epd-norge.no
The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804+A1

Owner of the declaration:	SunPower
Program operator:	The Norwegian EPD Foundation
Publisher:	The Norwegian EPD Foundation
Declaration and registration number:	NEPD-3087-1726-EN
Issue date:	09.09.2021
Valid to:	09.09.2026

MAXEON 3 MONO-CRYSTALLINE PHOTOVOLTAIC MODULE

SunPower

SUNPOWER®

www.epd-norge.no

General information

Product

MAXEON 3
MONO-CRYSTALLINE PHOTOVOLTAIC MODULE

Program holder

The Norwegian EPD Foundation

Post Box 5250 Majorstuen, 0303 Oslo, Norway
Phone: (+47) 23 08 80 00
e-mail: post@epd-norge.no

Declaration number

NEPD-3087-1726-EN

This declaration is based on Product Category Rules:

NPCR 029 version 1.1

Statements

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

Declared unit:

1m² of mono-crystalline solar panel

Declared unit with option:

N/A

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

Third party verifier:

Michael M. Jenssen, Asplan Viak AS
(Independent verifier approved by EPD Norway)

Owner of the declaration

SunPower

Manufacturer

SunPower

12 Allée du Levant, 69890 La Tour de Salvagny, France
Phone: (+33) 7 60 59 84 73
e-mail: Karin.Alberto-Burkhardt@sunpower.com
Web: www.sunpower.com

Place of production:

Prolongación Lazaro Cardenas, Agustín Sanguines 3101, Huertas de La Progreso, 21188 Mexicali, B.C
Mexico

Management system:

ISO 14001, ISO 9001

Organisation no:

FR52344584818

Issue date

09.09.2021

Valid to

09.09.2026

Year of study:

2020

Comparability:

EPD of construction products may not be comparable if they do not comply with EN15804 and are seen in a building context

The EPD has been worked out by:

EVEA
11 rue Voltaire
44000 NANTES
FRANCE

Approved

Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:
400Wp mono-crystalline solar photovoltaic module with back-contact conductivity, solid metal backing and thick connectors. The panels are designed to be installed on roofs or as stand-alone systems for local power production.

The 2 other products covered by the PEP differ only in colour for the BLK product and the connector type for the COM product.

As the differences between products is minor, no averaging has been performed.

To produce their panels, SunPower sources silicon wafers from Norway and the US, which are sent to their factory in the Phillipines to produce the solar cells. These cells are then sent to their factory in Mexico, where they are assembled with the backsheet, frame and electrical connections to produce the finished solar module.

Technical data:
The panel considered for this EPD has a power rating of 400W.
1 complete panel has a mass of 19 kg without packaging.
The packaging per panel weighs 1.36 kg.
The overall dimensions are 1690x1046x40 mm.

Certified: IEC 61215, IEC 61730 Class 1 fire rated per UNI 9177

Market:
Norway / Europe / World

Reference service life:
25 years

Product specification
Sold as individual panels, with an effective surface area of 1.77m². The packaging consists of LDPE film, PP, PET and a cardboard box, and the panels are delivered on a wooden pallet.

The product consists of the following materials per functional unit:

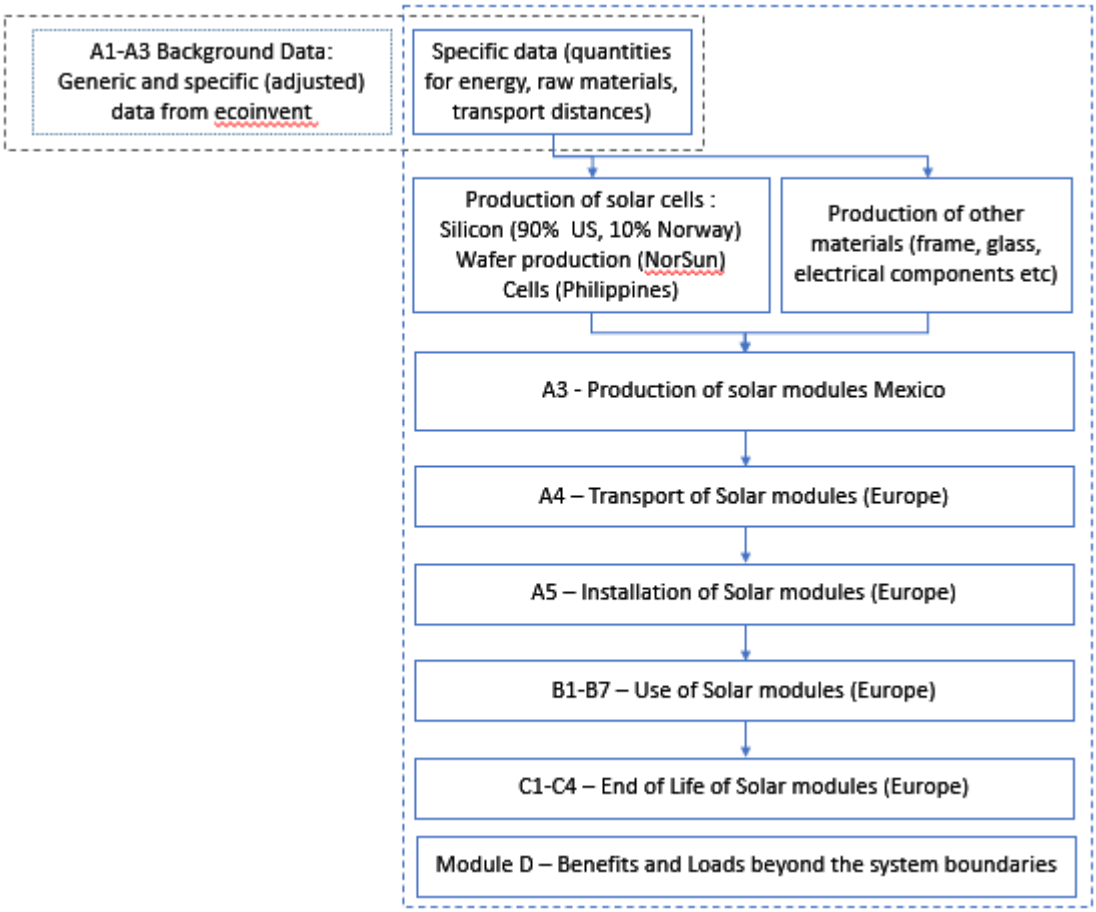
Materials	kg / FU	%
Copper	1,63E-04	0,31%
Tin	6,52E-06	0,01%
Silver	2,72E-07	0,00%
Cell	1,19E-03	2,29%
Label	1,23E-05	0,02%
Junction BOX	5,49E-04	1,06%
Backsheet PET	8,14E-04	1,57%
EVA	3,52E-03	6,80%
Aluminium	3,99E-03	7,72%
Solar glass	3,81E-02	73,58%
Packaging : LDPE Film	3,85E-07	0,00%
Packaging : PP	4,09E-04	0,79%
Packaging : PET	8,14E-04	1,57%
Packaging : Cardboard	2,56E-05	0,05%
Packaging : Pallet	2,17E-03	4,20%

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)

Declared unit:
1 m² of photovoltaic module – 1 m² = 226 Wp

System boundary:
The flow chart for the life cycle of SunPower Maxeon panels is shown below.



Data quality:
Specific data provided by SunPower for the year 2019.

The procedures defined by the PCR regarding the data quality have been respected according to the following criteria:
• Temporal factor: LCI data has been sourced from the database ecoinvent 3.6, which was updated in 2019, and ELCD, updated in 2018. As such all LCI data has been updated within the last 10 years All primary data dates from product specific data collections from within the last 5 years.
• Geographical factor: Datasets appropriate to the location of the modelled flow have been selected when available. Certain datasets have been modified to better reflect the specific energy consumptions (see Appendix 2) of certain countries which are not available in the database. When specific data for a country is not available and could not be created, European processes were selected for flows attributed to Europe, and Global or Rest of World flows were used for all other flows.
• Technological factor: Datasets have been selected according to the actual processes used by the manufacturer. For generic products where no upstream data is available (e.g. packaging), manufacturing has been modelled according current practices.

