epd-norway
Global Program Operator

ECO PLATFORM EPD VERIFIED

Environmental Product Declaration

In accordance with ISO14025:2006 and EN15804:2012+A2:2019

Photovoltaic modules

Owner of the declaration:
Q-SUN Anhui Co. Ltd.

Product name:
Mono-crystalline Photovoltaic module

Declared unit:
1m^2 of manufactured photovoltaic module

Product category /PCR:
[NPCR PART A:Construction products and services Version 2.0 & NPCR NPCR 029 Part B Version: 1.2]

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-6698-5940-EN

Registration number:
NEPD-6698-5940-EN

Issue date: 27.05.2024

Valid to: 27.05.2029

Q-SUN solar

The Norwegian
EPD Foundation

General information

Product:
QN-xxxHT,108-16BB (power rating: 400-415Wp)
QN-xxxHD,108-16BB (power rating:420-450Wp)
QN-xxxHD,144-16BB (power rating:560-600Wp)

Program operator:
The Norwegian EPD Foundation
Post Box 5250 Majorstuen, 0303 Oslo, Norway
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Declaration number:
NEPD-6698-5940-EN

This declaration is based on Product Category Rules:
NPCR PART A:Construction products and services Version 2.0, 2021-03-24
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, 2022-03-31

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 evidences.

Declared unit:
1m^2 of manufactured photovoltaic module

Declared unit with option:
Not applicable

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 ☑

Sign

[ ]

Independent verifier approved by EPD Norway

Owner of the declaration:
Q-SUN Anhui Co., Ltd.
Contact person: Rongyuan Gu
Phone: 13921144721
e-mail: rongyuan_gu@aliyun.com

Manufacturer:
Q-SUN Jiangsu Co., Ltd.
Contact person: Rongyuan Gu
Phone: 13921144721
e-mail: rongyuan_gu@aliyun.com

Place of production:
Fengfu No. 4 Road, Precision Manufacturing Industrial Park, 224200, DongTai City, Jiangsu Province

Management system:
ISO14001: USA21E45738R0M
ISO45001:USA21S25739R0M
ISO9001:USA22Q44077R0M

Organisation no:
91320981MA1Y8KX084

Issue date:
27.05.2024

Valid to:
27.05.2029

Year of study:
2024

Comparability:
EPD of construction products may not be able to compare if they do not comply with EN 15804 and are seen in a building context.

The EPD has been worked out by:
Jacky Lu

Approved

Manager of EPD Norway

Product

Product description:

This LCA considers a group of PV modules manufactured by the Q-Sun Solar, namely QN-xxxHD,108-16BB; QN-xxxHD,144-16BB. The average module product is based on the relative fractions in terms of the production volume. The PV module are based on the same technology of PV cells and provided in the same manufacturing line. Therefore, a grouped PV modules based on the relative share of the production volume can be justified. The average product from three modules are presented according to their respective production volumes. Thus, the weights are 14.7%, 83.3% and 2.0%.

Product Specification:

The details of materials mass are presented below

Materials	Unit	Value	%
Photovoltaic cell	kg	5.69E-01	2.3%
Front glass	kg	1.06E+01	43.3%
Photovoltaic back sheet	kg	1.93E-01	0.8%
Back glass	kg	8.33E+00	34.1%
Frame	kg	2.20E+00	9.0%
Solder strip	kg	1.63E-01	0.7%
Bus bar	kg	4.54E-02	0.2%
Silica gel	kg	2.27E-01	0.9%
Junction box	kg	2.30E-01	0.9%
EVA	kg	1.87E+00	7.7%
Nameplate	kg	2.99E-04	0.0%
Barcode	kg	1.33E-04	0.0%
Potting adhesive	kg	2.86E-02	0.1%

Technical data:

Parameters	QN-xxxHT,108-16BB		QN-xxxHD,108-16BB		QN-xxxHD,144-16BB	
	Value / pcs	Value / FU	Value/ pcs	Value/FU	Value/ pcs	Value / FU
Power output (W)	410	1.000	430	1.000	580	1
Module Area(m2)	1.96	0.0048	1.96	0.0046	2.6	0.0045
Dimension of the module(mm)	1722*1134*30		1722*1134*30		2278*1134*30	
Weight (kg)	21.4	0.052	24.6	0.057	32.5	0.056

First year degradation (%)	1%	1%	1%	1%	1%	1%
Degradation(%)	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%
Number of cells	108	0.263	108	0.251	144	0.248275862
Type of technology	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon
Conversion factor including the frame(W/m2)	210		221		223	

Market:
Europe

Reference service life, product:
The reference service life is 25 years (>80% of the labelled power output) according to the PCR since no third party report is available.

Additional technical info
None

LCA: Calculation rules

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).

Cut-off criteria:
No specific materials have been cut-off in this specific LCA. All materials provided by the manufacturer are properly modelled.

Allocation:
Since the three modules are produced from the same production line. Therefore, a multi-output allocation strategy is applied for the A3 phase to the specific PV modules.

The allocation strategy for the EoL process per PCR follows the same strategy listed in the EN15804. Thus, the "cut-off" strategy is applied. This scenario allocates the entire environmental impacts of waste treatment procedures (from deconstruction to the waste processing) to the producer. The recycled materials, on the other hand, are burden-free. An important note is that when materials 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

Data quality:

According to NPCR Part A Construction Products and Services v2.0 and NPCR 029 Part B v1.2, the data quality is assessed through the ISO 14044 standard and EN 15804.

Quality requirement	Specific requirement	Data quality	Level
Time-related coverage (age of data and the minimum length of time over which data should be collected)	Existing LCI data were, at most, 10 years old.	<10 years	**Good**
	Newly collected LCI data were current or up to 3 years old	Q-sun 2023-01 to 2023-12 production	**Good**
Geographical coverage (the geographical area from which data for unit processes should be collected to satisfy the goal of the study):	Upstream: Unit process for raw material should be collected for respective geogrpahic region	All raw material data were based on the respective geographic region	**Good**
	Core: unit process for production should represent the real site	Production data is collected and provided by Q-sun	**Good**
	Downstream: end-of-life disposal should represent the region of disposal	Parameter from IEC standards and generic data from the database was used for scenario development	**Good**
Completeness	95% percentage of flow is measured or estimated	All of the unit processes within the scope of the life cycle were included, with less than a 5% cut-off	**Good**
Representativeness	Qualitative assessment of the degree to which the data set reflects the true population of interest, i.e. geographical coverage, period and technology coverage	See geographical coverage, period, and technology coverage requirement above. These requirements are met.	**Good**
Consistency	Qualitative assessment of Whether the study methodology is applied uniformly to the various components of the analysis	the study methodology is applied uniformly to the different parts of the analysis	**Good**
Reproducibility	Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Yes	**Good**
Sources of the data	The foreground data should be from the primary producer	Yes	**Good**
Uncertainty of the information	Data, models, and assumptions should be verified	All the primary data and assumptions were confirmed with Q-sun, and models were built following ISO 14040/44 and PCR requirements	**Good**

