⁺ eq. | 7.83E-01 | 6.49E-01 | 9.24E-02 | 8.23E-04 | 0.00E+00 | 4.09E-02 |
| EP-freshwater | kg P eq. | 3.41E-03 | 3.22E-03 | 3.56E-05 | 5.82E-06 | 0.00E+00 | 1.47E-04 |
| EP-marine | kg N eq. | 1.38E-01 | 1.05E-01 | 2.48E-02 | 1.29E-03 | 0.00E+00 | 7.15E-03 |
| EP-terrestrial | mol N eq. | 1.55E+00 | 1.19E+00 | 2.75E-01 | 3.16E-03 | 0.00E+00 | 8.09E-02 |
| POCP | kg NMVOC eq. | 5.95E-01 | 4.99E-01 | 7.32E-02 | 1.06E-03 | 0.00E+00 | 2.23E-02 |
| ADP-M&M | kg Sb eq. | 6.52E-03 | 5.95E-03 | 1.45E-05 | 4.29E-07 | 0.00E+00 | 5.51E-04 |
| ADP-fossil | MJ | 1.03E+03 | 8.88E+02 | 8.06E+01 | 1.88E+00 | 0.00E+00 | 5.83E+01 |
| WDP | m ³ | 5.02E+01 | 4.80E+01 | 2.22E-01 | 4.55E-02 | 0.00E+00 | 1.94E+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*

Additional environmental impact indicators (per declared unit - m2)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|-------------------|----------|----------|------------------|-------------------|-----------|-------------------|
| PM | Disease incidence | 8.10E-06 | 7.37E-06 | 3.69E-07 | 1.17E-08 | 0.00E+00 | 3.44E-07 |
| IRP | kBq U235 eq. | 2.04E+00 | 1.44E+00 | 3.42E-01 | 7.88E-03 | 0.00E+00 | 2.56E-01 |
| ETP-fw | CTUe | 4.12E+03 | 3.82E+03 | 6.08E+01 | 9.04E+00 | 0.00E+00 | 2.26E+02 |
| HTP-c | CTUh | 1.02E-07 | 9.22E-08 | 2.99E-09 | 1.59E-10 | 0.00E+00 | 6.79E-09 |
| HTP-nc | CTUh | 7.05E-06 | 6.61E-06 | 5.88E-08 | 5.22E-09 | 0.00E+00 | 3.77E-07 |
| SQP | Dimensionless | 7.53E+02 | 6.21E+02 | 6.77E+01 | 2.76E+00 | 0.00E+00 | 6.16E+01 |

***PM**: Particulate matter emissions; **IRP**: Ionising 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*

Resource use (per declared unit - m2)

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|----------------|----------|----------|------------------|-------------------|-----------|-------------------|
| RPEE | MJ | 2.39E+02 | 1.98E+02 | 8.76E-01 | 9.71E-02 | 0.00E+00 | 4.04E+01 |
| RPEM | MJ | 1.00E+01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.00E+01 |
| TPE | MJ | 2.49E+02 | 1.98E+02 | 8.76E-01 | 9.71E-02 | 0.00E+00 | 5.04E+01 |
| NRPE | MJ | 9.91E+02 | 8.89E+02 | 8.06E+01 | 1.88E+00 | 0.00E+00 | 2.02E+01 |
| NRPM | MJ | 3.79E+01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.79E+01 |
| TRPE | MJ | 1.03E+03 | 8.88E+02 | 8.06E+01 | 1.88E+00 | 0.00E+00 | 5.80E+01 |
| SM | kg | 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 |
| NRSF | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| W | m ³ | 1.48E+00 | 1.15E+00 | 6.65E-03 | 1.35E-03 | 0.00E+00 | 3.26E-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 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 (per declared unit - m2)

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|------|----------|----------|------------------|-------------------|-----------|-------------------|
| HW | KG | 6.86E+00 | 6.22E+00 | 7.36E-02 | 1.26E-01 | 0.00E+00 | 4.39E-01 |
| NHW | KG | 1.38E+02 | 1.22E+02 | 3.96E+00 | 9.23E-01 | 0.00E+00 | 1.12E+01 |
| RW | KG | 2.27E-03 | 1.45E-03 | 5.43E-04 | 1.17E-05 | 0.00E+00 | 2.67E-04 |

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

End of life – output flow (per declared unit - m2)

| Parameter | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|-----------|------|----------|----------|------------------|-------------------|-----------|-------------------|
| CR | kg | 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 |
| MER | kg | 5.03E-01 | 0.00E+00 | 0.00E+00 | 5.03E-01 | 0.00E+00 | 0.00E+00 |
| EEE | MJ | 1.96E+04 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.96E+04 | 0.00E+00 |
| ETE | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+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

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

Information describing the biogenic carbon content at the factory gate (per declared unit - m2)

| Biogenic carbon content | Unit | Value |
|---|------|----------|
| Biogenic carbon content in product | kg C | 0 |
| Biogenic carbon content in the accompanying packaging | kg C | 2.40E-01 |

