

Environmental Product Declaration

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

Dualsun hybrid PVT panel SPRING 4



Owner of the declaration:
Dualsun SAS

Product name:
SPRING4

Declared unit:
1 m²

Product category /PCR:
NPCR 029 2022 Part B for PV modules 1.2

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
[text]

Registration number:
[text]

Issue date: 15/09/2024

Valid to: 14/09/2029

General information

Product:

SPRING 4

Program operator:

The Norwegian EPD Foundation
Post Box 5250 Majorstuen, 0303 Oslo, Norway
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Declaration number:

[From EPD-Norge]

This declaration is based on Product Category Rules:

NPCR 029 2022 Part B for PV modules 1.2

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 evidence.

Declared unit:

1 m2 of SPRING 4 module.

Functional unit:

Two FU were considered:

- 1 Wp of combined electricity and thermal power output, of which 32% is electricity and 68% is thermal.
- 1 Wp of PV power output.

Verification:

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

internal external

Kristine Bjordal

Independent verifier approved by EPD Norway

Owner of the declaration:

Dualsun SAS
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Manufacturer :

Dualsun SAS
2 rue Marc Donadille 13013 Marseille, France
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e-mail: contact@dualsun.fr

Place of production:

France

Management system:

ISO 9001

Organization no:

FR15523618320

Issue date:

15/09/2024

Valid to:

14/09/2029

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:

Yazid Charkani - Kapstan

Approved

Product

Product description:

SPRING product series are the 1st certified hybrid solar panels in the world, manufactured in France, for dual solar production: electricity on the front and hot water on the back.

The front pv panel is made of two parts, a front photovoltaic panel for electricity production and a back side for hotwater production.



⚡ FRONT SIDE

Electricity production

- ✓ Double-glass structure
- ✓ High-efficiency monocrystalline cells

🔥 BACK SIDE

Hot water production

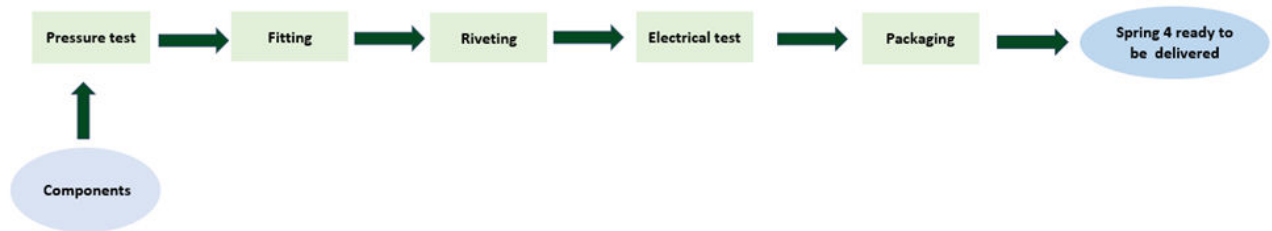
- ✓ Aluminum heat exchanger fully integrated into the panel
- ✓ Patented worldwide
- ✓ Increased photovoltaic efficiency by cooling of the cells

This EPD represents multiples references with small variations over the weight of the heat exchanger and the integration of insulation. The results are calculated based on the maximum inventory amongst the modules. The variation between each module results is lower than 10 %.

There are 3 different versions of the same product :

	DSTF	DSTN	DSTI
Technical specification	The heat exchanger is finned (Wings are soldered on the back)	The heat exchanger is not isolated	The heat exchanger is isolated
Target application	Combined to a heat pump	Combined to a geothermic heat pump	For domestic hot water production

Assembly process:



Step 1 - Pressure test : The front pv panels are first pressure tested with a regulator machine. Consuming only compressed air.

Step 2 – Fitting : Pv module are put in the assembling machine with the help of a handling arm

Step 3 - Riveting : Two rivets are manually created.

Step 4 - Electrical test : The module is tested to ensure the rear part is electrically isolated from the rest and that there is no electrical current.

Step 5 - Packaging : After the tests the modules are then packed with the help of the handling arm machine.