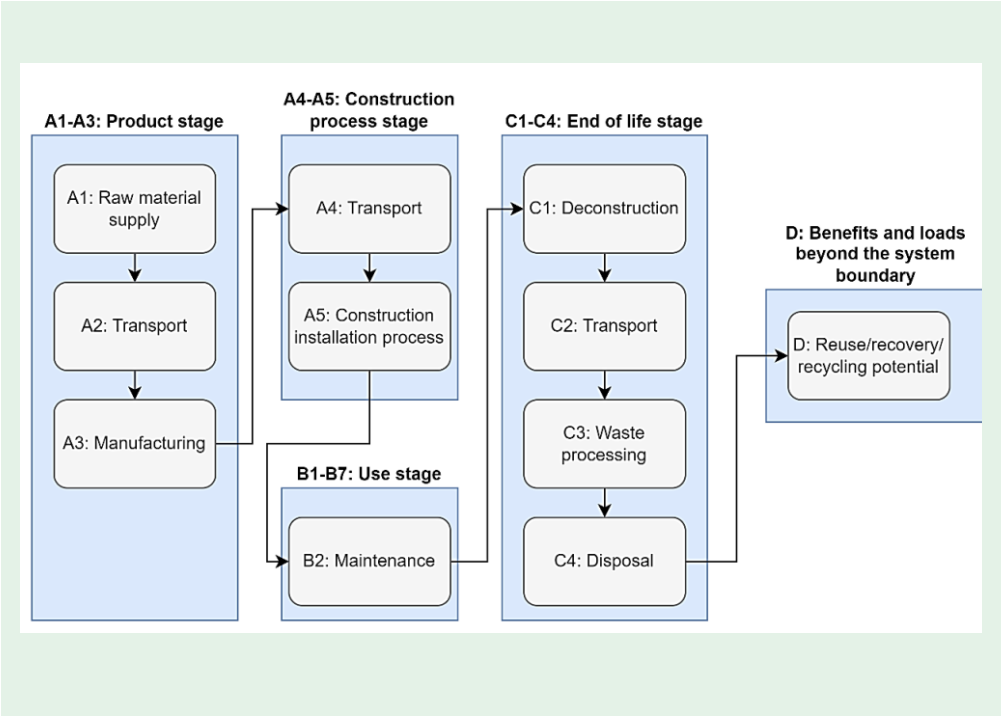
System boundaries (X=included, MND=module not declared, MNR=module not relevant)

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

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.



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)

Transport from production place to assembly/user (A4)	Capacity utilisation (incl. return) %	Distance (km)	Fuel/Energy consumption	Unit	Value
Truck, EURO5, 16- 32 metric ton	36.7%	1029	Diesel	kg/km	0.037
Container ship	50%	19400	Heavy oil	kg/km	0.0025

The distribution scenario(A4) is based on the information provided by the suppliers. The product is firstly tranported to the Shanghai Port at a distance of 229km by lorry. Then, the product is transported from Shanghai Port to Rotterdam Port by 19400km through the container ship. After than, the product is unloaded to the storage site by a distance of 300km. The distance between the storage site to the final consumers is assumed to be 500km as well per PCR B.

Assembly (A5)

	Unit	Value
Water consumption	m3	0
Electricity consumption	kWh	0.0274
Diesel	MJ	5.84
Material loss	Kg	0
Output materials for waste treatment	Kg	0.055

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 average PV power rating for the three modules is 434 Wp. The packaging materials of the PV modules include wood pallet, paper and plastics. Wood pallet is assumed to be directly reused. Packaging paper is assumed to be recycled and plastics are assumed to be incinerated. The transport distance for the packaging materials to the recycling site is assumed to be 50km according to the PCR. Other materials including the mounting system, cables, inverts are not considered based on the requirements listed in the PCR B

Use (B1)

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

Maintenance (B2)/Repair (B3)

	Unit	Value
Water consumption	m3	2.17
Electricity consumption	kWh	0

Only maintenance (B2) for PV panels is cleaning. It is assumed to be cleaned once per month with an application rate of 0.76L water per m^2 PV panel according to the reference[13].

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)

According the NPCR 029 Part B v1.2, PV module does not require operational energy nor water.

End of Life (C1, C3, C4)

	Unit	Value
Hazardous waste disposed	kg	0
Collected as mixed construction waste	kg	0
Reuse	kg	0
Recycling	kg	18.994
Energy recovery	kg	0
To landfill	kg	3.196
To incineration	kg	2.474

