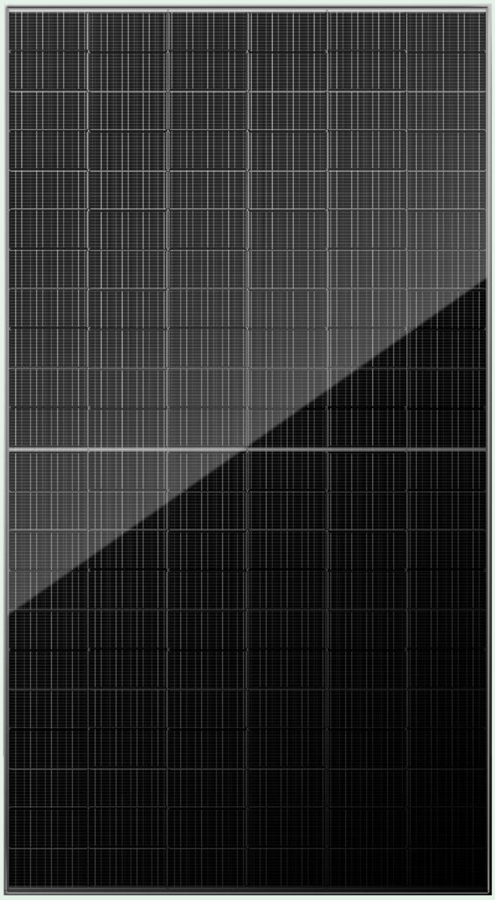
# Environmental Product Declaration

In accordance with 14025 and EN15804 +A2

132 HIGH PERFORMANCE MONOCRYSTALLINE HJT MODULE



**Owner of the declaration:**
Risen Energy Co., Ltd.

**Product name:**
Mono-crystalline Photovoltaic module

**Functional unit:**
1 Wp

**Product category /PCR:**
NPCR 029 Part B Version: 1.2

**Program holder and publisher:**
The Norwegian EPD foundation

**Declaration number:**
NEPD-5523-4819-EN

**Registration number:**
NEPD-5523-4819-EN

**Issue date:**
08.12.2023

**Valid to:**
08.12.2028

The Norwegian
EPD Foundation

# General information

## Product:
RSM132-8-xxxBHDG (Power rating: 650-715W)

## 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-5523-4819-EN

## This declaration is based on Product Category Rules:
NPCR 029 Part B Version: 1.2, 2022-03-31

## 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 evidences.

## Functional unit:
1 Wp

## System boundary:
Cradle to grave

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

internal ☐ external ☒

Gaylord K. Booto
Independent verifier approved by EPD Norway

## Owner of the declaration:
Risen Energy Co., Ltd.
Contact person: Mr. Yang shubo
Phone: 86-574-59953588
e-mail: yangsb@risenenergy.com

## Manufacturer:
Risen Energy (Changzhou) Co., Ltd.

## Place of production:
No.1, Shuinan Road, Industrial Concentration Area, Zhixi Town, Jintan District, Changzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

