Chint New Energy Technology Co., Ltd

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT NAME

CHSM72N-HC, CHSM72N(DG)/F-BH, CHSM54N(DGT)/ F-BH, CHSM54N-HC, CHSM54N(BL)-HC, CHSM54N(BLH)-HC, CHSM60N(DG)/F-HC

PLANT

Haining City, Zhejiang Province, China

In accordance with ISO 14025

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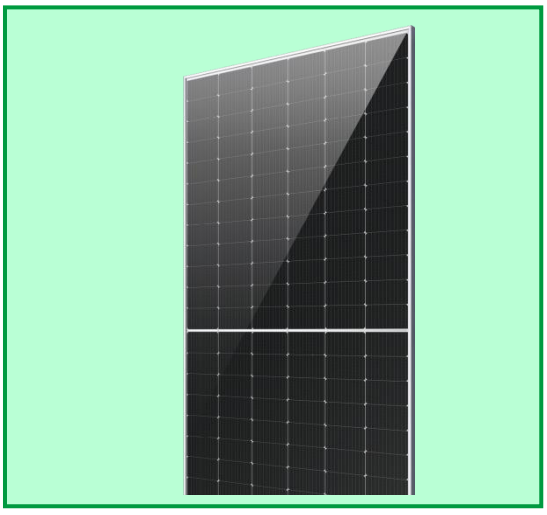

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GENERAL INFORMATION

EPD OWNER	
Name of the company	Chint New Energy Technology Co., Ltd
Registered office	No.1 Jisheng Road, Jianshan New Zone, 314415 Haining City, Zhejiang Province, China
Contacts for information on the EPD	na.shan@astronergy.com

PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD	
Product name (s)	CHSM72N-HC，CHSM72N(DG)/F-BH，CHSM54N(DGT)/ F-BH，CHSM54N-HC，CHSM54N(BL)-HC，CHSM54N(BLH)-HC，CHSM60N(DG)/F-HC
Site (s)	**Chint New Energy Technology Co., Ltd** No.1 Jisheng Road, Jianshan New Zone, 314415 Haining City, Zhejiang Province, China **Chint Solar (Haining) Co., Ltd** No.2 Jisheng Road, Jianshan New Zone, 314415 Haining City, Zhejiang Province, China
Short description and technical information of the product (s)	N-types PV modules, Reference service life: 30 years
Field of application of the product (s)	Electricity generation
Product (s) reference standards (if any)	
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	171

VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	EPDItaly 014: Electricity Produced by Photovoltaic Modules, version 1.1, 08/02/2022
EPDItaly Regulation (version, date of publication or update)	Regulations of the EPDItaly Programme, version 6, 2023/10/30
Project Report LCA	LCA report - Photovoltaic Module, Chint New Energy Technology Co., Ltd, v.4, 2024/08/09
Independent Verification Statement	The PCR review was performed by Ing. Daniele Pace, Arch. Michele Paleari, Ing. Sara Toniolo. Independent verification of the declaration and data, carried out according to ISO 14025: 2010. Internal ■ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.

Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable.
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

OTHER INFORMATION	
LCA software	SimaPro 9.5.1 (2023)
LCI database	Ecoinvent v3.9（2023）
LCIA methodology	EN 15804 + A2 Method

1. DESCRIPTION OF THE ORGANIZATION

EPD owner Chint New Energy Technology Co., Ltd. is part of the Astronergy.

Under the CHINT Group, Astronergy is an intelligent manufacturing enterprise focusing on photovoltaic cells and modules. Founded in 2006, it is one of the earliest private enterprises in China to set foot in the photovoltaic field. And it is a pioneer in n-type TOPCon PV modules.

Committed to being the most competitive photovoltaic module supplier worldwide, Astronergy sets its mission to create a sustainable and net-zero carbon world with solar power. Focusing on R&D, production and sales of high-efficiency crystalline silicon PV cells and PV modules, Astronergy has continuously launched the ASTRO series high-efficiency, high-quality, high-performance modules. Both its bifacial and monofacial ASTRO series modules using large-size wafers could be perfectly applied in various scenarios of utility-scale power stations, commercial & industrial (C&I) PV systems and residential PV systems. Pioneered in the mass production of n-type TOPCon PV modules, Astronergy keeps its lead in n-type TOPCon tech.