De-construction (C1) of the PV plant during the disposal stage is assumed mainly consuming electricity, and the electricity consumption is assumed the same as the construction stage (A5), 50km transportation distance from plant site to waste treatment site (C2) is assumed according to the PCR B. For the C3, phase, Since there is lack of existing data of recycling rate for PV module, this study refers to legal requirements issued by Waste Electrical and Electronic Equipment (WEEE). In 2012/19/EU-Article 11 & ANNEX V, the required collection rate for waste PV module is 85%. Therefore, 15% of waste PV module end up with waste disposal through landfill. A specific electricity 5.56E-2 kWh/kg and 3.24E-2 MJ/kg disel consumption is referenced to dissemble and sort the collected PV modules. The final disposal sceanrio for C4 is based on the following table

PV components	Materials	Recycling	Landfill	Incineration
PV cells	Silicon	80%	20%	0%
	Silver bar line	90%	10%	0%
Solar glass	Glass	85%	15%	0%
PET	PET	0%	0%	100%
Aluminium Frame	Aluminium alloy	94%	6%	0%
Cu strip and busbar	Copper	63%	37%	0%
	Pb	93%	7%	0%
	Tin	90%	10%	0%
Junction box	Bronze	63%	37%	0%
	Plastics	0%	0%	100%
Chemicals	Adhesive	0%	0%	100%
EVA	EVA	0%	0%	100%

Transport to waste processing (C2)

Transport from production place to assembly/user (C2)	Capacity utilisation (incl. return) %	Distance (km)	Fuel/Energy consumption	Unit	Value
Truck	36.7%	50	Diesel	kg/km	0.037

Waste transportation distance from the de-installation plant to the waste treatment facilities is assumed to be 50 km according to the NPCR 029 Part B v1.2

Benefits and loads beyond the system boundaries (D)

Benefits and loads beyond the system boundaries (D)	Unit	Value
Avoided Products		
Silicon, metallurgical grade {CN}| market for silicon, metallurgical grade | Cut-off, U	kg	1.09E-03

Silver {GLO}| market for silver | Cut-off, U	kg	2.93E-05
Glass cullet, for Saint-Gobain ISOVER SA {GLO}| glass cullet, for Saint-Gobain ISOVER SA, Recycled Content cut-off | Cut-off, U	kg	3.92E-02
Aluminium, primary, ingot {CN}| aluminium production, primary, ingot | Cut-off, U	kg	5.04E-03
Copper, anode {RoW}| smelting of copper concentrate, sulfide ore | Cut-off, U	kg	1.72E-04
Lead concentrate {GLO}| market for lead concentrate | Cut-off, U	kg	1.15E-04
Tin concentrate {GLO}| market for tin concentrate | Cut-off, U	kg	9.76E-05
Bronze {GLO}| market for bronze | Cut-off, U	kg	1.49E-04
Electricity, low voltage {ENTSO-E}| market group for electricity, low voltage | Cut-off, U	MJ	7.61E+00
Heat, central or small-scale, other than natural gas {Europe without Switzerland}| market for heat, central or small-scale, other than natural gas | Cut-off, U	MJ	1.48E+01

The environmental impacts are based on the average values of the three PV modules. The The

LCA: Results

The LCA results is based on the averaging weights, 14.7%, 83.3% and 2.0% for QN-xxxHT,108-16BB, QN-xxxHD,108-16BB and QN-xxxHD,144-16BB, respectively. The environmental impact deviations among these modules are less than 10%. The environmental impacts are presented per functional unit (1Wp) and declared unit (1m^2)

Core environmental impact indicators (per functional unit – 1Wp)