## Management system:
ISO 9001, ISO 14001, ISO 45001

## Organisation no:
91330201449739014

## Issue date:
05.12.2023

## Valid to:
05.12.2028

## Year of study:
2023

## Comparability:
EPD of construction products may not be comparable if they do not comply with EN 15804.

## The EPD has been worked out by:
TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch, Tian Hongyu

Approved

Manager of EPD Norway

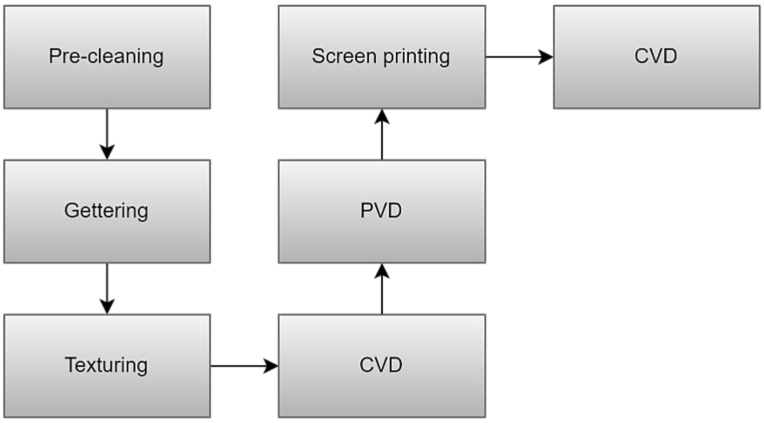
# Product

## Product description:

Risen Energy produces series of crystalline silicon photovoltaic (PV) modules. In this study, 1 type of Heterojunction module is included. The module uses industry-leading cell production with thin wafer and HJT encapsulation technology. And it has high power generation performance due to its stable power temperature coefficient and ultra-high bifacial technology. Function of the PV module is to generate electricity. For Building-Integrated-PV (BIPV) applications there is an additional function of providing roofing to the building.

The manufacturing processes of solar cells and PV modules production of Risen Energy are presented as following:

**Processes of heterojunction solar cells production**




**Step 1 Pre-cleaning**

There is a damaged layer in the cutting of silicon wafer, which contains dirty impurities, which affects the absorption effect, and is removed by pre-cleaning alkali solution

**Step 2 Gettering**

The gettering technology can reduce the metal impurity pollution caused by the processing of silicon wafers and is an effective way to improve the performance of silicon wafers. The metal impurity content of silicon wafers can be effectively reduced through the tube test diffusion of phosphorus source or the chain coating of phosphorus slurry.

**Step 3 Texturing**

To enhance the cell absorbing capability of solar light, silicon surfaces need to be textured into pyramids in micrometer-order, taking advantage of varied etch rates of wafer`s different crystal orientations by alkali solution.

**Step 4 Chemical vapor deposition (CVD)**

The function of CVD is to deposit intrinsic and doped silicon layers by plasma. The excellent passivation effect of amorphous silicon is used to achieve superior surface passivation, which can greatly increase the minority carrier lifetime of cells.

**Step 5 Physical vapor deposition (PVD)**

The role of PVD is to sputter "Transparent Conductive Oxide (TCO)" layers on the microcrystalline silicon layers of the front side and back side of the cell. The Argon ions generated by the glow discharge bombard the cathode target at high speed under the force of electric field, causing the atoms or molecules of the target to sputter onto the surface of the silicon wafer to form the required transparent conductive layers.

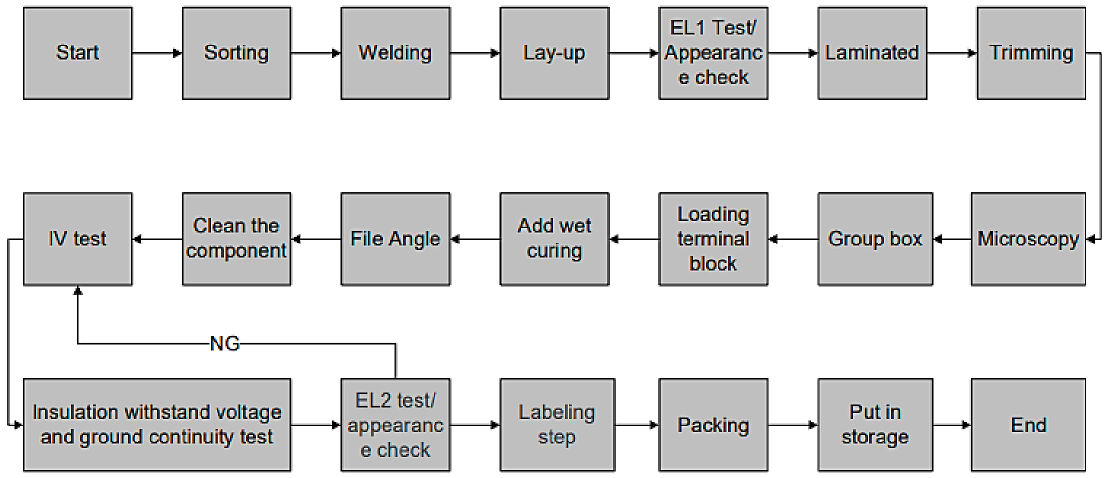
**Step 6 Screen printing**

Silver and aluminum pastes are screens printed on both sides to create designated patterns for effective carrier transport contacts.