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

Cut-off criteria:
All major raw materials and all the essential energy is included. The production process for raw materials and energy flows that are included with very small amounts (<1%) are not included – this included certain packaging materials used for the transport of components to the main production facility. The infrastructure relating to the manufacturing facility has also been exclude as it has negligeable impacts when considering the quantity of panels produced.

This cut-off rule does not apply for hazardous materials and substances.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD. All data is provided per functional unit
The transports step A4 covers the transport from the factory in Mexico to Europe by boat and truck.

Transport from production place to assembly/user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption	Value (tkm)
Truck	36	EURO5 16-32T	1000	0.0375 kg/tkm	0.09
Boat	50	Transoceanic Freight	8800	0.002 kg/tkm	0.79

Assembly (A5)
The installation of the product requires some metallic fasteners (screws).
The waste from the products packaging is counted in this stage.

	Unit	Value
Auxiliary (screws)	kg	2.34E-05
Material loss	kg	-
Output materials from waste treatment	kg	3.42E-03

Operational energy (B6) and water consumption (B7)
The panels produce electricity during their lifetime but require no inputs/outputs.

To calculate the expected energy production over the lifetime of the panels, the following formula may be used:

$$Energy = \sum_{k=1}^{25} P_{yield} \times \frac{P_{rated}}{1000} \times (\eta_r - 0.0025k)$$

Where:

Energy = Total energy produced by one panel (kWh)
P_{yield} = Average electricity produced per kWp (kWh/kWp – values available from IEC 61853-3)
P_{rated} = Energy rating of the panel (kWp)
η_r = 1 - Efficiency of the panel, assumed to consistently decrease by 0,25% per year for 25 years (initial value at k=1 of 99,75% efficiency assumed for the degradation during the first year)

End of Life (C1, C3, C4)
The end of life scenario taken into account is that of the program PVCYCLE, to which SunPower subscribe. Panels are sent for processing and separated into their component parts for recycling or elimination.

	Unit	Value
Hazardous waste disposed	kg	-
Collected as mixed construction waste	kg	4,83E-02
Reuse	kg	-
Recycling	kg	4,34E-02
Energy recovery	kg	4,88E-03
To landfill	kg	1,23E-05

Transport to waste processing (C2)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy Consumption	Value (tkm)
Truck	36	EURO5 16-32T	100	0.0375 kg/tkm	0.084

LCA: Results

The LCA results show the environmental impacts and resource input and output flows calculated according to EN 15804:2012+A1.
The results are shown per functional unit, which for this declaration is 1Wp, as well as per declared unit, which for this declaration is 1 m².
The LCA results have been calculated using the LCA software SimaPro 9.

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

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries
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	MNR	MNR	MNR	MNR	MNR	MNR	MNR	X	X	X	X

Environmental impact – Functional Unit

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
GWP	kg CO_2 -eqv	3,42E-01	1,35E-02	8,56E-04	7,97E-04	5,73E-04	6,39E-06	-1,38E-01
ODP	kg CFC11-eqv	3,47E-07	2,28E-09	2,07E-11	1,46E-10	5,87E-11	4,56E-14	-9,02E-09
POCP	kg C_2H_4 -eqv	2,89E-04	1,13E-05	1,26E-07	4,15E-07	1,65E-07	2,58E-10	-4,84E-05
AP	kg SO_2 -eqv	1,86E-03	1,33E-04	7,42E-07	2,55E-06	2,18E-06	2,74E-09	-5,57E-04
EP	kg PO_4^{3-}-eqv	2,60E-04	1,37E-05	1,55E-07	4,15E-07	3,05E-07	8,93E-10	-6,88E-05
ADPM	kg Sb-eqv	5,23E-05	2,39E-07	3,69E-09	2,18E-08	3,27E-09	3,58E-12	-1,43E-05
ADPE	3,95E+00	1,90E-01	2,06E-03	1,19E-02	5,37E-03	3,83E-06	-1,35E+00	3,83E-06