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
GWP - total	kg CO2 eq	4.22E-01	1.91E-02	1.71E-03	2.65E-03	1.36E-03	5.34E-04	1.26E-02	6.85E-02	-1.51E-01
GWP - fossil	kg CO2 eq	4.22E-01	1.91E-02	1.71E-03	2.65E-03	1.36E-03	5.34E-04	1.26E-02	6.85E-02	-1.51E-01
GWP - biogenic	kg CO2 eq	-9.74E-02	2.23E-06	9.74E-02	4.33E-06	1.17E-06	4.83E-07	3.81E-05	9.38E-04	-1.41E-03
GWP - luluc	kg CO2 eq	3.05E-04	1.26E-05	2.19E-07	3.49E-06	2.07E-07	2.59E-07	2.48E-06	4.02E-05	-5.28E-05
ODP	kg CFC11 eq	1.89E-08	3.21E-10	2.24E-11	5.14E-10	2.16E-11	1.16E-11	3.19E-11	1.73E-09	-1.25E-09
AP	molc H+ eq	2.83E-03	3.71E-04	1.26E-05	1.40E-05	1.25E-05	1.74E-06	8.24E-06	5.00E-04	-1.21E-03
EP- freshwater	kg P eq	1.27E-04	9.45E-07	6.36E-08	9.55E-07	6.15E-08	3.73E-08	8.99E-07	6.35E-06	-8.09E-05
EP-freshwater	kg PO_4 eq	3.88E-04	2.89E-06	1.95E-07	2.93E-06	1.88E-07	1.14E-07	2.76E-06	1.95E-05	-2.48E-04
EP -marine	kg N eq	6.03E-04	9.50E-05	5.92E-06	2.85E-06	5.75E-06	5.98E-07	2.91E-06	1.93E-04	-2.05E-04
EP - terrestrial	molc N eq	5.87E-03	1.05E-03	6.30E-05	2.91E-05	6.25E-05	6.32E-06	2.63E-05	2.07E-03	-2.27E-03
POCP	kg NMVOC eq	1.70E-03	2.96E-04	1.87E-05	9.36E-06	1.85E-05	2.60E-06	7.43E-06	7.00E-04	-6.49E-04
ADP-M&M[2]	kg Sb-Eq	1.66E-05	3.27E-08	5.96E-10	1.20E-08	5.10E-10	1.71E-09	2.34E-09	1.42E-07	-2.64E-05
ADP-fossil[2]	MJ	4.69E+00	2.50E-01	1.84E-02	3.17E-02	1.80E-02	7.57E-03	2.43E-02	1.53E+00	-1.42E+00
WDP[2]	m^3	2.32E-01	8.22E-04	4.53E-05	8.71E-02	4.28E-05	3.08E-05	2.83E-04	6.51E-02	-1.96E-02

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

Additional environmental impact indicators (per functional unit – 1Wp)

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
PM	Disease incidence	3.21E-08	1.04E-09	3.48E-10	1.78E-10	3.45E-10	4.25E-11	6.68E-11	1.13E-08	-1.32E-08
IRP[1]	kBq U235 eq.	1.87E-02	1.90E-04	2.29E-05	2.32E-04	2.22E-05	1.01E-05	5.97E-04	1.62E-03	-4.74E-03
ETP-fw[2]	CTUe	2.95E+00	1.25E-01	9.21E-03	1.16E-02	8.42E-03	3.73E-03	2.82E-02	2.19E+00	-1.67E+00
HTP-c[2]	CTUh	2.39E-10	8.31E-12	4.39E-13	6.24E-12	4.16E-13	2.42E-13	9.84E-13	4.17E-11	-1.87E-10
HTP-nc[2]	CTUh	8.94E-09	1.19E-10	3.89E-12	8.82E-11	3.03E-12	5.33E-12	3.56E-11	4.33E-10	-5.84E-09
SQP[2]	Dimensionless	1.43E+00	1.05E-01	1.51E-03	6.58E-03	1.26E-03	4.50E-03	3.93E-03	3.67E+00	-5.50E-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*

[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 – 1Wp)

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
RPEE	MJ	4.73E+00	2.53E-01	1.85E-02	3.20E-02	1.82E-02	7.64E-03	2.46E-02	3.58E-03	-3.35E-03
RPEM	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
TPE	MJ	1.82E-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
NRPE	MJ	4.50E-01	2.54E-03	2.13E-04	3.06E-03	2.03E-04	1.19E-04	4.45E-03	6.45E-05	-2.56E-04
NRPM	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
TRPE	MJ	7.37E-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
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
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
FW	m^3	5.23E-03	2.80E-05	2.09E-06	2.05E-03	1.80E-06	1.09E-06	3.11E-05	3.86E-06	-1.32E-06