**Step 7 Inspection**

Make final visual and functional inspection, and then sort them to corresponding cell boxes.

**Processes of PV modules production**




**Step 1: Sorting**

Sort the batteries which meet the requirements of the order and check whether they conform to the standards. Prepare for welding procedure.

**Step 2: Welding**

Solder the positive and negative electrodes of the single-welded batteries together to form a battery string and prepare for the lamination process. Repair the nonconforming battery string.

**Step 3: Lay-up**

Connect the soldered battery strings with busbar, and play glass, EVA film, TPT or glass back plate to protect the battery.

**Step 4: EL1 test/Appearance check**

Conduct appearance and Electroluminescent imaging (El) inspection on the PV modules before lamination.

**Step 5: Lamination**

Preliminary inspection on the appearance and EL of laminated components to improve yield and product quality. Rework the undesirable laminated components.

**Step 6: Laminated**

The lamination process is to melt EVA and solidify the laminate at a certain temperature. Laminating process is a key step of component production, which has a key influence on the quality of component products.

**Step 7: Trimming**

Trim the laminated components to prepare the frame.

**Step 8: Microscopy**

Re-check the laminated components, isolate the defective products timely and give feedback to improve the quality of components.

**Step 9: Group box**

The profile and junction box are mounted with sealed silicone on laminates to increase component strength, further seal the battery assembly, and extend the service life of the components. Put the automatic glue uneven secondary tonic. Install aluminum frame and junction box on the laminate with sealed silica gel, increase the strength of the component, further seal the battery component, and extend the service life of the component.

**Step 10: Loading terminal block**

The junction box is glued with silicone to the back of the assembly and the lead-out wire is welded to make the assembly and the wire box work. Then in the AB glue potting.

**Step 11: Add wet curing**

Solidify the assembled components and place the poor sealing of components to prepare for cleaning.

**Step 12: File Angle**

Fix and polish the four corners of the component.

**Step 13: Clean the component**

The silica gel and other dirt on the surface of the component shall be cleaned with alcohol to make the appearance of the component clean and beautiful, and check whether the appearance of the component meets the standards.

**Step 14: IV test**

Verify the output power of the battery component, test its output characteristics, and determine the power level of the component.

**Step 15: Insulation withstand voltage and ground continuity test**

Insulation test: test whether the current-carrying part of the component is well insulated with the frame or external; Voltage withstand test: the insulation material and insulation structure of the voltage withstand test; Grounding test: to determine whether the safety grounding wire can bear the current flow of the fault under the condition of the fault of the measured object.

**Step 16: EL2 test/appearance check**

Check whether there is any problem with battery cells in the component, such as hidden cracking, fragment, black plate, etc., and determine the level of component EL.

**Step 17: Labeling step**

Separate components in different gear positions to prepare for packaging.

**Step 18: Packing**

Packing finished components in specified quantity for easy transportation and sale.

**Step 19: Put in storage**

Put the packed components into the warehouse procedure.

## Product specification:

RSM132-8-xxxBHDG is bifacial heterojunction double glass module that applied 132 pieces of 210mm half- cut heterojunction cells. The PV modules comply with the requirement of IEC 61215 :2016 series and IEC 61730:2016 series test standards.

| Materials | KG | % |
|---|---|---|
| Glass | 4.43E-02 | 73.11 |
| PVB | 2.59E-03 | 4.26 |
| Frame | 1.14E-02 | 18.84 |
| Cell connector | 2.80E-04 | 0.46 |
| String connector | 7.76E-05 | 0.13 |
| Cell | 1.05E-03 | 1.73 |
| Junction box | 1.59E-04 | 0.26 |
| Glue | 2.94E-04 | 0.48 |
| Silicone adhesive | 4.36E-04 | 0.72 |

## Technical data:

| Technical parameters | RSM132-8-xxxBHDG |
|---|---|
| Power output (W) | 650-715 |
| Dimension (mm) | 2384*1303*35 |
| Area (m2) | 3.11 |
| Converting factor (Wp/m2) | 229.9 |
| Weight (kg) | 41 |
| Degradation (%) | 0.3 |

## Market:

Global

## Reference service life, product:

A standard reference service life of 25 years for ≥80% of the labelled power output is used.