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Resource use – Functional Unit

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
RPEE	MJ	1,41E+00	3,53E-03	1,81E-04	1,71E-04	1,73E-03	1,31E-07	-4,73E-01
RPEM	MJ	4,11E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TPE	MJ	1,61E+00	3,53E-03	1,81E-04	1,71E-04	1,73E-03	1,31E-07	-4,73E-01
NRPE	MJ	4,56E+00	1,95E-01	2,40E-03	1,21E-02	9,37E-03	4,01E-06	-1,55E+00
NRPM	MJ	2,09E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TRPE	MJ	4,77E+00	1,95E-01	2,39E-03	1,21E-02	9,37E-03	4,01E-06	-1,55E+00
SM	kg	2,85E-03	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
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3	1,63E-02	2,17E-05	2,19E-06	1,25E-06	1,11E-05	1,43E-08	-1,15E-03

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

End of life - Waste – Functional Unit

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
HW	kg	2,51E-02	1,46E-04	3,44E-05	7,81E-06	3,28E-05	3,28E-06	-1,34E-03
NHW	kg	1,77E-01	7,54E-03	4,35E-04	6,38E-04	1,77E-04	1,56E-07	-3,92E-02
RW	kg	1,67E-05	1,31E-06	1,29E-08	8,28E-08	6,79E-08	1,42E-11	-4,46E-06

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

End of life - Output flow – Functional Unit

Parameter	Unit	A1 – A3	A4	A5	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
MR	kg	3,76E-03	0,00E+00	2,21E-03	0,00E+00	4,32E-02	0,00E+00	0,00E+00
MER	kg	1,61E-04	0,00E+00	5,68E-04	0,00E+00	4,88E-03	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
ETE	MJ	5,97E+00	1,99E-01	2,58E-03	1,23E-02	1,11E-02	4,14E-06	-2,02E+00

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

Reading example: 9,0 E-03 = $9,0*10^{-3}$ = 0,009

Environmental impact – Declared Unit (1 m²)

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
GWP	kg CO_2 -eqv	7,72E+01	3,04E+00	1,93E-01	1,80E-01	1,29E-01	1,45E-03	-3,12E+01
ODP	kg CFC11-eqv	7,84E-05	5,15E-07	4,67E-09	3,30E-08	1,33E-08	1,03E-11	-2,04E-06
POCP	kg C_2H_4 -eqv	6,53E-02	2,56E-03	2,84E-05	9,37E-05	3,73E-05	5,84E-08	-1,09E-02
AP	kg SO_2 -eqv	5,87E-02	3,09E-03	3,51E-05	9,38E-05	6,90E-05	2,02E-07	-1,55E-02
EP	kg PO_4^{3-}-eqv	5,87E-02	3,09E-03	3,51E-05	9,38E-05	6,90E-05	2,02E-07	-1,55E-02
ADPM	kg Sb-eqv	1,18E-02	5,39E-05	8,35E-07	4,93E-06	7,38E-07	8,08E-10	-3,23E-03
ADPE	8,92E+02	4,29E+01	4,65E-01	2,69E+00	1,21E+00	8,65E-04	-3,06E+02	8,65E-04

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Resource use – Declared Unit (1 m²)

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
RPEE	MJ	3,19E+02	7,98E-01	4,09E-02	3,87E-02	3,90E-01	2,95E-05	-1,07E+02
RPEM	MJ	9,29E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TPE	MJ	3,64E+02	7,98E-01	4,09E-02	3,87E-02	3,90E-01	2,95E-05	-1,07E+02
NRPE	MJ	1,03E+03	4,41E+01	5,41E-01	2,74E+00	2,12E+00	9,06E-04	-3,50E+02
NRPM	MJ	4,73E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
TRPE	MJ	1,08E+03	4,41E+01	5,41E-01	2,74E+00	2,12E+00	9,06E-04	-3,49E+02
SM	kg	6,45E-01	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
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
W	m^3	3,69E+00	4,91E-03	4,96E-04	2,83E-04	2,50E-03	3,22E-06	-2,61E-01