Product specification:

	Materials	KG / DU	%
Production materials	Cells	5.15E-01	1%
	Aluminium in frame	2.70E+00	7%
	Aluminium in back panel	1.06E+01	28%
	Stainless steel	1.80E+00	5%
	PP	1.32E-01	0%
	Glass	1.94E+01	51%
	EVA	1.03E+00	3%
	Copper	1.78E-01	0%
	EPE	1.02E+00	3%
	Tin	2.06E-02	0%
	Junction box	2.50E-01	1%
	Sealant	2.20E-01	1%
	Packaging materials	Pallet	1.60E+00
Cardboard		1.73E+01	92%

Technical data:

IEC 61215 / 61730, IEC 61701, IEC 61215, IEC 62782, IEC 62716, ISO 11925-2, IEC 62938, IEC 62804, AS 40404.2 DIN EN 12975:2022-06, DIN EN ISO 9806:2018-04, ISO 17065.

Market:

World

Reference service life, product:

30 years

Product scope

This EPD is valid for the following module references:

- DSTF
- DSTN
- DSTI

Characteristics	Unit	DSTF	DSTN	DSTI
Height	m	1.722	1.722	1.722
Width	m	1.134	1.134	1.134
Area	m ²	1.95	1.95	1.95
Power electricity output	Wp	425	425	425
Power heat output	Wp	895.05	939.9	854.1
Weight	kg	36.3	33.7	34.5

LCA: Calculation rules

Declared unit:

1 m2 of manufactured SPRING4 hybrid PVT module.

Cut-off criteria:

No known flows has been excluded from the study.

Allocation:

No allocation has been conducted in this study.

Data quality:

Specific data comes from actual consumption of the module assembly factory (May 2024). This data has been collected by the manufacturer and checked by the LCA practitioner. SPRING 4 is an innovative new product, so only one month of production was available. The results can be impacted by two parameters linked to the data period :

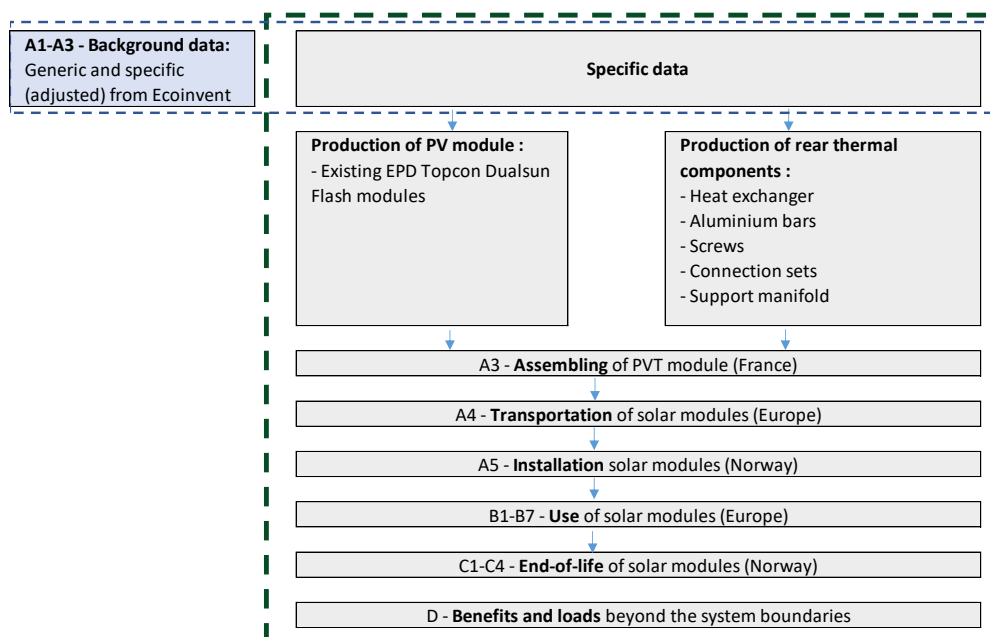
1. The Breakage and losses (the production yield of the factory).
2. The energy consumption ratio, in the case of the Spring 4 , the assembly process is very simple with manual labor thus not having any impact on the results.

