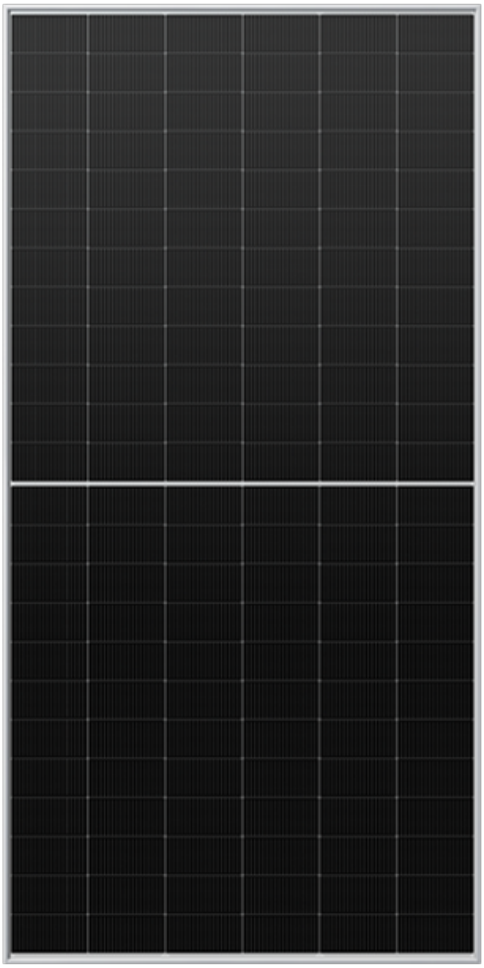
epd-norway
Global Program Operator

Environmental Product Declaration

In accordance with ISO14025:2006 and EN15804:2012+A2:2019/AC: 2021

LONGi MONOCRYSTALLINE TOPCon PV MODULE LR5-72HGD AND LR7-72HGD



Owner of the declaration:
LONGi Green Energy Technology Co., Ltd.

Product name:
LR5-72HGD, LR7-72HGD

Functional unit:
1Wp

Product category /PCR:
[NPCR 029 Version 1.2]

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-7253-6671-EN

Registration number:
NEPD-7253-6671-EN

Issue date:

15.08.2024

Valid to:

15.08.2029

The Norwegian
EPD Foundation

General information

Product:
LR5-72HGD (Power range: 560~590W)

LR7-72HGD (Power range: 585~620W)

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-7253-6671-EN

This declaration is based on Product Category Rules:
NPCR 029 version 1.2

This EPD follows additional requirements for construction products considered as Electronic or Electric Equipment.

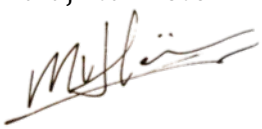
Statement of liability:
The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturer, life cycle assessment data and evidences.

Functional unit:
1 Wp

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

internal ☐ external √

Martijn van Hövell



Independent verifier approved by EPD Norway

Owner of the declaration:
LONGi Green Energy Technology Co., Ltd.
e-mail: market@longi.com

Manufacturer:
LONGi Solar Technology (Chuzhou) Co., Ltd.

LONGi Solar Technology (Jiaxing) Co., Ltd.

Place of production:
No. 18 Huizhou Road, Chuzhou City, Anhui Province, China
No. 19 Huaian Road, Chuzhou City, Anhui Province, China
No.130, Ruifeng Street, Gaozhao Subdistrict, Xiuzhou District, Jiaxing City, Zhejiang Province, P.R.China

Management system:
ISO 9001, ISO 14001, ISO 45001

Organisation no:
916101167101813521

Issue date:
15.08.2024

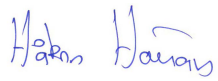
Valid to:
15.08.2029

Year of study:
2023.04-2024.03

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:
TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Approved



Manager of EPD Norway

Product

Product description:

LR5-72HGD and LR7-72HGD are LONGi's cutting-edge solution tailored for the utility market. This latest generation of high-efficiency modules integrates HPDC (High Performance and Hybrid Passivated Dual-Junction Cell) technology, ensuring exceptional power generation performance and reliability. The HPDC cell incorporates advanced hybrid passivation techniques on both the front and back, effectively minimizing carrier recombination. This results in an amplified power generation capacity, with higher Voc and efficiency, lower degradation, and an improved power temperature coefficient. These features collectively contribute to outstanding performance in diverse environments. With an impressive bifaciality of approximately 80%, the LR5-72HGD and LR7-72HGD excels in challenging settings such as the desert Gobi. It delivers up to a 3% power generation gain compared to mainstream bifacial modules. The superior power temperature coefficient and lower operating temperatures further enhance its suitability for demanding environments. To ensure a stable and reliable life cycle, the LR5-72HGD and LR7-72HGD comes with a power warranty featuring linear degradation of no more than 0.4%. This commitment underscores LONGi's confidence in the module's durability and consistent performance over time. It offers an optimal solution for maximizing energy output in challenging conditions.

Product specification:

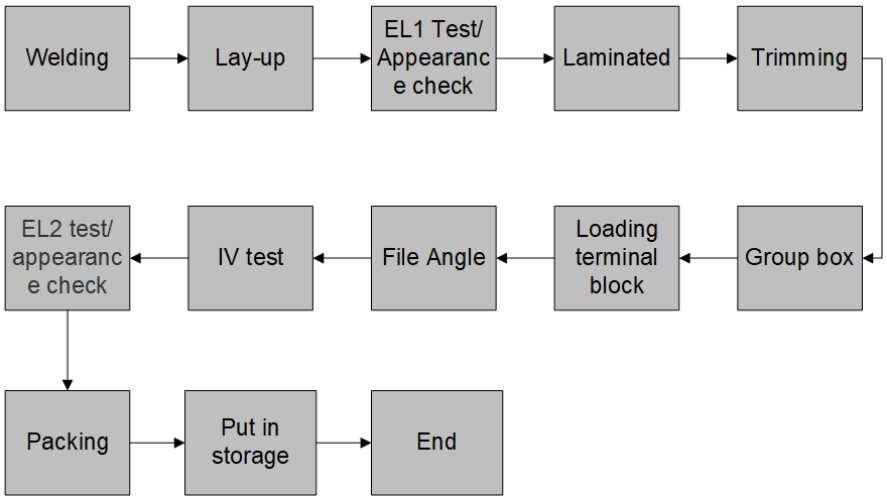
LR5-72HGD has a power range from 560W to 590W and a weight of 31.8 kg. 590W is chosen as the representative product power output.

LR7-72HGD has a power range from 585W to 620W and a weight of 33.5 kg. 620W is chosen as the representative product power output.

Material compositions and technical data are shown below. The models are manufactured in Chuzhou City, Anhui Province, and Jiaxing City, Zhejiang Province.

Materials	LR5-72HGD		LR7-72HGD	
	KG/FU	%	KG/FU	%
Solar glass	4.34E-02	78.45%	4.32E-02	79.56%
EVA	1.66E-03	3.00%	1.64E-03	3.03%
Frame	4.12E-03	7.45%	3.90E-03	7.19%
POE	1.79E-03	3.24%	1.76E-03	3.25%
Solder	4.11E-04	0.74%	4.22E-04	0.78%
Solar cell	1.19E-03	2.15%	1.18E-03	2.17%
Junction box	1.49E-04	0.27%	1.71E-04	0.32%
Flux	5.30E-05	0.10%	5.04E-05	0.09%
Silicone gel	1.03E-03	1.87%	6.76E-04	1.25%
Packaging: Pallet	8.31E-04	1.50%	7.90E-04	1.46%
Packaging: Corrugated board	3.37E-04	0.61%	3.56E-04	0.66%
Packaging: paper	2.09E-04	0.38%	1.23E-05	0.02%
Packaging: bag	7.47E-05	0.13%	8.87E-05	0.16%
Packaging: LDPE Film	5.30E-05	0.10%	4.28E-05	0.08%

Description of production processes:



Step 1: 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 2: Lay-up

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

Step 3: EL1 test/Appearance check

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

Step 4: 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 5: Trimming

Trim the laminated components to prepare the frame.

Step 6: 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 7: 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. Finally, AB glue is used for potting.

Step 8: File Angle

Fix and polish the four corners of the component.

Step 9: IV test

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

Step 10: 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 11: 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 12: Packing

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

Step 13: Put in storage

Put the packed components into the warehouse procedure.