# LCA: Calculation rules

## Functional unit:

In this report, the functional unit is defined as 1 Wp of manufactured photovoltaic module, from cradle-to-grave, with activities needed for a study period for a RSL of 25 years.

## Data quality:

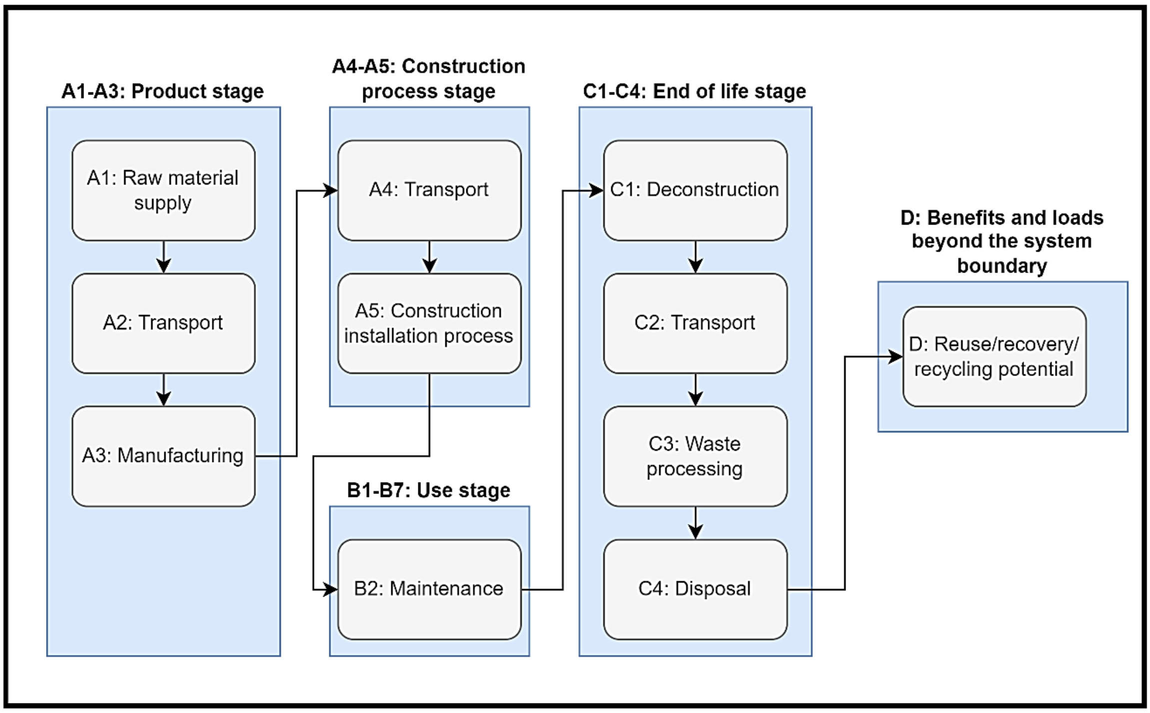
The inventory is based on the collection of measured data in the manufacturer plant from 2021-12-01 to 2022-11-30. A high accuracy and quality are expected for specific data. Missing data are completed by data from secondary database, wafer and ingot production is from IEA PVPS Task 12, 2020 report . Consistency checks are performed. Data quality of the main contributors are improved when possible. Generic data related to the life cycle impacts of the material or energy flows that enter and leave the production system is sourced from Ecoinvent 3.8 "allocation, cut-off by allocation - unit" database.

## Allocation:

In this study, raw materials as well as packaging materials of different solar cells and PV modules are based on the BOM from Risen Energy, no allocation is used at the stage. For input and output flows during manufacturing processes such as electricity, auxiliary consumption, emissions and waste, the allocation is based on the amounts for solar cells and power rating for PV modules.

## System boundary:

The study is a cradle to grave analysis from the extraction of raw materials up to the decommission of the product, including raw materials acquisition, transportation, manufacturing, delivery, installation, maintenance and waste disposal for end-of-life, benefits and loads after end-of-life.




## Cut-off criteria:

In case of insufficient input data or data gaps for a unit process, according to the PCR requirement, the cut-off criteria chosen is 2% of the total mass and energy of that unit process. (Respectively, of the photovoltaic module's unit weight and the energy needed to produce and assemble it).