It has been decided to limit the data period to one month as the product is an updated of an existing product (Spring 3), full 12 months data have been collected for this past version, the breakage and losses of both versions were compared, max value has been kept.

Generic data is from Ecoinvent v3.10 and Simapro v9.6.0.1. Characterization factors from EN15804:2012 + A2: 2019 adapted with EF3.1 method. Generic data <10 years old. Ecoinvent system model used: cut-off.

System boundary:

Cradle to grave



LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD. All data is provided per declared unit.

Transport from production place user (A4)

The transport step A4 covers the transport from the factory in France to the installation site in Norway by road. There is no installation site specifically identified. Therefore, Oslo has been considered for the calculations.

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance (km)	Fuel/Energy consumption	Value (tkm)
Truck	26.13%	16-32 metric ton lorry, EURO5	2 400	Diesel (4.44E-2 l/tkm)	8.71E+01

Fuel consumption is taken from ecoinvent 3.8

Assembly (A5)

The modules are installed by hand. The screwdriver electricity consumption is neglected. The fasteners (screws) and other additional materials are not included in the LCA. The only impact is the packaging waste given in the table below:

Item	Unit	Value
Wooden pallet	kg	1.60E+00
Cardboard	kg	6.92E-01

Use (B1)

Photovoltaic modules harness solar energy throughout their entire lifecycle via the photovoltaic effect. The amount of electricity they produce is directly influenced by solar irradiance. The electricity production is calculated as below:

$$Energy_{year\ i} = I_{sun} \times PR \times Eff_{panel} \times S_{1kWp} \times D_{panel}$$

Where :

- I_{sun} is the sun irradiation received by the module in kWh. m⁻².year⁻¹. The electricity production is calculated with a default $I_{sun} = 1300$ kWh. m⁻².year⁻¹. For a site with a different irradiation, the electricity production can be extrapolated based on the irradiation difference.
- PR, or Performance ratio, is the ratio between the energy produced by the panel and the final energy at the output of the photovoltaic system in order to take into account the various losses (cables, inverter, etc.). The energy produced is calculated by default with a PR of 0.75.
- Eff_{panel} , or panel efficiency, is the ratio between the energy produced and the solar radiation received.

- S_{1kWp} is the surface area to get 1 kWp.
- D_{panel} corresponds to the degradation of the panel in year i . This degradation is 1% the first year and then $0.4\% D_{panel} = 0.99 \times (1 - 0.40\%)^{i-1}$

As a result, the following chart illustrates the exported electricity energy (EEE):

Solar irradiance	Total electricity production	kWh/ piece
1 000	8 912	
1 100	9 803	
1 200	10 695	
1 300	11 586	
1 400	12 477	
1 500	13 368	
1 600	14 260	
1 700	15 151	

According to internal simulations the heat production per panel are :

Product	System	Heat production per year and per panel (kWh)	Source simulation	City (country)	Type of house	Needs (heating & hot water)	Assumptions
Spring 4 finned (DSTF)	Solar heatpump	870	TRNSys (ISFH)	Strasbourg (France)	4 people , house type SFH100 (heating consumption 100 kWh/m ² /year)	Heating : 15MWh	14 SPRING4 F
						Hot water : 2,4MWh	heat pump 12,5 kW BO/W35
						Electricity : 4MWh	N/A

Use (B2-B7)

The modules are considered as self-cleaning materials. No maintenance, repair, replacement or refurbishment is required during the module lifetime.

End of Life - Deinstallation (C1)

The modules are considered as removed by hand.

Transport to waste processing (C2)

It has been assumed that the modules are collected by truck and sent for recycling. 50 km is considered from the site to the recycling factory.

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance (km)	Fuel/Energy consumption	Value (tkm)
Truck	26.3%	16-32 metric ton lorry, EURO5	50	Diesel (4.44E-2 l/tkm)	1.82E+00

End of Life – Waste treatment (C3)

The detailed treatment route for each component is presented below :

	Quantity for modelling EPD	Unit	Scenarios
Module	3.63E+01	kg	Manually deconstructed and separation of waste into fractions. Processing of waste fractions until they reach an end-of-waste state and become materials for recycling.
Heat exchanger	8.07E+00	kg	Recycled
Aluminium bars	2.53E+00	kg	Recycled
Screws	4.03E-02	kg	Recycled
Connection set Inlet outlet	1.79E+00	kg	Recycled
Intermodule connection set	1.64E-01	kg	Recycled
Support manifold	1.88E-01	kg	Recycled

End of Life – Waste disposal (C4)

There is no incineration or refused parts for disposable.