Technical data:

Series	LR5-72HGD	LR7-72HGD
Power output range (W)	560~590	585-620
Dimensions (mm)	2278*1134*30	2382*1134*30
Area (m^2)	2.583	2.701
Converting factor (Wp/m^2)	216.8~228.42	216.59~229.54
Module efficiency (%)	21.7~22.8	21.7~23.0
Weight (kg)	31.8	33.5
Weight (incl. package)	32.69	34.30
First year degradation (%)	0.8	1.0
Annual degradation (%)	0.38	0.40

Geographical area:

The products are produced and manufactured in China, and are intended for global distribution and application. In this EPD, the scenario of transporting to Italy was analyzed. End-of-life scenarios are based on EU regulation.

Reference service life, product:

30 years (based on ≥80% of the labelled power output)

Type of EPD

This declaration is a specific EPD using a representative power output for each product. LCA Results of various power output ranges could be obtained using the conversion factors presented in the Chapter "additional requirements".

LCA: Calculation rules

Functional unit:

Functional unit is 1 Wp of manufactured photovoltaic module, with activities needed for a study period for a defined reference service life (⩾80% of the labelled power output).

Cut-off criteria:

For the processes within the system boundary, all available energy and material flow data 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. The following steps/stages are not included in the system boundary due to the reason that the elements below are considered irrelevant or not within the boundary:

• Impacts related to the production, transportation and installation of capital goods (buildings, infrastructure, machinery, internal transport packaging) and general operations (staff travel, marketing and communication actions) that cannot be directly allocated to products are excluded from the LCA study.

• The packaging for silicon wafer and solar cells is reused internally and its impact was excluded from the system;

• Emissions during the PV module installation and operation due to no obvious emission observable.

• Storage phases and sales of PV products due to no observable impact. Product losses due to abnormal damage such as natural disasters or fire accidents would occur at a rather low frequency.

• Handling operations at the distribution center and retail outlet due to small contribution and negligible impact.

• Research and development activities.

• Long-term emissions.

Allocation:

The allocation is made in accordance with the provisions of EN 15804. Incoming energy and water and waste production in-house is allocated equally among all products through power output allocation. For the end-of-life allocation of background data (energy and materials), the model “allocation cut-off by classification (ISO standard)" is used. As for the end-of-life stage of the solar PV modules, the load and benefit of reuse, recycling, and recovery processes is reported separately following the PCR’s recommendation.

Data quality:

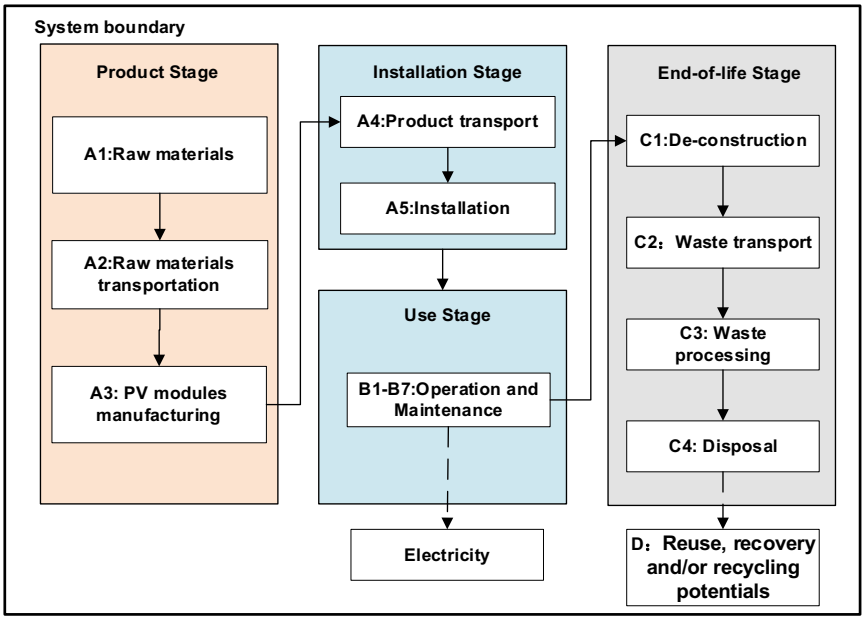
Primary data (such as materials or energy flows that enter and leave the production system) is from LONGi's manufacturing facilities for the period spanning from April. 2023 to March. 2024 (annual average). Generic data related to the life cycle impacts of the material or energy flows that enter and leave the production system is sourced from Ecoinvent 3.9 "allocation, cut-off by classification - unit" database.