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 – 1Wp)

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
HW	kg	8.49E-04	4.78E-06	2.40E-06	1.77E-06	1.70E-07	1.89E-07	1.32E-04	1.64E-05	-1.34E-07
NHW	kg	5.64E-02	8.48E-03	1.31E-04	3.70E-04	2.66E-05	3.73E-04	2.21E-04	1.49E-02	-5.30E-05
RW	kg	4.60E-06	4.52E-08	5.73E-09	5.65E-08	5.56E-09	2.48E-09	1.55E-07	8.84E-10	-2.78E-09

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

End of life – output flow (per functional unit – 1Wp)

Parameter	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	1.59E-04	0.00E+00	5.10E-04	0.00E+00	0.00E+00	0.00E+00	3.75E-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
EEE	MJ	0.00E+00	0.00E+00	2.59E-04	0.00E+00	0.00E+00	0.00E+00	1.93E-02	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	5.08E-04	0.00E+00	0.00E+00	0.00E+00	3.76E-02	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.*

Core environmental impact indicators (per declared unit – 1m²)

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
GWP - total	kg CO2 eq	9.26E+01	4.19E+00	3.75E-01	5.82E-01	2.98E-01	1.17E-01	2.77E+00	1.50E+01	-3.31E+01
GWP - fossil	kg CO2 eq	9.26E+01	4.19E+00	3.75E-01	5.82E-01	2.98E-01	1.17E-01	2.77E+00	1.50E+01	-3.31E+01
GWP - biogenic	kg CO2 eq	-2.14E+01	4.89E-04	2.14E+01	9.50E-04	2.57E-04	1.06E-04	8.36E-03	2.06E-01	-3.09E-01
GWP - luluc	kg CO2 eq	6.69E-02	2.77E-03	4.81E-05	7.66E-04	4.54E-05	5.68E-05	5.44E-04	8.82E-03	-1.16E-02
ODP	kg CFC11 eq	4.15E-06	7.04E-08	4.92E-09	1.13E-07	4.74E-09	2.55E-09	7.00E-09	3.80E-07	-2.74E-07
AP	molc H+ eq	6.21E-01	8.14E-02	2.77E-03	3.07E-03	2.74E-03	3.82E-04	1.81E-03	1.10E-01	-2.66E-01
EP- freshwater	kg P eq	2.79E-02	2.07E-04	1.40E-05	2.10E-04	1.35E-05	8.19E-06	1.97E-04	1.39E-03	-1.78E-02
EP-freshwater	kg PO_4 eq	8.52E-02	6.34E-04	4.28E-05	6.43E-04	4.13E-05	2.50E-05	6.06E-04	4.28E-03	-5.44E-02
EP -marine	kg N eq	1.32E-01	2.08E-02	1.30E-03	6.25E-04	1.26E-03	1.31E-04	6.39E-04	4.24E-02	-4.50E-02
EP - terrestrial	molc N eq	1.29E+00	2.30E-01	1.38E-02	6.39E-03	1.37E-02	1.39E-03	5.77E-03	4.54E-01	-4.98E-01
POCP	kg NMVOC eq	3.73E-01	6.50E-02	4.10E-03	2.05E-03	4.06E-03	5.71E-04	1.63E-03	1.54E-01	-1.42E-01
ADP-M&M[2]	kg Sb-Eq	3.64E-03	7.18E-06	1.31E-07	2.63E-06	1.12E-07	3.75E-07	5.14E-07	3.12E-05	-5.79E-03
ADP-fossil[2]	MJ	1.03E+03	5.49E+01	4.04E+00	6.96E+00	3.95E+00	1.66E+00	5.33E+00	3.36E+02	-3.12E+02
WDP[2]	m^3	5.09E+01	1.80E-01	9.94E-03	1.91E+01	9.39E-03	6.76E-03	6.21E-02	1.43E+01	-4.30E+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

Additional environmental impact indicators (per declared unit – 1m²)