Benefits and loads beyond the system boundaries (D)

Benefits and loads have been based on glass and aluminium frame recycling only. Waste from A1-A3 is not included.

Item	Unit	Value
Glass	Kg	1.93E+01
Aluminium	Kg	1.33E+01
Stainless steel	Kg	1.80E+00

LCA: Results

The LCA results show the environmental impacts and resource input and output flows calculated according to ISO 14025 and EN 15804 +A2. The results are shown per declared unit (which is 1 hybrid panel) and several functional units (PV part only and combined PV + thermal). The LCA results have been calculated using the LCA software SimaPro 9.4.

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

Classification of disclaimers to the declaration of core and additional environmental impact indicators

ILCD classification	Indicator	Disclaimer
ILCD type / level 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
	Acidification potential, Accumulated Exceedance (AP)	None
ILCD type / level 2	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
ILCD type / level 3	Potential Human exposure efficiency relative to U235 (IRP)	1
	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
Potential Soil quality index (SQP)	2	
Disclaimer 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.		
Disclaimer 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		

Results presented per functional unit (1Wp combined)

Core environmental impact indicators

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq.	2.53E-01	1.28E-02	1.97E-03	0.00E+00	0.00E+00	2.67E-04	9.37E-03	0.00E+00	-1.95E-01
GWP-fossil	kg CO2 eq.	2.53E-01	1.28E-02	9.17E-04	0.00E+00	0.00E+00	2.67E-04	9.36E-03	0.00E+00	-1.94E-01
GWP-biogenic	kg CO2 eq.	-9.08E-04	2.29E-06	1.05E-03	0.00E+00	0.00E+00	4.78E-08	8.81E-06	0.00E+00	-2.73E-04
GWP-LULUC	kg CO2 eq.	2.38E-04	4.19E-06	2.10E-08	0.00E+00	0.00E+00	8.75E-08	2.46E-06	0.00E+00	-5.55E-04
ODP	kg CFC11 eq.	1.75E-08	2.54E-10	1.44E-12	0.00E+00	0.00E+00	5.30E-12	3.56E-11	0.00E+00	-8.57E-10
AP	mol H ⁺ eq.	1.88E-03	4.00E-05	5.61E-07	0.00E+00	0.00E+00	8.35E-07	2.02E-05	0.00E+00	-1.30E-03
EP-freshwater	kg P eq.	1.94E-05	9.82E-08	1.11E-09	0.00E+00	0.00E+00	2.05E-09	7.55E-08	0.00E+00	-6.18E-06
EP-marine	kg N eq.	3.21E-04	1.33E-05	2.50E-07	0.00E+00	0.00E+00	2.78E-07	3.79E-06	0.00E+00	-1.97E-04
EP-terrestrial	mol N eq.	3.56E-03	1.47E-04	2.59E-06	0.00E+00	0.00E+00	3.06E-06	4.25E-05	0.00E+00	-2.19E-03
POCP	kg NMVOC eq.	1.31E-03	6.26E-05	7.15E-07	0.00E+00	0.00E+00	1.31E-06	1.27E-05	0.00E+00	-6.82E-04
ADP-M&M	kg Sb eq.	1.45E-05	4.19E-08	2.30E-10	0.00E+00	0.00E+00	8.75E-10	1.38E-07	0.00E+00	6.62E-07
ADP-fossil	MJ	1.73E+00	1.47E-02	1.17E-04	0.00E+00	0.00E+00	3.07E-04	7.33E-03	0.00E+00	-1.32E+00
WDP	m ³	8.61E-02	7.45E-04	1.12E-04	0.00E+00	0.00E+00	1.56E-05	1.12E-03	0.00E+00	-1.48E-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	B1-B7	C1-C4	C2	C3	C4	D
PM	disease incidence	2.08E-08	1.00E-09	6.10E-12	0.00E+00	0.00E+00	2.10E-11	2.19E-10	0.00E+00	-1.65E-08
IRP	kBq U-235 eq	2.24E-02	2.30E-04	1.71E-06	0.00E+00	0.00E+00	4.81E-06	1.76E-04	0.00E+00	-2.64E-03
ETP-fw	CTUe	2.48E+00	3.68E-02	3.11E-03	0.00E+00	0.00E+00	7.68E-04	3.69E-02	0.00E+00	-3.55E-01
HTP-c	CTUh	1.44E-09	8.84E-11	6.13E-13	0.00E+00	0.00E+00	1.85E-12	1.84E-11	0.00E+00	-1.08E-09
HTP-nc	CTUh	1.22E-08	4.37E-11	8.87E-13	0.00E+00	0.00E+00	9.13E-13	4.53E-11	0.00E+00	-1.25E-09
SQP	Dimensionless	1.20E+00	1.07E-01	5.03E-04	0.00E+00	0.00E+00	2.23E-03	2.25E-02	0.00E+00	-2.90E-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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
RPEE	MJ	5.55E-01	3.04E-03	1.83E-04	0.00E+00	6.36E-05	1.47E-05	1.36E-03	0.00E+00	-2.11E-02
RPEM	MJ	2.95E-05	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	5.55E-01	3.04E-03	1.83E-04	0.00E+00	6.36E-05	1.47E-05	1.36E-03	0.00E+00	-2.11E-02
NRPE	MJ	1.73E+00	1.47E-02	4.60E-03	0.00E+00	3.07E-04	1.16E-03	1.92E-03	0.00E+00	-2.00E-01
NRPM	MJ	1.50E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	1.73E+00	1.47E-02	4.60E-03	0.00E+00	3.07E-04	1.16E-03	1.92E-03	0.00E+00	-2.00E-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
W	m3	-9.05E-03	-1.14E-04	3.09E-06	0.00E+00	-2.38E-06	1.25E-07	1.54E-05	0.00E+00	-3.10E-05