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

End of life - Waste – Declared Unit (1 m²)

Parameter	Unit	A1 – A3	A4	A5	C2	C3	C4	D
HW	kg	5,68E+00	3,29E-02	7,78E-03	1,76E-03	7,41E-03	7,42E-04	-3,04E-01
NHW	kg	3,99E+01	1,70E+00	9,83E-02	1,44E-01	4,01E-02	3,52E-05	-8,86E+00
RW	kg	3,78E-03	2,96E-04	2,91E-06	1,87E-05	1,53E-05	3,21E-09	-1,01E-03

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

End of life - Output flow – Declared Unit (1 m²)

Parameter	Unit	A1 – A3	A4	A5	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
MR	kg	8,49E-01	0,00E+00	5,00E-01	0,00E+00	9,77E+00	0,00E+00	0,00E+00
MER	kg	3,63E-02	0,00E+00	1,28E-01	0,00E+00	1,10E+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
ETE	MJ	1,35E+03	4,49E+01	5,82E-01	2,78E+00	2,51E+00	9,35E-04	-4,56E+02

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

Additional Norwegian requirements

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

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

Data source	Process	Amount	Unit
Mexico: Ecoinvent v3.6	Electricity, medium voltage {MX}| market for | Cut-off, U	0.583	CO_2-eqv/kWh
Phillipines: Ecoinvent v3.6	Electricity, medium voltage {PH}| market for electricity, medium voltage | Cut-off, U	0.723	CO_2-eqv/kWh
Germany: Ecoinvent v3.6	Electricity, medium voltage {DE}| market for | Cut-off, U	0.168	CO_2-eqv/kWh
Norway: Ecoinvent v3.6	Electricity, medium voltage {NO}| market for | Cut-off, U	0.020	CO_2-eqv/kWh
USA: Ecoinvent v3.6	Electricity, medium voltage {US}| market group for | Cut-off, U	0.558	CO_2-eqv/kWh

Dangerous substances

☑ The product contains no substances given by the REACH Candidate list or the Norwegian priority list.

Indoor environment

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

Carbon footprint

Carbon footprint has not been worked out for the product.

Bibliography

ISO 14025:2010	*Environmental labels and declarations - Type III environmental declarations - Principles and procedures*
ISO 14044:2006	*Environmental management - Life cycle assessment - Requirements and guidelines*
EN 15804:2012+A1:2013	*Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products*
ISO 21930:2007	*Sustainability in building construction - Environmental declaration of building products*
LCA Report	*SUNPOWER MAXEON 3 MONO-CRYSTALLINE PHOTOVOLTAIC MODULE REPORT (EVEA, 2021)*
LCA Report	*Life Cycle Assessment – Modules production in Mexico, Ensenada (Solstyce SAS, 2018)*
PCR	*NPCR 029 version 1.1* *PCR – 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*
Other references	-

epd-norge.no The Norwegian EPD Foundation	**Program operator** The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo Norway	Phone: e-mail: web	+47 23 08 80 00 post@epd-norge.no www.epd-norge.no
epd-norge.no The Norwegian EPD Foundation	**Publisher** The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo Norway	Phone: e-mail: web	+47 23 08 80 00 post@epd-norge.no www.epd-norge.no
SUNPOWER®	**Owner of the declaration** SunPower 12 Allée du Levant 69890 La Tour de Salvagny France	Phone: e-mail: web	+33 7 60 59 84 73 Karin.Alberto-Burkhardt@sunpower.com www.sunpower.com
evea fabrique de solutions durables	**Author of the Life Cycle Assessment** EVEA 11 rue Voltaire 44000 Nantes France	Phone: e-mail: web	+33 2 28 07 87 00 info@evea-conseil.com www.evea-conseil.com