2. PRODUCT INTRODUCTION

Table 1 Technical data and geographical coverage

Manufacturing company name	Address	Country
CHINT NEW ENERGY TECHNOLOGY CO.,LTD.	No.1 Jisheng Road, Jianshan New District, Haining City, Zhejiang Province, China	China

Table 2. Different PV module products models

Product model/name	Weight （kg）	Cell size (mm)	Dimensions (mm)	Module efficiency (%)	Power Output range (W)
1. CHSM72N-HC	26.9	182	2278*1134*35	21.9%~22.6%	565~585W
2. CHSM72N(DG)/F-BH	32.1	182	2278*1134*30	21.7%~22.5%	560~580W
3. CHSM54N(DGT)/ F-BH	20.8	182	1722 * 1134* 30	21.0%~21.8%	410~425W
4. CHSM54N-HC	21.3	182	1722*1134*30	21.5%~22.3%	420~435W
5. CHSM54N(BL)-HC	21.3	182	1722*1134*30	21.3%~22.0%	415~430W
6.CHSM54N(BLH)-HC	21.3	182	1722*1134*30	21.3%~22.0%	415~430W
7. CHSM60N(DG)/F-HC	23	182	1908*1134*30	21.5%~22.4%	465~485W

Table 3: The PV material composition

Components	Units	CHSM72N-HC	CHSM72N(DG)/ F-BH	CHSM54N(DGT)/ F-BH	CHSM54N-HC	CHSM54N(BL)-HC	CHSM54N(BLH)-HC	CHSM60N(DG)/ F-HC
Cells	PCS	72.000	72.000	54.000	54.000	54.000	54.000	60.000
Connecting strip	kg	0.155	0.155	0.121	0.121	0.121	0.121	0.134
Positive glass	PCS	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Adhesive film (glass)	㎡	2.545	2.554	1.929	1.922	1.915	1.915	2.138
Adhesive film (back)	㎡	2.554	2.554	1.929	1.929	1.914	1.914	2.138
Back plane	㎡	2.572	/	/	1.944	1.944	1.944	/
Back glass	片	/	1.000	1.000	/	/	/	1.000
Metal strip	kg	0.040	0.040	0.040	0.040	0.045	0.045	0.040
Frame (long)	PCS	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Frame (short)	PCS	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Junction box	set	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sealant	kg	0.345	0.360	0.292	0.300	0.260	0.260	0.310
Sealant (A)	kg	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Sealant (B)	kg	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Components	Units	CHSM72N-HC	CHSM72N(DG)/ F-BH	CHSM54N(DGT)/ F-BH	CHSM54N-HC	CHSM54N(BL)-HC	CHSM54N(BLH)-HC	CHSM60N(DG)/ F-HC
Frame	PCS	0.032	0.028	0.028	0.028	0.028	0.028	0.028
Pallet	PCS	0.032	0.028	0.028	0.028	0.028	0.028	0.028
Lid	PCS	0.032	0.028	0.028	0.028	0.028	0.028	0.028
Paper washer	PCS	0.032	0.028	0.028	0.028	0.028	0.028	0.028
Corner protector	PCS	2.065	2.111	2.111	2.111	2.111	2.111	2.111
Wrapping film	roll	0.005	0.005	0.005	0.005	0.005	0.005	0.005
packing tape	kg	0.052	0.050	0.044	0.044	0.044	0.044	0.049
Corner protector	PCS	0.581	0.500	0.500	0.500	0.500	0.500	0.500

3. LCA BACKGROUND INFORMATION

3.1 DECLARED UNIT (FUNCTIONAL UNIT)

In this study, this declared unit shall be used for every life cycle module: 1 kWh of electricity generated as output from the solar photovoltaic plant. Once total energy has been calculated, the overall environmental impacts generated throughout the entire life cycle are divided by this value to return the results in the individual kWh produced.

$$Etot[kWh] = Eyear * RSL$$

RSL represents the reference service life of the module or plant. In order to ensure that EPDs based on this PCR can be compared, a constant fixed reference service life of 30 years is assumed.

For E_{tot} and E_{year} measurements, CHINT used the PVsyst software for each product and selected Italy as the site for simulation runs.

Table 4. PVsyst Simulation Run Info

Parameter	Numerical	Unit
Station	Italy	/
Longitude	12.83	°E
Latitude	42.83	°N
Meteorological data	Italy Meteonorm 8.1 (1991-2002), Sat=100%	/
Tilt	40	°
System power	31.52	MWp
Peak power of the plant	29139.1	kw

3.2 SYSTEM BOUNDARIES

The system boundary considered in this LCA study is from the cradle to the grave. According to the PCR, the life cycle stage must refer to segmentation in the following three modules:

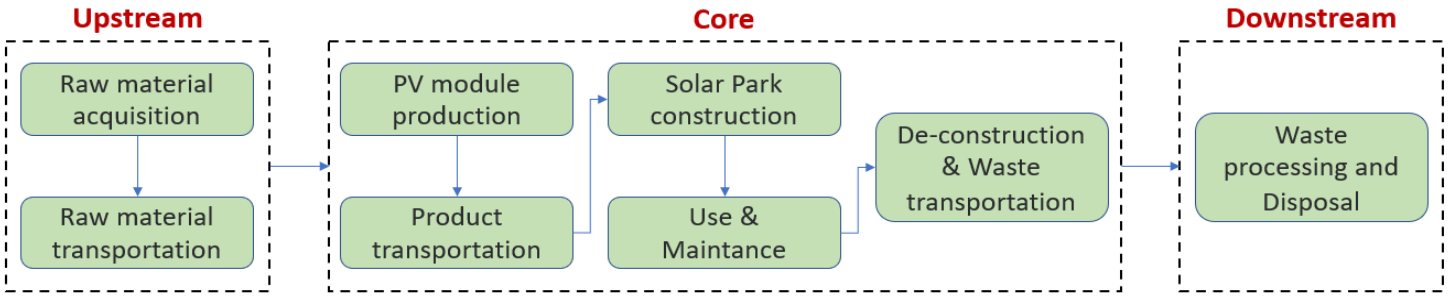
1. Upstream module： contains extraction and processing of raw materials, including silicon, hydrochloric acid, cell, and the transportation of the raw material to the factory.

2. Core module： which includes all the relevant processes managed by the Organization proposing the EPD; it includes manufacturing PV modules, transportationof PV modules to solar plant, construction of the solar plant, the use, maintenance, repair, replacement, refurbishment and the operational energy use and water use, de-construction and demolition of the solar plant, transport to waste processing.

3. Downstream module： in this study covers the processes of the final waste processing and disposal. According to the PCR, the benefit and avoided loads beyond the product system boundary are not reported within this study, nor will the benefit and loads be reported in other stages by following a cut-off allocation approach.

Figure 1 below illustrates the system boundaries for the PV modules, including manufacturing stage, transportation stage, installation stage, use stage, de-installation stage and disposal stage.

Figure 1. System boundary of PV



Detailed information on the segmentation for the upstream, core and downstream modules are presented in the following. To better illustrate the contents within each module, life cycle stages interpretations according to the EN 15804 is also provided.

Table 5. Division and declarations of life cycle stages

PCR Setting	Inclusion	Stages according to the EN 15804	
Upstream Module	X	A1	Raw material supply
	X	A2	Transport (to the manufacturer)
Core Module	X	A3	Manufacturing
	X	A4	Transport (to installation site)
	X	A5	Construction – installation process
	X	B1	Use
	X	B2	Maintenance
	X	B3	Repair
	X	B4	Replacement
	X	B5	Refurbishment
	X	B6	Operational energy use
	X	B7	Operational water use
	X	C1	De-construction and demolition
	X	C2	Transport (to waste processing)
Downstream Module	X	C3	Waste processing
	X	C4	Disposal
Benefits and loads beyond the system boundary	NMD	D	reuse, recovery and/or recycling potentials

Note: X =Declared Module, MND=Module not Declared in this LCA study

3.3 TEMPORAL AND GEOGRAPHICAL BOUNDARIES

All raw data collected by Astronergy is PV module production data from 1 November 2022 to 31 October 2023, which is a representative production time period. This is a full year annual cycle and the data is representative. Secondary data are also representative for this time period, as provided by ecoinvent v3.9.

3.4 EXCLUDED PROCESSES

The following steps/stages are not included in the system boundary for the reason that the elements below are considered irrelevant or can be omitted according to the PCR：

1.Production and disposal of the infrastructure and capital equipment (buildings, machines, transport media, roads, etc.) during products manufacturing, installation, and maintenance.

2.The load and benefit of recycling waste solar module as well as waste equipment from solar plant are excluded from the analysis.

3.Storage phases and sales of PV modules.

4. Product losses due to abnormal damage such as natural disasters or fire accidents.

5.The recycling process of defective products as it is reused internally for the manufacturing process.

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

3.5 KEY ASSUMPTIONS

The key assumptions of this LCA study are as follows:

1.For missing background data, substitution of missing data using similar background data approach was taken to shorten the gap.

2.For PV plant construction, operation and maintenance, the study refers to regulated publicly available PV plant construction reports as assumed values for calculations.

3.Assuming that the PV module dismantling phase (C1) uses the same amount of electricity as the PV module installation phase (A5). Refer to publicly available feasibility studies for the construction of photovoltaic power plants.

4. The transport distance from the sale of the product to the photovoltaic plant for installation is set at 300km, as is usual in Italy.

5. The transport distance of the dismantled PV modules to the waste treatment plant is 50km according to the usual situation in the Italian region.

6. All land transport during the transport phase is assumed to be 7.5-16 metric tons of truck transport.

7. Waste external packaging generated during the installation of photovoltaic modules is mainly plastic and wood and paper. These waste packages are assumed to be fully recycled.

8. The waste disposal method is assumed to be total landfill disposal.

9.It is assumed that the treatment (C3) and disposal (C4) of waste will be completed simultaneously at the disposal site. . Disposal method and ratio refer to WEEE.