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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
HW	kg	8.74E-04	5.43E-06	4.34E-04	0.00E+00	0.00E+00	1.13E-07	3.98E-03	0.00E+00	1.00E-03
NHW	kg	3.24E-01	1.04E-02	8.59E-05	0.00E+00	0.00E+00	2.18E-04	4.99E-03	0.00E+00	-1.85E-01
RW	kg	6.36E-06	5.72E-08	4.36E-10	0.00E+00	0.00E+00	1.19E-09	4.49E-08	0.00E+00	-6.45E-07

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

End of life – output flow

Indicator	Unit	A1-A3	A4	A5	B1-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
MR	kg	2.38E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-01	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-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.

Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit	Value
Biogenic carbon content in product	kg C	0.00E+00
Biogenic carbon content in the accompanying packaging	kg C	4.35E-04

Results presented per functional unit (1Wp PV)

Core environmental impact indicators

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq.	7.84E-01	3.97E-02	6.12E-03	0.00E+00	0.00E+00	8.29E-04	2.91E-02	0.00E+00	-6.04E-01
GWP-fossil	kg CO2 eq.	7.86E-01	3.97E-02	2.85E-03	0.00E+00	0.00E+00	8.29E-04	2.91E-02	0.00E+00	-6.02E-01
GWP-biogenic	kg CO2 eq.	-2.82E-03	7.10E-06	3.27E-03	0.00E+00	0.00E+00	1.48E-07	2.74E-05	0.00E+00	-8.49E-04
GWP-LULUC	kg CO2 eq.	7.41E-04	1.30E-05	6.52E-08	0.00E+00	0.00E+00	2.72E-07	7.63E-06	0.00E+00	-1.73E-03
ODP	kg CFC11 eq.	5.43E-08	7.89E-10	4.47E-12	0.00E+00	0.00E+00	1.65E-11	1.11E-10	0.00E+00	-2.66E-09
AP	mol H ⁺ eq.	5.82E-03	1.24E-04	1.74E-06	0.00E+00	0.00E+00	2.59E-06	6.29E-05	0.00E+00	-4.03E-03
EP-freshwater	kg P eq.	6.04E-05	3.05E-07	3.43E-09	0.00E+00	0.00E+00	6.37E-09	2.35E-07	0.00E+00	-1.92E-05
EP-marine	kg N eq.	9.98E-04	4.13E-05	7.77E-07	0.00E+00	0.00E+00	8.64E-07	1.18E-05	0.00E+00	-6.13E-04
EP-terrestrial	mol N eq.	1.11E-02	4.55E-04	8.05E-06	0.00E+00	0.00E+00	9.51E-06	1.32E-04	0.00E+00	-6.82E-03
POCP	kg NMVOC eq.	4.08E-03	1.94E-04	2.22E-06	0.00E+00	0.00E+00	4.06E-06	3.93E-05	0.00E+00	-2.12E-03
ADP-M&M	kg Sb eq.	4.50E-05	1.30E-07	7.13E-10	0.00E+00	0.00E+00	2.72E-09	4.28E-07	0.00E+00	2.06E-06
ADP-fossil	MJ	5.37E+00	4.56E-02	3.62E-04	0.00E+00	0.00E+00	9.54E-04	2.28E-02	0.00E+00	-4.11E+00