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	X

System boundary:

The system boundary for this LCA study of PV modules encompasses product stage, installation stage, use stage, and end-of-life stage, from cradle to grave and module D.



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 (domestic)	36.7	370	Diesel	kg/tkm	0.0366
Ship	70	15616	Heavy oil	kg/tkm	0.0025
Truck (overboard)	36.7	199	Diesel	kg/tkm	0.0366

The product distribution involves a scenario for transporting the product to Italy.

Assembly (A5)

	Unit	LR5-72HGD	LR7-72HGD
Water consumption	m^3/FU	-	-
Electricity consumption	kWh/FU	6.32E-5	6.32E-5
Other energy carriers	MJ/FU	Diesel: 1.35E-2	Diesel: 1.35E-2
Material loss	kg/FU	-	-
Output materials from waste treatment	kg/FU	6.23E-4	5.93E-4

According to PCR, mounting structures and electrical components will not be included in this stage, only energy consumption, waste generation and treatment of packaging materials will be considered. The waste from the products' packaging is considered in this stage, and waste treatment of wood pallet is modeled as 75% recycling and 25% incineration. Other packaging materials including paper and plastic film are modeled with 100% incineration.

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	LR5-72HGD	LR7-72HGD
Water consumption	m3/FU	1.95E-5	1.85E-5

As for the maintenance stage (B2), water used for cleaning to maintain the performance is considered, 0.23L water used per module each time, and 2 times in a year are assumed. During the operation of PV module, no repair (B3) is required.

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)

It is assumed that there is no operational electricity (B6) or water consumption (B7). To calculate the expected energy production over the lifetime of the panels, the following formula may be used:

$$E_1 = S_{\text{rad}} * A * y * PR * (1 - \text{deg})$$

Where:

E_1= Energy produced in the first year of operation, kWh/year

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, m^2.

y = Module yield: electrical power, kWp for standard test conditions (STC) of the module divided by the area of the module.

STC: The ratio is given for standard test conditions: irradiance 1000 W/m^2, cell temperature 25 °C, wind speed 1 m/s, AM1.5.

PR = Performance ratio, coefficient for losses. Site specific performance ratio can be modelled with PV simulation software tools, such as PVSYST or similar.

Energy production second year of operation:

$$E_2 = E_1 * (1 - \text{deg})$$

Energy production n year of operation:

$$E_n = E_1 * (1 - \text{deg})^{n-1}$$

Energy production over reference service life of module, assuming linear annual degradation:

$$E_{RSL} = E_1 * (1 + \sum_{n=1}^{RSL-1} (1 - deg)^n)$$

Operational energy (B6) and water consumption (B7)

No inputs and outputs during operation stage.

End of Life (C1, C3, C4)

	Unit	LR5-72HGD	LR7-72HGD
Hazardous waste disposed	kg/FU	-	-
Collected as mixed construction waste	kg/FU	5.39E-02	5.40E-02
Reuse	kg/FU	-	-
Recycling	kg/FU	4.61E-02	4.62E-02
Energy recovery	kg/FU	1.49E-04	1.71E-04
To landfill	kg/FU	7.70E-03	7.65E-03

Assumptions are made for C1, C3 and C4 stage. Decommissioning stage (C1) of PV modules is assumed to be taken with same energy and fuel consumption as for installation stage. Waste

processing (C3) stage is assumed to be mechanically treated to yield the bulk materials. Modelling of disposal stage (C4) refers to legal requirements issued by Waste Electrical and Electronic Equipment (WEEE) under the EU scenario.

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/tkm	0.036

50km transportation distance from the plant site to waste treatment site (C2) is assumed according to PCR.