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
PM	Disease incidence	7.04E-06	2.28E-07	7.64E-08	3.91E-08	7.57E-08	9.33E-09	1.47E-08	2.48E-06	-2.90E-06
IRP[1]	kBq U235 eq.	4.10E+00	4.17E-02	5.03E-03	5.09E-02	4.87E-03	2.22E-03	1.31E-01	3.56E-01	-1.04E+00
ETP-fw[2]	CTUe	6.47E+02	2.74E+01	2.02E+00	2.55E+00	1.85E+00	8.19E-01	6.19E+00	4.81E+02	-3.67E+02
HTP-c[2]	CTUh	5.25E-08	1.82E-09	9.63E-11	1.37E-09	9.13E-11	5.31E-11	2.16E-10	9.15E-09	-4.10E-08
HTP-nc[2]	CTUh	1.96E-06	2.61E-08	8.54E-10	1.94E-08	6.65E-10	1.17E-09	7.81E-09	9.50E-08	-1.28E-06
SQP[2]	Dimensionless	3.14E+02	2.30E+01	3.31E-01	1.44E+00	2.77E-01	9.88E-01	8.63E-01	8.05E+02	-1.21E+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*

[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 declared unit – 1m²)

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
RPEE	MJ	1.04E+03	5.55E+01	4.06E+00	7.02E+00	3.99E+00	1.68E+00	5.40E+00	7.86E-01	-7.35E-01

RPEM	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
TPE	MJ	3.99E+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
NRPE	MJ	9.88E+01	5.57E-01	4.67E-02	6.72E-01	4.46E-02	2.61E-02	9.77E-01	1.42E-02	-5.62E-02
NRPM	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
TRPE	MJ	1.62E+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
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
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
FW	m^3	1.15E+00	6.15E-03	4.59E-04	4.50E-01	3.95E-04	2.39E-04	6.83E-03	8.47E-04	-2.90E-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*** *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 declared unit – $1m^2$)

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
HW	kg	1.86E-01	1.05E-03	5.27E-04	3.88E-04	3.73E-05	4.15E-05	2.90E-02	3.60E-03	-2.94E-05
NHW	kg	1.24E+01	1.86E+00	2.88E-02	8.12E-02	5.84E-03	8.19E-02	4.85E-02	3.27E+00	-1.16E-02
RW	kg	1.01E-03	9.92E-06	1.26E-06	1.24E-05	1.22E-06	5.44E-07	3.40E-05	1.94E-07	-6.10E-07

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

End of life – output flow (per declared unit – $1m^2$)

Parameter	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	3.49E-02	0.00E+00	1.12E-01	0.00E+00	0.00E+00	0.00E+00	8.23E+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
EEE	MJ	0.00E+00	0.00E+00	5.68E-02	0.00E+00	0.00E+00	0.00E+00	4.24E+00	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	1.11E-01	0.00E+00	0.00E+00	0.00E+00	8.25E+00	0.00E+00	0.00E+00

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	2.66E-02

Additional requirements

Location based electricity mix from the use of electricity in manufacturing

National production mix from import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process (A3). The average grid loss for the Jiangsu province is 3.07% according to the Chinese Energy Year book 2023.