The total of neglected input flows per module, e.g., per module A1-A3, A4-A5, B2, C1-C4 is maximum 2% of energy usage and mass.

In this study, no flows are cut off, all available energy and material flows have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

# LCA: Scenarios and additional technical information

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

For road transportation, lorry of EURO6, 16-32 metric ton is used for modelling, while container ship is used for sea transportaion. Since the inventory of Risen Energy only includes the transportation from the factory to arriving ports, the distance from the arrival ports to PV plant site is assumed as 500km for modelling the distribution of PV modules.

## Transport from production place to assembly/user (A4)

| Type | Capacity utilisation (incl. return) % | Type of vehicle | Distance KM | Fuel/Energy consumption | value (kg/tkm) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Truck | 36.7 | EURO6, 16-32 metric ton | 930 | Diesel | 0.037 |
| Container ship | 70 | Container ship | 19240 | Heavy oil | 0.0025 |

## Assembly (A5)

According to NPCR 029 Part B, the waste treatment of packaging, energy use during installation shall be included. The electricity consumption and diesel consumption during installation stage is scaled up based on the data from Ecoinvent database value (36.03 kWh/570kWp and 7673 MJ/570kWp respectively) according to the power rating of PV modules. The compositions of the packing waste are mainly waste pallet, waste corrugated box, waste kraft paper and plastic packaging film. The disposal is assumed 100% incineration for plastic packaging film and 100% recycling for the rest of waste packaging materials. The transportation distance to disposal site is assumed as 50km.

| | Unit | Value |
|---|---|---|
| Auxiliary | Kg | - |
| Water consumption | m3 | - |
| Electricity consumption | kWh | 4.52E-02 |
| Other energy carriers ( diesel) | MJ | 9.62E+00 |
| Material loss | Kg | - |
| Output materials from waste treatment | Kg | 1.24E-00 |
| Dust in the air | kg | - |

## Use (B1)

There are no material or energy inputs, nor emissions during the use phase (B1) of the PV module.

## Maintenance (B2)/Repair (B3)

During the maintenance stage (B2), water used for cleaning is assumed 0.3L per module per time and cleaning frequency is two time per year. And it assumed small manual systems with handheld that spray water onto panels are used, no electricity consumption during the cleaning process. And the PV modules do not require repair during its RSL.

| | Unit | Value |
|---|---|---|
| Maintenance cycle* | frequency/year | 2 |
| Auxiliary | kg | - |
| Other resources | kg | - |
| Water consumption | m3/year | 0.0003 |
| Electricity consumption | kWh | - |

| | | |
|---|---|---|
| Other energy carriers | MJ | - |
| Material loss | Kg | - |

## Replacement (B4)/Refurbishment (B5)

It is assumed that the PV module itself does not require replacement and refurbishment during its RSL.

## Operational energy (B6) and water consumption (B7)

There is no operational energy and water consumption needed in life stage B6 and B7 respectively. The energy produced by a PV module depends on the installed power peak [Wp], degradation factor, geographic location, and direction/placement of the installation. The calculation formula of energy production are as follows:

- $S_{rad}$= Site specific annual average solar radiation on module (shadings not included), kWh/kWp/year. The annual radiation must take into consideration the specific inclination (slope, tilt) and orientation.
- A = Area of module, from functional unit (FU), m2 (stated in the EPD).
- y = Module yield: electrical power, kWp for standard test conditions (STC) of the module divided by the area of the module (stated in the EPD).
- deg = yearly degradation rate (stated in the EPD).
- RSL = Reference service life for energy-producing unit, from functional unit (FU), stated in the EPD.
- PR = Performance ratio, coefficient for losses. Site specific performance ratio can be modelled with PV simulation software tools, such as PVSyst or similar.

