epd-norway
Global Program Operator

Environmental Product Declaration

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

Photovoltaic modules

LEDVANCE

The Norwegian
EPD Foundation

Owner of the declaration:
LEDVANCE GmbH.

Product name:
Mono-crystalline Photovoltaic module

Declared unit:
1 Wp of manufactured photovoltaic module, with processes at construction and end-of-life stage

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

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-99330-9858

Registration number:
NEPD-99330-9858

Issue date: 05.05.2025

Valid to: 05.05.2030

General information

Product:
MxxxN72LB-SF/BF-F7 (power rating: 575-600Wp)
MxxxN60LB-SF/BF-F7 (power rating: 470-500Wp)
MxxxN60LB-BB-F7 (power rating: 470-500Wp)
MxxxN54LB-SF/BF-F7 (power rating: 425-450Wp)
MxxxN54LB-BB-F7 (power rating: 420-445Wp)
MxxxN66UB-SF/BF-F7 (power rating: 690-720Wp)
MxxxN48RB-SF/BF-F7 (power rating: 435-455Wp)
MxxxN48RB-BB-F7 (power rating: 430-450Wp)
MxxxN66RB-SF/BF-F7 (power rating: 600-630Wp)

Program operator:
The Norwegian EPD Foundation
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Declaration number: NEPD-99330-9858

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:
1Wp of manufactured photovoltaic module, with processes at construction and end-of-life stage

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

[Michael ZHU Jiang]

Independent verifier approved by EPD Norway

Owner of the declaration:
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Manufacturer:
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Phone: +48 734 134 386
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Place of production:
South of Kunming Road, Peixian Economic Development Zone Xuzhou City, Jiangsu Province, P.R. China, No.1299, Shanghai

Management system:
IEC 61215; IEC61730;
ISO9001

Organisation no:
HRB220074

Issue date:
05.05.2025

Valid to:
05.05.2030

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:
Yixiao Zhang, TUV-Nord

Approved

Manager of EPD Norway

Product

Product description:

This LCA considers a group of PV modules manufactured by the LEDVANCE, namely MxxxN72LB-SF/BF-F7, MxxxN60LB-SF/BF-F7, MxxxN60LB-BB-F7, MxxxN54LB-SF/BF-F7, MxxxN54LB-BB-F7, MxxxN66UB-SF/BF-F7, MxxxN48RB-SF/BF-F7, MxxxN48RB-BB-F7 and MxxxN66RB-SF/BF-F7. All the modules included in this EPD are double glass and the solar cells are produced with TOPCON process. The average module product is based on the product average. So, the average PV module product from nine modules is presented according to their product average. The results are calculated based on the average inventory amongst the modules.

Product Specification:

The details of materials mass are presented below. The value is the average of the nine PV modules.

PV Components	Materials	Unit	Value	%
Photovoltaic cell	Silicon	kg	5.87E-01	2.13%
Front glass	Glass	kg	1.13E+01	40.95%
Back glass	Glass	kg	1.13E+01	40.95%
Frame	Aluminium alloy	kg	1.88E+00	6.84%
Solder strip	Coppe, Pb, Tin	kg	1.57E-01	0.57%
Bus bar	Coppe, Pb, Tin	kg	4.51E-02	0.16%
Silica gel	Silicone	kg	3.04E-01	1.10%
Junction box	Bronze, XLPE, Tin	kg	1.18E-01	0.43%
EVA	EVA	kg	1.86E+00	6.75%
Nameplate	Paper	kg	1.01E-03	0.00%
Barcode	Paper	kg	3.03E-03	0.01%
Potting adhesive	Silicon rubbe	kg	2.63E-02	0.10%

Technical data:

Parameters	MxxxN54 LB-SF/BF-F7		MxxxN54 LB-BB-F7		MxxxN60 LB-SF/BF-F7		MxxxN60 LB-BB-F7		MxxxN72L B-SF/BF-F7		MxxxN66 UB-SF/BF-F7		MxxxN48 RB-BB-F7		MxxxN48 RB-SF/BF-F7		MxxxN66 RB-SF/BF-F7	
	Value / pcs	Value / FU	Value/ pcs	Value/ FU	Value/ pcs	Value / FU	Value / pcs	Value / FU	Value / pcs	Value / FU	Value / pcs	Value / FU	Value / pcs	Value / FU	Value / pcs	Value / FU	Value / pcs	Value / FU
Power output (W)	450	1	445	1	500	1	500	1	600	1	720	1	450	1	455	1	630	1
Module Area(m2)	1.95	0.043	1.95	0.044	2.16	0.043	2.16	0.043	2.58	0.0043	3.11	0.043	1.998	0.044	1.998	0.044	2.70	0.043
Dimension of the module(mm)	1722*1134*30		1722*1134*30		1909*1134*30		1909*1134*30		2278*1134*30		2384*1303*33		1762*1134*30		1762*1134*30		2382*1134*30	
Weight (kg)	24	0.053	24	0.054	25	0.050	25	0.050	31.2	0.052	37.5	0.052	24.5	0.054	24.5	0.538	32.5	0.052
Weight including packaging(kg)	25.58	0.057	25.58	0.057	27.09	0.054	27.09	0.054	33.61	0.056	39.32	0.055	26.08	0.057	26.08	0.058	34.98	0.056

First year degradation (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Degradation(%)	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%
Number of cells	108	0.24	108	0.243	120	0.24	120	0.24	144	0.24	132	0.183	96	0.213	96	0.211	132	0.210
Type of technology	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	Mono-crystalline silicon	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)	230	0.513	228	0.513	231	0.463	231	0.463	233	0.388	231	0.322	225	0.500	227	0.500	233	0.370

Market:
World

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 nine 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	2024-01 to 2024-12 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 LEDVANCE	**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 LEDVANCE, and models were built following ISO 14040/44 and PCR requirements	**Good**

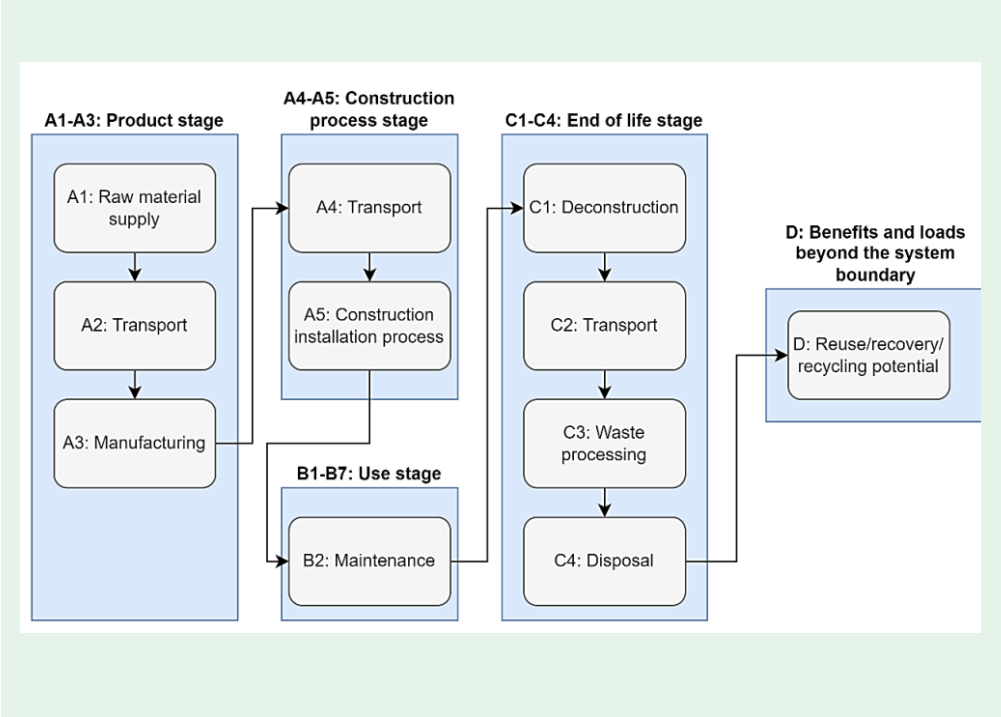
System boundaries (X=included, MND=module not declared, MNR=module not relevant)

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 describes 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%	1599	Diesel	kg/km	0.037
Container ship	50%	19961	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 799km by lorry. Then, the product is transported from Shanghai Port to Hamburg Port by 19961 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	0.032
Diesel	MJ	6.999
Material loss	Kg	0
Output materials for waste treatment	Kg	0.239

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 nine modules is 520 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	m^3	0.52
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	20.405
Energy recovery	kg	0
To landfill	kg	3.488
To incineration	kg	2.176

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 {RoW}| market for silicon, metallurgical grade | Cut-off, U	kg	4.05E-01