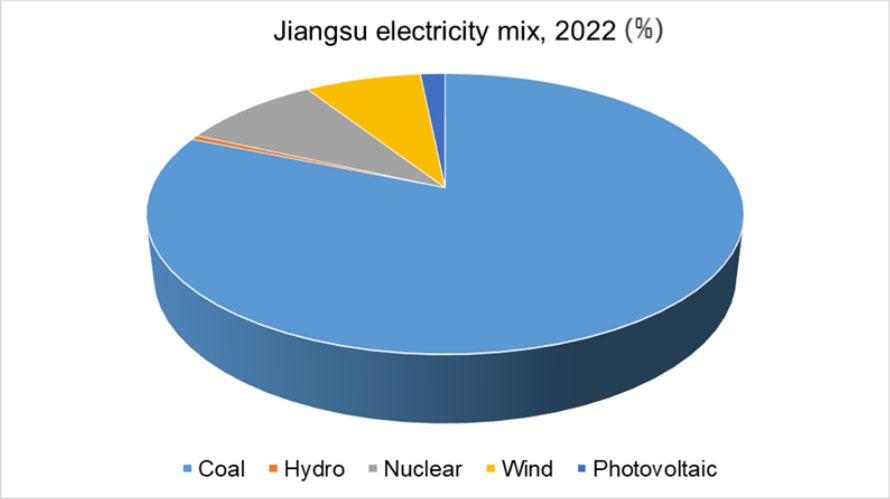


Figure 2 the electricity production mix for Jiangsu province at 2022

National electricity grid, medium voltage, in Jiangsu Province	Data source	core [kWh]	GWP_{total} [kg CO2 -eq/kWh]	SUM [kg CO2 -eq]
Electricity production at low voltage	Chinese Energy Year book 2023	0.0355	0.921	0.0326

Guarantees of origin from the use of electricity in the manufacturing phase

None

Additional environmental impact indicators required 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.

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
GWP-IOBC	kg	4.18E-01	1.91E-02	1.76E-03	6.28E-03	1.36E-03	5.34E-04	1.18E-03	1.18E-03	-1.45E-01

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

Hazardous substances

The PV modules does not contain any Substances of Very High Concern (SVHC) and other REACH listed substances according to the REACH Authorisation List https://echa.europa.eu/authorisation-list

-Indoor environment

Not relevant for PV modules since it is installed in outdoor environment.

Carbon footprint

None

Bibliography

[1] Ecoinvent, 2023. Swiss Centre for Life Cycle Assessment, v3.9 (www.ecoinvent.ch).

[2] EN 15804:2012+A2:2019/AC:2021, Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products.

[3] ISO 14025:2006, Environmental labels and declarations-Type III environmental declarations-Principles and procedures.

[4] ISO 14040: 2006/Amd 1:2020 Environmental management - Life cycle assessment - Principles and framework Amendment 1 (ISO 2020).

[5] ISO 14044: 2006/Amd 2:2020 Environmental management - Life cycle assessment - Requirements and guidelines Amendment 2 (ISO 2020).

[6] ISO 21930:2017, Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.

[7] Latunussa C E L, Ardente F, Blengini G A, et al. Life Cycle Assessment of an innovative recycling process for crystalline silicon photovoltaic panels[J]. Solar energy materials and solar cells, 2016, 156: 101-111.

[8] EPD-norge. (2023). General Programme Instructions for The Norwegian EPD Foundation/EPD-Norge (www.epd-norge.no) version 3:2019 updated 250523

[9] EPD-norge (2021) Part A: Construction products and services ver. 2

[10] EPD-norge. (2022). 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 1.2.

[11] R. Frischknecht, P. Stolz, L. Krebs, M. de Wild-Scholten, P. Sinha, V. Fthenakis, H. C. Kim, M. Raugei, M. Stucki, 2020, Life Cycle Inventories and Life Cycle Assessment of Photovoltaic Systems, International Energy Agency (IEA) PVPS Task 12, Report T12-19:2020.

[12] Cynthia E.L. Latunussa, Fulvio Ardente, Gian Andrea Blengini, Lucia Mancini, Life Cycle Assessment of an innovative recycling process for crystalline silicon photovoltaic panels, Solar Energy Materials and Solar Cells, Volume 156, 2016, Pages 101-111, ISSN 0927-0248, https://doi.org/10.1016/j.solmat.2016.03.020.

[13] Qing Yang, Tianyue Huang, Fuying Chen, Javier Uche, Yuxuan Wang, Peng Yuan, Yinya Zhang, Jianlan Li, Water saving potential for large-scale photovoltaic power generation in China: Based on life cycle assessment, Renewable and Sustainable Energy Reviews, Volume 167,2022, 112681

[14] [14] WEEE Directive 2012/19/EU Article 4,11&15

[15] 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

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