**<u>Energy production in the first year of operation:</u>**

$E1=S_{rad}*A*y*PR*(1-deg)$

**<u>Energy production over reference service life of module：</u>**

$E_{RSL}=E1*(1+\sum_{n=1}^{RSL-1}(1-\text{deg})^{n})$

## End of Life (C1, C3, C4)

For the end-of-life stage, default scenarios in section 6.3.8.4 of NPCR 029 version 1.2 of EPD Norway are used. De-construction (C1) is assumed mainly energy use for onsite dismantling and the energy use is assumed the same as the construction stage (A5). The electricity consumption for demolition of PV modules and sorting of waste (C3) is assumed the same as the manufacture stage (A3) of PV modules.  For the end-of-life disposal stage (C4), the recycling rate for waste glass and waste solar cells are assumed as 85%, while the refused parts are disposed with land filling. And the waste steel and waste copper are assumed as 100% recycled. Waste junction box, waste silicon adhesive, glue, PVB is end up with incineration while the incineration ash of landfilling is assumed 10% of the waste for incineration.

| | Unit | Value |
|---|---|---|
| Hazardous waste disposed | Kg | - |
| Collected as mixed construction waste | Kg | - |
| Reuse | Kg | - |

| | | |
|---|---|---|
| Recycling | Kg | 3.60E+01 |
| Energy recovery | Kg | 2.48E+00 |
| To landfill | Kg | 5.12E+00 |

## Transport to waste processing (C2)

Transport distance of 50 km is assumed for transporting to waste processing site (C2).

| Type | Capacity utilisation (incl. return) % | Type of vehicle | Distance KM | Fuel/Energy consumption | value (kg/tkm) |
|---|---|---|---|---|---|
| Truck | 36.7 | EURO6, 16-32 metric ton | 50 | Diesel | 0.037 |

## Benefits and loads beyond the system boundaries (D)

In the disposal stage, 100% of metal scrap and 85% of glass scrap and waste solar cells are recycled. Plastic components will be incinerated with energy recovery while recycled materials will be used as substitution of primary material.

| | Unit | Value |
|---|---|---|
| Substitution of primary glass with glass cullet | kg | 2.69E+01 |
| Substitution of primary iron with iron scrap | kg | 5.50E+00 |
| Substitution of primary copper with net scrap | kg | 2.56E-01 |
| Substitution of MG silicon with recycled silicon | kg | 6.36E-01 |
| Electrical energy recovery | MJ | 3.45E+00 |
| Thermal energy recovery | MJ | 7.08E+00 |

# LCA: Results

The core environmental impact results are calculated basing on the highest rating of the module type and expressed per functional unit. The LCA results been calculated by using SimaPro 9.3 LCA software.

## 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 | MNR | X | MNR | MNR | MNR | MNR | MNR | X | X | X | X | X |

## Core environmental impact indicators

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| GWP-total | kg CO2 eq. | 3.90E-01 | 2.01E-02 | 1.37E-03 | 7.06E-06 | 1.26E-03 | 4.68E-04 | 9.48E-03 | 6.56E-03 | -7.05E-03 |
| GWP-fossil | kg CO2 eq. | 3.90E-01 | 2.00E-02 | 1.31E-03 | 6.91E-06 | 1.26E-03 | 4.67E-04 | 6.71E-03 | 4.47E-04 | -6.13E-03 |
| GWP-biogenic | kg CO2 eq. | -5.83E-04 | 3.76E-06 | 5.69E-05 | 1.41E-07 | 1.21E-06 | 4.03E-07 | 2.76E-03 | 5.73E-03 | -8.38E-04 |
| GWP-LULUC | kg CO2 eq. | 2.76E-04 | 1.17E-05 | 1.89E-07 | 1.20E-08 | 1.83E-07 | 1.87E-07 | 1.16E-05 | 2.85E-08 | -4.49E-06 |
| ODP | kg CFC11 eq. | 1.77E-08 | 4.14E-09 | 2.69E-10 | 4.62E-13 | 2.66E-10 | 1.08E-10 | 2.61E-10 | 2.60E-11 | -5.80E-10 |
| AP | mol $H^+$ eq. | 2.37E-03 | 3.75E-04 | 1.31E-05 | 3.85E-08 | 1.30E-05 | 1.33E-06 | 2.89E-05 | 1.11E-06 | -3.46E-05 |
| EP-freshwater | kg P eq. | 5.56E-05 | 1.17E-07 | 6.92E-09 | 5.38E-10 | 6.78E-09 | 3.33E-09 | 5.25E-07 | 3.59E-08 | -1.39E-07 |
| EP-marine | kg N eq. | 5.62E-04 | 9.10E-05 | 5.72E-06 | 6.24E-09 | 5.71E-06 | 2.63E-07 | 4.01E-06 | 8.65E-06 | -6.65E-06 |
| EP-terrestial | mol N eq. | 5.07E-03 | 1.01E-03 | 6.28E-05 | 7.05E-08 | 6.26E-05 | 2.94E-06 | 4.57E-05 | 3.45E-06 | -7.27E-05 |
| POCP | kg NMVOC eq. | 1.38E-03 | 2.69E-04 | 1.73E-05 | 2.30E-08 | 1.72E-05 | 1.13E-06 | 1.24E-05 | 2.41E-06 | -2.78E-05 |
| ADP-M&M | kg Sb eq. | 1.43E-05 | 4.71E-08 | 9.25E-10 | 3.42E-11 | 8.68E-10 | 1.66E-09 | 4.57E-08 | 5.35E-10 | -3.24E-08 |
| ADP-fossil | MJ | 4.29E+00 | 2.75E-01 | 1.77E-02 | 1.19E-04 | 1.75E-02 | 7.08E-03 | 1.05E-01 | 2.22E-03 | -6.44E-02 |
| WDP | $m^3$ | 2.08E-01 | 7.19E-04 | 3.85E-05 | 9.02E-04 | 3.28E-05 | 2.15E-05 | 1.45E-03 | 1.25E-05 | -7.04E-04 |