Silver {GLO}| market for silver | Cut-off, U	kg	4.14E-03
Glass cullet, for Saint-Gobain ISOVER SA {GLO}| glass cullet, for Saint-Gobain ISOVER SA, Recycled Content cut-off | Cut-off, U	kg	1.65E+01
Aluminium, primary, ingot {CN}| aluminium production, primary, ingot | Cut-off, U	kg	1.52E+00
Copper, anode {RoW}| smelting of copper concentrate, sulfide ore | Cut-off, U	kg	8.33E-02
Lead concentrate {GLO}| market for lead concentrate | Cut-off, U	kg	1.55E-02
Tin concentrate {GLO}| market for tin concentrate | Cut-off, U	kg	2.25E-02
Bronze {GLO}| market for bronze | Cut-off, U	kg	1.49E-02
Electricity, medium voltage {CN-JS }| market group for electricity, medium voltage | Cut-off, U	MJ	9.16E+00
Heat, central or small-scale, other than natural gas {RoW }| market for heat, central or small-scale, other than natural gas | Cut-off, U	MJ	1.79E+01

LCA: Results

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

Core environmental impact indicators

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
GWP - total	kg CO2 eq	3.72E-01	1.92E-02	2.25E-03	1.23E-03	1.39E-03	5.04E-04	2.45E-03	1.36E-02	-8.90E-02
GWP - fossil	kg CO2 eq	3.73E-01	1.92E-02	1.88E-03	1.23E-03	1.39E-03	5.04E-04	2.46E-03	1.36E-02	-8.88E-02
GWP - biogenic	kg CO2 eq	-2.01E-03	8.05E-06	3.71E-04	2.01E-06	-1.64E-08	1.70E-07	-1.20E-05	1.37E-06	-1.76E-04
GWP - luluc	kg CO2 eq	5.07E-04	1.11E-05	1.82E-07	1.62E-06	1.59E-07	2.59E-07	4.10E-07	1.26E-07	-3.06E-05
ODP	kg CFC11 eq	5.36E-09	3.49E-10	2.24E-11	2.39E-10	2.14E-11	7.53E-12	1.01E-11	8.94E-12	-7.30E-10
AP	molc H+ eq	2.27E-03	2.25E-04	1.29E-05	6.49E-06	1.27E-05	1.78E-06	1.35E-05	4.06E-06	-6.85E-04
EP- freshwater	kg P eq	1.48E-04	1.18E-06	5.58E-08	4.44E-07	5.19E-08	4.09E-08	4.36E-07	1.20E-07	-3.63E-05
EP-freshwater	kg PO_4 eq	4.52E-04	3.60E-06	1.71E-07	1.36E-06	1.59E-07	1.25E-07	1.33E-06	3.67E-07	-1.11E-04
EP -marine	kg N eq	4.21E-04	6.03E-05	6.15E-06	1.32E-06	5.81E-06	5.85E-07	3.41E-06	2.53E-06	-1.10E-04
EP - terrestrial	molc N eq	4.53E-03	6.60E-04	6.41E-05	1.35E-05	6.32E-05	6.20E-06	3.63E-05	2.05E-05	-1.20E-03
POCP	kg NMVOC eq	1.33E-03	2.00E-04	1.91E-05	4.34E-06	1.87E-05	2.40E-06	1.00E-05	5.27E-06	-3.51E-04
ADP-M&M[2]	kg Sb-Eq	1.16E-05	4.57E-08	6.01E-10	5.58E-09	4.91E-10	1.61E-09	1.16E-09	6.44E-10	-8.72E-06
ADP-fossil[2]	MJ	4.51E+00	2.63E-01	1.86E-02	1.47E-02	1.81E-02	7.08E-03	2.69E-02	4.20E-03	-8.38E-01
WDP[2]	m^3	4.55E-01	1.00E-03	5.22E-05	4.05E-02	4.40E-05	3.14E-05	3.29E-04	3.03E-04	-1.02E-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

Indicator	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
PM	Disease incidence	2.33E-08	1.32E-09	3.85E-10	8.25E-11	3.50E-10	4.00E-11	2.09E-10	2.75E-11	-7.55E-09
IRP[1]	kBq U235 eq.	2.72E-02	2.59E-04	1.30E-05	1.08E-04	1.23E-05	6.03E-06	1.58E-04	4.80E-06	-2.10E-03
ETP-fw[2]	CTUe	2.14E+00	1.33E-01	1.05E-02	5.38E-03	8.52E-03	3.95E-03	7.47E-03	1.37E-01	-6.66E-01
HTP-c[2]	CTUh	1.85E-10	8.49E-12	5.78E-13	2.90E-12	4.20E-13	2.28E-13	5.12E-13	1.72E-12	-1.13E-10