Benefits and loads beyond the system boundaries (D)

Benefits and loads beyond the system boundaries (D)	Unit	LR5-72HGD	LR7-72HGD
Substitution of electricity	MJ/FU	2.44E-02	2.38E-02
Substitution of thermal energy, district heating	MJ/FU	4.57E-02	4.44E-02
Substitution of converter aluminum with net scrap	kg/FU	1.02E-03	9.63E-04
Substitution of primary silver with net scrap	kg/FU	6.61E-06	6.56E-06
Substitution of primary copper with net scrap	kg/FU	1.12E-05	1.15E-05
Substitution of primary glass with glass gullets	kg/FU	3.69E-02	3.67E-02
Substitution of primary wood pallet with recycled wood	kg/FU	6.23E-04	5.93E-04

LCA: Results

The LCA results show the environmental impacts and resource input and output flows calculated according to EN 15804:2012+A2. The results are shown per functional unit (1Wp). The LCA results have been calculated using the LCA software SimaPro 9.5.

Core environmental impact indicators

LR5-72HGD (590Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq	3.55E-01	1.44E-02	3.64E-03	0.00E+00	6.01E-06	0.00E+00	1.36E-03	4.98E-04	5.98E-03	3.56E-04	-8.99E-02
GWP - fossil	kg CO_2 eq	3.55E-01	1.44E-02	1.59E-03	0.00E+00	5.98E-06	0.00E+00	1.36E-03	4.98E-04	5.91E-03	3.56E-04	-8.92E-02
GWP - biogenic	kg CO_2 eq	-5.28E-04	3.13E-06	2.05E-03	0.00E+00	2.25E-08	0.00E+00	4.67E-07	1.45E-07	7.05E-05	1.52E-07	-5.69E-04
GWP - luluc	kg CO_2 eq	3.83E-04	9.64E-06	1.93E-07	0.00E+00	1.04E-08	0.00E+00	1.54E-07	2.46E-07	9.31E-07	4.32E-08	-1.57E-04
ODP	kg CFC11 eq	7.59E-09	2.33E-10	2.63E-11	0.00E+00	1.69E-13	0.00E+00	2.18E-11	1.08E-11	1.33E-10	8.05E-12	-1.23E-09
AP	molc H+ eq	2.12E-03	2.72E-04	1.29E-05	0.00E+00	3.27E-08	0.00E+00	1.25E-05	1.09E-06	2.14E-05	5.09E-07	-4.54E-04
EP- freshwater	kg P eq	1.68E-05	8.61E-08	6.17E-09	0.00E+00	4.31E-10	0.00E+00	5.29E-09	4.04E-09	1.11E-07	1.28E-09	-2.92E-06
EP -marine	kg N eq	4.72E-04	6.77E-05	5.90E-06	0.00E+00	5.41E-09	0.00E+00	5.75E-06	2.68E-07	3.44E-06	1.86E-07	-9.50E-05
EP - terrestrial	molc N eq	4.65E-03	7.47E-04	6.42E-05	0.00E+00	6.12E-08	0.00E+00	6.26E-05	2.79E-06	4.15E-05	1.99E-06	-1.11E-03
POCP	kg NMVOC eq	1.41E-03	2.12E-04	1.91E-05	0.00E+00	2.24E-08	0.00E+00	1.86E-05	1.69E-06	1.78E-05	7.50E-07	-3.33E-04
ADP-M&M[2]	kg Sb-Eq	4.18E+00	1.87E-01	1.88E-02	0.00E+00	1.07E-04	0.00E+00	1.79E-02	7.07E-03	9.30E-02	1.66E-03	-1.14E+00
ADP-fossil[2]	MJ	1.84E-05	2.71E-08	7.50E-10	0.00E+00	3.14E-11	0.00E+00	5.11E-10	1.63E-09	1.05E-08	2.39E-10	-2.27E-06
WDP[2]	m^3	3.50E-01	5.90E-04	6.36E-05	0.00E+00	8.20E-04	0.00E+00	5.35E-05	2.92E-05	3.73E-03	4.45E-05	-9.71E-03