***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 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

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| PM | Disease incidence | 2.65E-08 | 1.07E-09 | 3.46E-10 | 3.55E-13 | 3.45E-10 | 3.75E-11 | 8.58E-11 | 1.38E-11 | -2.10E-10 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| IRP | kBq U235 eq. | 8.00E-03 | 1.16E-03 | 7.80E-05 | 8.36E-07 | 7.70E-05 | 3.07E-05 | 9.23E-04 | 1.48E-05 | -2.11E-04 |
| ETP-fw | CTUe | 2.20E+01 | 2.03E-01 | 1.06E-02 | 1.26E-04 | 1.03E-02 | 5.56E-03 | 7.47E-02 | 4.22E-02 | -2.14E-01 |
| HTP-c | CTUh | 1.59E-09 | 9.96E-12 | 4.11E-13 | 2.91E-14 | 3.94E-13 | 1.79E-13 | 2.53E-12 | 5.11E-12 | -1.85E-11 |
| HTP-nc | CTUh | 5.67E-08 | 1.66E-10 | 8.10E-12 | 4.09E-13 | 7.53E-12 | 5.61E-12 | 8.32E-11 | 3.59E-11 | -8.33E-11 |
| SQP | Dimensionless | 1.73E+00 | 1.13E-01 | 2.42E-03 | 2.68E-05 | 2.26E-03 | 4.93E-03 | 1.95E-02 | 4.74E-03 | -7.09E-02 |

***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

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| RPEE | MJ | 8.14E-01 | 2.54E-03 | 2.06E-04 | 1.64E-05 | 2.02E-04 | 1.01E-04 | 2.09E-02 | 3.11E-04 | -5.25E-02 |
| RPEM | MJ | 2.39E-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 |
| TPE | MJ | 8.38E-01 | 2.54E-03 | 2.06E-04 | 1.64E-05 | 2.02E-04 | 1.01E-04 | 2.09E-02 | 3.11E-04 | -5.25E-02 |
| NRPE | MJ | 4.25E+00 | 2.75E-01 | 1.77E-02 | 1.19E-04 | 1.75E-02 | 7.08E-03 | 1.05E-01 | 2.22E-03 | -6.44E-02 |
| NRPM | MJ | 3.07E-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 |
| TRPE | MJ | 4.29E+00 | 2.75E-01 | 1.77E-02 | 1.19E-04 | 1.75E-02 | 7.08E-03 | 1.05E-01 | 2.22E-03 | -6.44E-02 |
| SM | kg | 1.09E-02 | 3.76E-04 | 1.32E-05 | 1.41E-06 | 1.38E-05 | 6.12E-06 | -5.34E-06 | 1.93E-06 | -7.98E-03 |
| 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 |
| 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 |
| W | $m^3$ | 5.48E-03 | 2.40E-05 | 1.53E-06 | 2.11E-05 | 1.42E-06 | 8.01E-07 | 9.26E-05 | 3.06E-06 | -2.92E-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*