WDP	m ³	2.67E-01	2.32E-03	3.48E-04	0.00E+00	0.00E+00	4.84E-05	3.47E-03	0.00E+00	-4.60E-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	B1-B7	C1-C4	C2	C3	C4	D
PM	disease incidence	6.40E-08	3.10E-09	1.89E-11	0.00E+00	0.00E+00	6.49E-11	6.76E-10	0.00E+00	-5.11E-08
IRP	kBq U-235 eq	3.24E-02	2.54E-04	1.81E-06	0.00E+00	0.00E+00	5.31E-06	1.85E-04	0.00E+00	-3.08E-03
ETP-fw	CTUe	7.70E+00	1.14E-01	9.65E-03	0.00E+00	0.00E+00	2.39E-03	1.14E-01	0.00E+00	-1.10E+00
HTP-c	CTUh	4.48E-09	2.75E-10	1.90E-12	0.00E+00	0.00E+00	5.74E-12	5.73E-11	0.00E+00	-3.36E-09
HTP-nc	CTUh	3.79E-08	1.36E-10	2.76E-12	0.00E+00	0.00E+00	2.84E-12	1.41E-10	0.00E+00	-3.90E-09
SQP	Dimensionless	3.71E+00	3.31E-01	1.56E-03	0.00E+00	0.00E+00	6.92E-03	6.99E-02	0.00E+00	-9.00E-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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
RPEE	MJ	1.72E+00	9.45E-03	5.68E-04	0.00E+00	1.97E-04	4.57E-05	4.24E-03	0.00E+00	-6.56E-02
RPEM	MJ	9.18E-05	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	1.72E+00	9.45E-03	5.68E-04	0.00E+00	1.97E-04	4.57E-05	4.24E-03	0.00E+00	-6.56E-02
NRPE	MJ	5.37E+00	4.57E-02	1.43E-02	0.00E+00	9.54E-04	3.59E-03	5.95E-03	0.00E+00	-6.23E-01
NRPM	MJ	4.65E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	MJ	5.37E+00	4.57E-02	1.43E-02	0.00E+00	9.54E-04	3.59E-03	5.95E-03	0.00E+00	-6.22E-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
W	m3	-2.81E-02	-3.53E-04	9.61E-06	0.00E+00	-7.38E-06	3.87E-07	4.80E-05	0.00E+00	-9.64E-05

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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
HW	kg	2.72E-03	1.69E-05	1.35E-03	0.00E+00	0.00E+00	3.52E-07	1.23E-02	0.00E+00	3.11E-03
NHW	kg	1.01E+00	3.24E-02	2.67E-04	0.00E+00	0.00E+00	6.78E-04	1.55E-02	0.00E+00	-5.74E-01
RW	kg	1.97E-05	1.78E-07	1.36E-09	0.00E+00	0.00E+00	3.71E-09	1.39E-07	0.00E+00	-2.00E-06

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

End of life – output flow

Indicator	Unit	A1-A3	A4	A5	B1-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
MR	kg	7.39E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-01	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-01	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.