LR7-72HGD (620Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
GWP - total	kg CO_2 eq	3.50E-01	1.44E-02	3.26E-03	0.00E+00	5.72E-06	0.00E+00	1.36E-03	5.00E-04	6.00E-03	4.01E-04	-8.82E-02
GWP - fossil	kg CO_2 eq	3.50E-01	1.44E-02	1.55E-03	0.00E+00	5.69E-06	0.00E+00	1.36E-03	4.99E-04	5.92E-03	4.00E-04	-8.75E-02
GWP - biogenic	kg CO_2 eq	-2.43E-04	3.13E-06	1.71E-03	0.00E+00	2.14E-08	0.00E+00	4.67E-07	1.46E-07	7.07E-05	1.66E-07	-5.59E-04
GWP - luluc	kg CO_2 eq	3.74E-04	9.66E-06	1.85E-07	0.00E+00	9.92E-09	0.00E+00	1.54E-07	2.46E-07	9.33E-07	4.69E-08	-1.53E-04
ODP	kg CFC11 eq	7.04E-09	2.34E-10	2.50E-11	0.00E+00	1.61E-13	0.00E+00	2.18E-11	1.09E-11	1.33E-10	8.99E-12	-1.20E-09
AP	molc H+ eq	2.09E-03	2.72E-04	1.28E-05	0.00E+00	3.11E-08	0.00E+00	1.25E-05	1.09E-06	2.14E-05	5.32E-07	-4.44E-04

EP- freshwater	kg P eq	1.66E-05	8.63E-08	5.97E-09	0.00E+00	4.10E-10	0.00E+00	5.29E-09	4.05E-09	1.12E-07	1.41E-09	-2.88E-06
EP -marine	kg N eq	4.67E-04	6.78E-05	5.86E-06	0.00E+00	5.15E-09	0.00E+00	5.75E-06	2.69E-07	3.44E-06	1.92E-07	-9.30E-05
EP - terrestrial	molc N eq	4.59E-03	7.49E-04	6.38E-05	0.00E+00	5.82E-08	0.00E+00	6.26E-05	2.80E-06	4.16E-05	2.06E-06	-1.09E-03
POCP	kg NMVOC eq	1.39E-03	2.12E-04	1.90E-05	0.00E+00	2.13E-08	0.00E+00	1.86E-05	1.69E-06	1.78E-05	7.73E-07	-3.26E-04
ADP-M&M[2]	kg Sb-Eq	4.12E+00	1.88E-01	1.86E-02	0.00E+00	1.02E-04	0.00E+00	1.79E-02	7.09E-03	9.33E-02	1.72E-03	-1.12E+00
ADP-fossil[2]	MJ	1.86E-05	2.71E-08	7.03E-10	0.00E+00	2.99E-11	0.00E+00	5.11E-10	1.63E-09	1.05E-08	2.63E-10	-2.15E-06
WDP[2]	m^3	3.46E-01	5.92E-04	6.10E-05	0.00E+00	7.80E-04	0.00E+00	5.35E-05	2.92E-05	3.74E-03	4.85E-05	-9.69E-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*

Reading example: 9.0 E-03 = $9.0*10^{-3}$ = 0.009

Additional environmental impact indicators

LR5-72HGD (590Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
PM	Disease incidence	2.62E-08	6.79E-10	3.52E-10	0.00E+00	3.26E-13	0.00E+00	3.46E-10	3.69E-11	9.77E-11	9.43E-12	-4.28E-09
IRP1	kBq U235 eq.	7.53E-03	5.52E-05	5.25E-06	0.00E+00	7.30E-07	0.00E+00	4.53E-06	3.58E-06	2.25E-04	1.63E-06	-2.89E-03
ETP-fw2	CTUe	2.28E+00	9.53E-02	1.00E-02	0.00E+00	2.74E-05	0.00E+00	8.41E-03	3.50E-03	1.16E-02	1.89E-02	-2.23E-01
HTP-c2	CTUh	2.11E-10	6.35E-12	6.36E-13	0.00E+00	2.64E-14	0.00E+00	4.16E-13	2.27E-13	1.58E-12	6.38E-14	-4.51E-11
HTP-nc2	CTUh	4.18E-09	8.88E-11	4.88E-12	0.00E+00	3.46E-13	0.00E+00	2.97E-12	5.02E-12	2.90E-11	1.85E-12	-7.23E-10
SQP2	Dimensionless	1.26E+00	5.69E-02	1.74E-03	0.00E+00	2.34E-05	0.00E+00	1.24E-03	4.28E-03	1.43E-02	2.81E-03	-4.50E-01

LR7-72HGD (620Wp)