## End of life – Waste

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| HW | KG | 3.05E-04 | 4.92E-07 | 4.75E-08 | 2.09E-10 | 4.69E-08 | 1.85E-08 | 8.27E-08 | 7.21E-09 | -5.47E-08 |
| NHW | KG | 5.35E-02 | 7.47E-03 | 3.97E-05 | 1.56E-06 | 2.45E-05 | 3.70E-04 | 5.53E-04 | 7.52E-03 | -1.73E-03 |
| RW | KG | 7.11E-06 | 1.85E-06 | 1.23E-07 | 7.11E-10 | 1.21E-07 | 4.78E-08 | 7.63E-07 | 1.52E-08 | -2.27E-07 |

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

## End of life – output flow

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | 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 |
| MR | kg | 8.78E-04 | 0.00E+00 | 1.65E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 5.04E-02 | 0.00E+00 | 0.00E+00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MER | kg | 2.61E-05 | 0.00E+00 | 7.41E-05 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.47E-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 | 4.83E-03 |
| 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 | 9.90E-03 |

*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

| Biogenic carbon content | Unit | Value |
|---|---|---|
| Biogenic carbon content in product | kg C | **0** |
| Biogenic carbon content in the accompanying packaging | kg C | 5.74E-01 |

# Additional requirements

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

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

| National electricity grid | Unit | Value |
|---|---|---|
| China electricity grid mix (Electricity, medium voltage {CN}\| market group for \| Cut-off, U from Ecoinvent 3.8) | kg CO2 -eq/kWh | 1.02 |

## 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 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.

| Indicator | Unit | A1-A3 | A4 | A5 | B2 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| GWP-IOBC | kg CO2 eq. | 3.90E-01 | 2.00E-02 | 1.31E-03 | 6.91E-06 | 1.26E-03 | 4.67E-04 | 6.71E-03 | 4.47E-04 | -6.13E-03 |

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

## Hazardous substances

The samples of RSM132-8-xxxBHDG have been tested according to USEPA 200.8-1994 method (Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry) and USEPA 7473-2007 method (Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry). The PV modules have passed the tests. Test reports are available upon request to EPD owner.

## Indoor environment

Not relevant for outdoor products.

# Bibliography


1. ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework
2. ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
3. EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
4. ISO 14025: 2006: Environmental labels and declarations - Type III environmental declarations - principles and procedures.
5. ISO 21930:2007 Sustainability in building construction - Environmental declaration of building products
6. General Programme Instructions for The Norwegian EPD Foundation version 3:2019 updated 250523
7. NPCR Part A: Construction products and services. Version: 2.0.
8. NPCR 029 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: 1.2
9. Ecoinvent database 3.8, http://www.ecoinvent.org.
10. Rolf Frischknecht, Philippe Stolz, Luana Krebs, Mariska de Wild-Scholten, Parikhit Sinha, Life Cycle Inventories and Life Cycle Assessment of Photovoltaic Systems, International Energy Agency (IEA) PVPS Task 12: PV Sustainability, Report IEA-PVPS T12-19:2020 December 2020
11. WEEE Directive 2012/19/EU Article 4,11&15


| | | | |
|---|---|---|---|
| epd-norway Global Program Operator | **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 Global Program Operator | **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 |
| risen | **Owner of the declaration** | tlf | 86-574-59953588 |
| | Risen Energy Co., Ltd. | Fax | |
| | Tashan Industry Zone, Meilin Street, Ninghai, Ningbo | e-post: | yangsb@risenenergy.com |
| | China | web | www.risenenergy.com |
| TÜV SÜD | **Author of the life cycle assessment** | tlf | +86 512 6809 5318 |
| | TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch | Fax | |
| | 3-13, No.151 Heng Tong Road, Jingan District Shanghai | e-post: | hongyu.tian@tuvsud.com |
| | China | web | www.tuvsud.cn |
| ECO PLATFORM EPD VERIFIED | ECO Platform<br>ECO Portal | web<br>web | www.eco-platform.org<br>ECO Portal |