Additional requirements

Greenhous gas emission from the use of electricity in the manufacturing phase

Regional production mix from import, high voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing prosess(A3).

| Regional electricity grid | Unit | Value |
|---|----------------|-------|
| Electricity, high voltage {CN-SC} – China, Sichuan : Ecoinvent v3.8 | kg CO2 -eq/kWh | 0,297 |
| Electricity, high voltage {CN-YN} – China, Yunnan : Ecoinvent v3.8 | kg CO2 -eq/kWh | 0,476 |
| Electricity, high voltage {CN-HB} – China, Hebei : Ecoinvent v3.8 | kg CO2 -eq/kWh | 1,26 |
| Electricity, high voltage {CN-AH} – China, Anhui : Ecoinvent v3.8 | kg CO2 -eq/kWh | 1,06 |

Additional environmental impact indicators required in NPCR Part A for construction products

In order to increase the transparency of biogenic carbon contribution to climate impact, the indicator for GWP has been sub-divided into the following:

GWP-IOBC Climate impacts calculated according to the principle of instantaneous oxidation
GWP-BC Climate impacts from the net uptake and emission of biogenic carbon from each module.

In addition, EP-freshwater shall also be declared as PO4 eq.

Additional environmental impact indicators required in NPCR Part A (per functional unit - Wp)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|----------------|------------|----------|----------|------------------|-------------------|-----------|-------------------|
| EP-freshwater* | kg PO4 eq. | 7.00E-06 | 6.61E-06 | 7.31E-08 | 1.20E-08 | 0.00E+00 | 3.02E-07 |
| GWP-IOBC | kg CO2 eq. | 4.44E-01 | 3.85E-01 | 2.51E-02 | 1.71E-03 | 0.00E+00 | 3.24E-02 |
| GWP-BC | kg CO2 eq. | 3.91E-03 | 3.91E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| GWP | kg CO2 eq. | 4.48E-01 | 3.89E-01 | 2.51E-02 | 1.71E-03 | 0.00E+00 | 3.24E-02 |

EP-freshwater* Eutrophication potential, fraction of nutrients reaching freshwater end compartment. Declared as PO4 eq. **GWP-IOBC** Global warming potential calculated according to the principle of instantaneous oxidation. **GWP-BC** Global warming potential from net uptake and emissions of biogenic carbon from the materials in each module. **GWP** Global warming potential.

Additional environmental impact indicators required in NPCR Part A (per declared unit - m2)

| Indicator | Unit | Total | A1-A3 | A4- Distribution | A5 - Installation | B - Usage | C1-C4 End of life |
|----------------|------------|----------|----------|------------------|-------------------|-----------|-------------------|
| EP-freshwater* | kg PO4 eq. | 1.58E-03 | 1.49E-03 | 1.65E-05 | 2.69E-06 | 0.00E+00 | 6.80E-05 |
| GWP-IOBC | kg CO2 eq. | 1.00E+02 | 8.67E+01 | 5.66E+00 | 3.86E-01 | 0.00E+00 | 7.31E+00 |
| GWP-BC | kg CO2 eq. | 8.81E-01 | 8.81E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| GWP | kg CO2 eq. | 1.01E+02 | 8.76E+01 | 5.66E+00 | 3.86E-01 | 0.00E+00 | 7.31E+00 |

EP-freshwater* Eutrophication potential, fraction of nutrients reaching freshwater end compartment. Declared as PO4 eq. **GWP-IOBC** Global warming potential calculated according to the principle of instantaneous oxidation. **GWP-BC** Global warming potential from net uptake and emissions of biogenic carbon from the materials in each module. **GWP** Global warming potential.

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 no substances given by the REACH Candidate list or the Norwegian priority list.

Indoor environment

No tests have been carried out on the product concerning indoor climate.

Carbon footprint (A1-C4)

The carbon footprint per kWh with a production in Norway ($I_{\text{rad}}=1000 \text{ kWh} \cdot \text{m}^{-2} \cdot \text{year}^{-1}$) is 18,55 gCO₂-eq / kWh.

The carbon footprint per kWh with a production in Italy ($I_{\text{rad}}=1600 \text{ kWh} \cdot \text{m}^{-2} \cdot \text{year}^{-1}$) is 11,59 gCO₂-eq / kWh.

Extrapolation rules

Solar Irradiation





The amount of electricity produced by the solar panels depends on the solar irradiation. The results are given with a default irradiation in Norway $I_{soleil} = 1000 \text{ kWh} \cdot \text{m}^{-2} \cdot \text{year}^{-1}$. For a site with a different irradiation I_{site} the result can be extrapolated by multiplying “Exported energy - electricity” by the ratio $\frac{I_{site}}{I_{soleil}}$.

For example if $I_{site} = 1600 \text{ kWh} \cdot \text{m}^{-2} \cdot \text{year}^{-1}$ and for I_{soleil} , Exported energy - electricity = $8,72 \times 10^1$

$$\text{Exported energy - electricity}_{I_{site}} = (8,72 \times 10^1) \times \frac{1600}{1000}$$

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 |

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