Information describing the biogenic carbon content at the factory gate

	Biogenic carbon content	Unit	Value
Biogenic carbon	Biogenic carbon content in product	kg C	0.00E+00
	Biogenic carbon content in the accompanying packaging	kg C	1.35E-03

Results presented per declared unit (1m2)

Core environmental impact indicators

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq.	1.71E+02	8.65E+00	1.33E+00	0.00E+00	0.00E+00	1.81E-01	6.35E+00	0.00E+00	-1.32E+02
GWP-fossil	kg CO2 eq.	1.71E+02	8.65E+00	6.21E-01	0.00E+00	0.00E+00	1.81E-01	6.34E+00	0.00E+00	-1.31E+02
GWP-biogenic	kg CO2 eq.	-6.15E-01	1.55E-03	7.13E-01	0.00E+00	0.00E+00	3.23E-05	5.97E-03	0.00E+00	-1.85E-01
GWP-LULUC	kg CO2 eq.	1.61E-01	2.84E-03	1.42E-05	0.00E+00	0.00E+00	5.92E-05	1.66E-03	0.00E+00	-3.76E-01
ODP	kg CFC11 eq.	1.18E-05	1.72E-07	9.74E-10	0.00E+00	0.00E+00	3.59E-09	2.41E-08	0.00E+00	-5.80E-07
AP	mol H ⁺ eq.	1.27E+00	2.71E-02	3.80E-04	0.00E+00	0.00E+00	5.65E-04	1.37E-02	0.00E+00	-8.79E-01
EP-freshwater	kg P eq.	1.32E-02	6.65E-05	7.48E-07	0.00E+00	0.00E+00	1.39E-06	5.11E-05	0.00E+00	-4.18E-03
EP-marine	kg N eq.	2.18E-01	9.01E-03	1.69E-04	0.00E+00	0.00E+00	1.88E-04	2.57E-03	0.00E+00	-1.34E-01
EP-terrestrial	mol N eq.	2.41E+00	9.92E-02	1.76E-03	0.00E+00	0.00E+00	2.07E-03	2.87E-02	0.00E+00	-1.49E+00
POCP	kg NMVOC eq.	8.90E-01	4.24E-02	4.84E-04	0.00E+00	0.00E+00	8.85E-04	8.57E-03	0.00E+00	-4.62E-01
ADP-M&M	kg Sb eq.	9.80E-03	2.84E-05	1.55E-07	0.00E+00	0.00E+00	5.92E-07	9.33E-05	0.00E+00	4.48E-04
ADP-fossil	MJ	1.17E+03	9.95E+00	7.90E-02	0.00E+00	0.00E+00	2.08E-01	4.96E+00	0.00E+00	-8.95E+02
WDP	m ³	5.83E+01	5.05E-01	7.59E-02	0.00E+00	0.00E+00	1.05E-02	7.57E-01	0.00E+00	-1.00E+01

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	B1-B7	C1-C4	C2	C3	C4	D
PM	disease incidence	1.39E-05	6.77E-07	4.12E-09	0.00E+00	0.00E+00	1.41E-08	1.47E-07	0.00E+00	-1.11E-05
IRP	kBq U-235 eq	7.06E+00	5.54E-02	3.95E-04	0.00E+00	0.00E+00	1.16E-03	4.04E-02	0.00E+00	-6.72E-01
ETP-fw	CTUe	1.68E+03	2.49E+01	2.10E+00	0.00E+00	0.00E+00	5.20E-01	2.50E+01	0.00E+00	-2.41E+02
HTP-c	CTUh	9.77E-07	5.98E-08	4.15E-10	0.00E+00	0.00E+00	1.25E-09	1.25E-08	0.00E+00	-7.32E-07
HTP-nc	CTUh	8.27E-06	2.96E-08	6.01E-10	0.00E+00	0.00E+00	6.18E-10	3.07E-08	0.00E+00	-8.49E-07
SQP	Dimensionless	8.09E+02	7.22E+01	3.40E-01	0.00E+00	0.00E+00	1.51E+00	1.52E+01	0.00E+00	-1.96E+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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
RPEE	MJ	3.75E+02	2.06E+00	1.24E-01	0.00E+00	4.30E-02	9.97E-03	9.24E-01	0.00E+00	-1.43E+01
RPEM	MJ	2.00E-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	3.75E+02	2.06E+00	1.24E-01	0.00E+00	4.30E-02	9.97E-03	9.24E-01	0.00E+00	-1.43E+01
NRPE	MJ	1.17E+03	9.95E+00	3.11E+00	0.00E+00	2.08E-01	7.83E-01	1.30E+00	0.00E+00	-1.36E+02
NRPM	MJ	1.01E+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	1.17E+03	9.95E+00	3.11E+00	0.00E+00	2.08E-01	7.83E-01	1.30E+00	0.00E+00	-1.36E+02
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
W	m3	-6.12E+00	-7.70E-02	2.09E-03	0.00E+00	-1.61E-03	8.44E-05	1.05E-02	0.00E+00	-2.10E-02