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
PM	Disease incidence	2.58E-08	6.81E-10	3.50E-10	0.00E+00	3.10E-13	0.00E+00	3.46E-10	3.70E-11	9.80E-11	9.58E-12	-4.17E-09
IRP[1]	kBq U235 eq.	7.45E-03	5.54E-05	5.08E-06	0.00E+00	6.95E-07	0.00E+00	4.53E-06	3.59E-06	2.25E-04	1.79E-06	-2.84E-03
ETP-fw[2]	CTUe	2.25E+00	9.56E-02	9.58E-03	0.00E+00	2.61E-05	0.00E+00	8.41E-03	3.50E-03	1.16E-02	2.16E-02	-2.23E-01
HTP-c[2]	CTUh	2.05E-10	6.37E-12	5.71E-13	0.00E+00	2.51E-14	0.00E+00	4.16E-13	2.28E-13	1.58E-12	7.00E-14	-4.40E-11
HTP-nc[2]	CTUh	4.12E-09	8.91E-11	4.47E-12	0.00E+00	3.29E-13	0.00E+00	2.97E-12	5.03E-12	2.91E-11	2.08E-12	-7.12E-10
SQP[2]	Dimensionless	1.19E+00	5.70E-02	1.65E-03	0.00E+00	2.23E-05	0.00E+00	1.24E-03	4.29E-03	1.44E-02	2.82E-03	-4.45E-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

LR5-72HGD (590Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
RPEE	MJ	7.66E-01	1.88E-03	2.23E-04	0.00E+00	1.59E-05	0.00E+00	1.99E-04	1.11E-04	2.36E-02	1.79E-02	-1.38E-01
RPEM	MJ	1.78E-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	-1.78E-02	0.00E+00
TPE	MJ	7.84E-01	1.88E-03	2.23E-04	0.00E+00	1.59E-05	0.00E+00	1.99E-04	1.11E-04	2.36E-02	7.81E-05	-1.38E-01
NRPE	MJ	4.81E+00	1.82E-01	1.65E-01	0.00E+00	7.36E-05	0.00E+00	1.73E-02	6.83E-03	8.71E-02	1.59E-03	-1.23E+00
NRPM	MJ	1.47E-01	0.00E+00	-1.47E-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	4.96E+00	1.82E-01	1.82E-02	0.00E+00	7.36E-05	0.00E+00	1.73E-02	6.83E-03	8.71E-02	1.59E-03	-1.23E+00
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W	m^3	9.30E-03	2.02E-05	2.37E-06	0.00E+00	1.92E-05	0.00E+00	1.80E-06	1.02E-06	1.00E-04	1.08E-05	-4.06E-04

LR7-72HGD (620Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
RPEE	MJ	7.52E-01	1.89E-03	2.18E-04	0.00E+00	1.51E-05	0.00E+00	1.99E-04	1.12E-04	2.36E-02	1.52E-02	-1.36E-01
RPEM	MJ	1.51E-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	-1.51E-02	0.00E+00
TPE	MJ	7.67E-01	1.89E-03	2.18E-04	0.00E+00	1.51E-05	0.00E+00	1.99E-04	1.12E-04	2.36E-02	8.59E-05	-1.36E-01
NRPE	MJ	4.74E+00	1.83E-01	1.64E-01	0.00E+00	7.00E-05	0.00E+00	1.73E-02	6.85E-03	8.73E-02	1.65E-03	-1.21E+00
NRPM	MJ	1.46E-01	0.00E+00	-1.46E-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	4.89E+00	1.83E-01	1.80E-02	0.00E+00	7.00E-05	0.00E+00	1.73E-02	6.85E-03	8.73E-02	1.65E-03	-1.21E+00
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W	m^3	9.18E-03	2.02E-05	2.22E-06	0.00E+00	1.82E-05	0.00E+00	1.80E-06	1.02E-06	1.01E-04	1.21E-05	-4.02E-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

LR5-72HGD (590Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
HW	kg	5.76E-04	1.05E-06	1.25E-07	0.00E+00	3.12E-10	0.00E+00	1.19E-07	4.50E-08	3.13E-07	8.49E-09	2.47E-06
NHW	kg	4.60E-02	4.28E-03	7.23E-05	0.00E+00	1.24E-06	0.00E+00	2.62E-05	3.51E-04	4.25E-02	1.14E-02	-1.03E-02
RW	kg	5.00E-06	3.17E-08	3.25E-09	0.00E+00	5.83E-10	0.00E+00	2.77E-09	2.33E-09	2.01E-07	1.02E-09	-1.75E-06