HTP-nc[2]	CTUh	6.34E-09	1.56E-10	5.72E-12	4.10E-11	3.36E-12	5.08E-12	2.10E-11	3.08E-10	-3.60E-09
SQP[2]	Dimension less	1.67E+00	1.46E-01	1.62E-03	3.06E-03	1.29E-03	4.22E-03	9.04E-03	4.75E-03	-3.04E-01

PM: *Particulate matter emissions;* ***IRP:*** *Ionising radiation, human health;* ***ETP-fw:*** *Ecotoxicity (freshwater);* ***HTP-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

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
RPEE	MJ	7.96E-01	3.26E-03	1.40E-04	1.41E-03	1.29E-04	9.02E-05	1.18E-03	8.95E-05	-6.32E-02
RPEM	MJ	3.76E-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	8.34E-01	3.26E-03	1.40E-04	1.41E-03	1.29E-04	9.02E-05	1.18E-03	8.95E-05	-6.32E-02
NRPE	MJ	4.35E+00	2.63E-01	1.86E-02	1.47E-02	1.81E-02	7.08E-03	2.69E-02	4.20E-03	-8.38E-01
NRPM	MJ	1.60E-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
TRPE	MJ	4.51E+00	2.63E-01	1.86E-02	1.47E-02	1.81E-02	7.08E-03	2.69E-02	4.20E-03	-8.38E-01
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	1.44E-02	3.38E-05	2.17E-06	9.44E-04	1.53E-06	9.87E-07	8.08E-06	9.21E-06	-2.79E-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

Parameter	Unit	A1-A3	A4	A5	B2	C1	C2	C3	C4	D
HW	kg	1.63E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHW	kg	1.59E-07	0.00E+00	2.09E-04	0.00E+00	0.00E+00	0.00E+00	7.85E-03	7.09E-03	0.00E+00
RW	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

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

End of life – output flow

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	0.00E+00	0.00E+00	1.06E-03	0.00E+00	0.00E+00	0.00E+00	4.45E-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	3.27E-06	0.00E+00	8.22E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-02	0.00E+00
ETE	MJ	3.68E-05	0.00E+00	1.61E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-02	0.00E+00

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

Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit	Value
Biogenic carbon content in product	kg C	0
Biogenic carbon content in the accompanying packaging	kg C	1.22E-03

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. The coal power generation accounts for 81.27%, the hydro accounts for 0.53%, the nuclear accounts for 9.09%, the wind accounts for 7.51% and the photovoltaic accounts for 1.60%. The details of the electricity mix are shown in Figure 2 below.

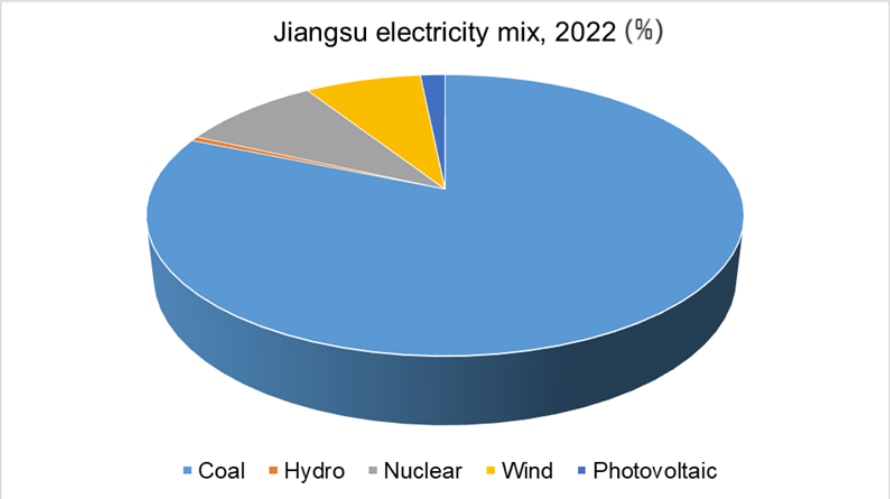


Figure 2 the electricity production mix for Jiangsu province at 2022

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	0.0119	0.921	0.0109

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	3.74E-01	1.92E-02	1.88E-03	1.23E-03	1.39E-03	5.04E-04	2.46E-03	1.36E-02	-8.89E-02

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

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