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

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
HW	kg	5.92E-01	3.67E-03	2.94E-01	0.00E+00	0.00E+00	7.67E-05	2.69E+00	0.00E+00	6.77E-01
NHW	kg	2.19E+02	7.07E+00	5.81E-02	0.00E+00	0.00E+00	1.48E-01	3.38E+00	0.00E+00	-1.25E+02
RW	kg	4.30E-03	3.87E-05	2.95E-07	0.00E+00	0.00E+00	8.09E-07	3.04E-05	0.00E+00	-4.37E-04

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

End of life – output flow

Indicator	Unit	A1-A3	A4	A5	B1-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
MR	kg	3.14E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.67E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E+02	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.18E+01	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.

Information describing the biogenic carbon content at the factory gate

	Biogenic carbon content	Unit	Value
Biogenic carbon	Biogenic carbon content in product	kg C	0.00E+00
	Biogenic carbon content in the accompanying packaging	kg C	2.94E-01

Additional requirements

Electricity reporting : location-based vs Market based approach

The electricity consumption of the manufacturing phase has been considered as insignificant, thus considered null.¹ For background electricity consumption (used in the manufacturing of aluminium heat exchanger) there is no system of GoO² in Romania, thus not applicable.

Additional environmental impact indicators required in NPCR Part A for construction products (per functional unit Wp combined)

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. GWP-BC is also presented for information.

Indicator	Unit (per FU)	EPD	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
EP-freshwater*	kg PO4 eq.	1.95E-05	1.94E-05	9.82E-08	1.11E-09	0.00E+00	0.00E+00	2.05E-09	7.55E-08	0.00E+00	-6.18E-06
GWP-IOBC	kg CO2 eq.	3.50E-01	8.28E-02	2.53E-01	1.28E-02	9.17E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.94E-01
GWP-BC	kg CO2 eq.	0.00E+00	-1.59E-03	0.00E+00	1.59E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GWP	kg CO2 eq.	3.50E-01	8.12E-02	2.53E-01	1.44E-02	9.17E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.94E-01

EP-freshwater* Eutrophication potential, fraction of nutrients reaching freshwater end compartment. Declared as PO4 eq. **GWP-IOBC** Global warming potential calculated according to the principle of instantaneous oxidation. **GWP-BC** Global warming potential from net uptake and emissions of biogenic carbon from the materials in each module. **GWP Global** warming potential.

Hazardous substances

The declaration is based upon reference to threshold values provided to EPD verifiers. Documentation available upon request to EPD owner.

➔ The product contains substances given by the REACH Candidate list that are less than 0,1 % by weight.

Indoor environment

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

Carbon footprint




Carbon footprint has been carried out for the product.

¹ The LCA practioner has visited the factory and checked that the assembly process is mainly with manual labor and no energy intensive machine is used.

² Guarantee of origins - [Renewable Energy Guarantees of Origin \(REGOs\) – Policies - IEA](#)

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+A2:2019	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	EPD SPRING4 report Dualsun crystalline solar panels v1.0
NPCR	NPCR 029 2022 Part B for PV modules 1.2
Simapro	Version 9.6.0.1
Ecoinvent	Version 3.10

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