LR7-72HGD (620Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
HW	kg	5.71E-04	1.05E-06	1.24E-07	0.00E+00	2.97E-10	0.00E+00	1.19E-07	4.51E-08	3.14E-07	8.81E-09	2.22E-06
NHW	kg	4.52E-02	4.29E-03	6.41E-05	0.00E+00	1.18E-06	0.00E+00	2.62E-05	3.52E-04	4.27E-02	1.14E-02	-1.01E-02
RW	kg	4.95E-06	3.18E-08	3.14E-09	0.00E+00	5.55E-10	0.00E+00	2.77E-09	2.33E-09	2.02E-07	1.12E-09	-1.72E-06

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

End of life – output flow

LR5-72HGD (590Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
CR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	6.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.25E-02	0.00E+00

MER	kg	0.00E+00	0.00E+00	7.53E-04	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-02	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-02	0.00E+00

LR7-72HGD (620Wp)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
CR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	5.93E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E-02	0.00E+00
MER	kg	0.00E+00	0.00E+00	5.67E-04	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-02	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.44E-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	LR5-72HGD	LR7-72HGD
Biogenic carbon content in product	kg C/FU	0	0
Biogenic carbon content in the accompanying packaging	kg C/FU	5.59E-04	4.67E-04

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2

Additional requirements

Location based electricity mix from the use of electricity in manufacturing

In the context of China, a market-based approach is not applicable due to the absence of a Guarantee of Origin system. Therefore, a location-based approach is employed to assess the environmental impact of electricity in this EPD. Regional production mix from medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process (A3).

Regional electricity grid	Data source	Foreground / core [kWh]	GWP_{total} [kg CO_2 -eq/kWh]	SUM [kg CO_2 -eq]
Electricity, medium voltage {CN-ECGC}| market for electricity, medium voltage | Cut-off, U	ecoinvent 3.9	1.25E-2~1.34E-2	0.857	1.07E-2~1.15E-2
Electricity, low voltage {CN-SH}| electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted | Cut-off, U	ecoinvent 3.9	1.26E-3~1.50E-3	0.0885	1.11E-4~1.33E-4

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.

Series	Unit	A1-A3	A4	A5	B1	B2	B3-B7	C1	C2	C3	C4	D
LR5-72HGD	kg CO_2 eq	3.55E-01	1.44E-02	1.59E-03	0.00E+00	5.99E-06	0.00E+00	1.36E-03	4.98E-04	5.91E-03	3.56E-04	-8.93E-02
LR7-72HGD	kg CO_2 eq	3.50E-01	1.44E-02	1.55E-03	0.00E+00	5.70E-06	0.00E+00	1.36E-03	4.99E-04	5.92E-03	4.00E-04	-8.77E-02

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

Hazardous substances

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

- ☐ The product contains no substances given by the REACH Candidate list.
- ✓ The product contains substances given by the REACH Candidate list that are less than 0,1 % by weight.
- ☐ The product contains dangerous substances, more than 0,1% by weight, given by the REACH Candidate List, see table.
- ☐ The product contains no substances given by the REACH Candidate list.
- ☐ The product is classified as hazardous waste, see table.

Indoor environment

This is not relevant to the product under study.

Carbon footprint (A1-C4)

Product	Unit	Norway (I_{rad}=1000 kWh·m^{-2}year^{-1})	Italy (I_{rad}=1600 kWh·m^{-2}year^{-1})
LR5-72HGD (590Wp)	g CO2 eq./kWh	13.8	8.65
LR7-72HGD (620Wp)	g CO2 eq./kWh	13.6	8.48

EPD results conversion factors of various power output ranges

LR5-72HGD

Rated power output range (Wp)	560	565	570	575	580	585
Conversion factor*	1.054	1.044	1.035	1.026	1.017	1.009

*Note: Environmental impacts of other power outputs are determined by multiplying the results for 590 Wp by relevant conversion factors.

LR7-72HGD

Rated power output range (Wp)	585	590	595	600	605	610	615
Conversion factor*	1.060	1.051	1.042	1.033	1.025	1.016	1.008

*Note: Environmental impacts of other power outputs are determined by multiplying the results for 620 Wp by relevant conversion factors.

Bibliography

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