10. Replacement (B4) No replacement for the module.

3.6 CUT-OFF CRITERI

In case of insufficient input data or data gaps for a unit process, according to the PCR requirement, the cut-off criteria chosen is 2% of the total mass and energy of that unit process. (Respectively, of the photovoltaic module's unit weight and the energy needed to produce and assemble it). The neglected flow is demonstrated in Table 6. For missing background data, substitution of missing data using similar background data was taken to shorten the gap.

Table 6. Cut -off flows

Flow name	Process stage	Mass%	Criteria to cut-off
Alkali polishing additive	Upstream	＜0.003%	＜2%
Cleaning additive		＜0.0001%	
Trimethyl aluminum		＜0.0001%	
Fleece additive		＜0.002%	
Junction box		＜0.3%	
sealant		＜0.02%	
3-Glycidoxypropyltrimethoxysilane		＜0.002%	
Dibutyltin diacetate		＜0.002%	
Production, use, and disposal of the packaging of components and semi-finished intermediates		＜1%	Specified in PCR
Any extraordinary maintenance done on the PV modules	Downstream	Not applicable	Specified in PCR
Total cut-off mass % estimated <2%			

3.7 DATA QUALITY

In this EPD, both primary and secondary data are used. Site specific foreground data have been

provided by CHINT. The main data sources are bill of materials,
production energy records, purchase and sales orders, etc. in the ERP system. For all processes for which primary are not available, generic data originating from the ecoinvent v3.9 database, allocation cut-off by classification, are used. The ecoinvent database is available in the SimaPro 9.5 software used for the calculation.

3.8 ALLOCATION RULES

1. Multi-input allocation

Multi-input assignments exist in module A3. The input of power consumption during the production of a product is the allocation of the total power of the different workshops according to the share of the production of the corresponding product in the different workshops.

2. Multi-output allocation

Multi-input assignments exist in modules A3, A4, B.

Module A3 Output Waste is an allocation of the total waste volume of the different workshops to the percentage of the corresponding products produced in the different workshops.

Module A4 is a distribution of product shipments by percentage corresponding to different sales regions.

As the power plant construction study was used for the data in module B, the data on the various types of raw materials and energy consumption therein were apportioned on a per WP basis, calculations are then made based on the WP values of different products.

3.End of life allocation

Multi-input assignments exist in modules C3, and C4.

Modules C3 and C4 allocate product end-of-life disposal and pollutant treatment according to the different substances, disposal methods and ratios required by WEEE.

4. Polluter Pays Principle

Modularity and polluter payer principles have been followed.

3.9 ENVIRONMENTAL IMPACT INDICATORS

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. It is mandatory that the LCA report and the EPD include the following environmental impact indicators, taken from EN 15804:2012+A2:2019. Meanwhile PCR EPDItaly014 also stipulates to include resource and waste disposed descriptive indicators. All indicators are calculated following the EN 15804:2012+A2:2019 (EF 3.1 normalization and weighting values, published in July 2022, were used).

Table 7. Environmental impact index

Impact category	Impact indicator	Abbreviation	Unit of measurement
Group 1: Indicators derived from LCA	Climate change (total)	GWP-total	kg CO2 eq
	Climate change (fossil)	GWP-fossil	kg CO2 eq
	Climate change (biogenic)	GWP-biogenic	kg CO2 eq
	Climate change (land use and land use change)	GWP-luluc	kg CO2 eq
	Ozone layer depletion (ODP steady state)	ODP	kg CFC-11 eq
	Acidification potential (accumulated exceedance)	AP	mol H+ eq
	Eutrophication (aquatic freshwater)	EP-F	kg P- eq
	Eutrophication (aquatic marine)	EP-M	kg N- eq
	Eutrophication (terrestrial)	EP-T	mol N eq
	Photochemical ozone creation potential (tropospheric ozone formation potential)	POCP	kg NMVOC eq
	Depletion of abiotic resources - elements, ultimate reserves	ADPE	kg Sb eq
	Depletion of abiotic resources - fossil fuels	ADPF	MJ
	Water use (Water (user) deprivation potential - weighted water consumption	WDP	m3(world equivalent deprived)
Group 2: Energy indicators	Renewable primary energy as energy carrier	PERE	MJ
	Renewable primary energy resources as material utilisation	PERM	MJ
	Total renewable primary energy use (sum of the two parameters above)	PERT	MJ
	Non-renewable primary energy as energy carrier	PENRE	MJ
	Non-renewable primary energy resources as material utilisation	PENRM	MJ
	Total non-renewable primary energy use (sum of the two parameters above)	PENRT	MJ
Group 3: Material and waste indicators	Use of secondary material	SM	kg
	Net use of fresh water	FW	m3
	Use of renewable secondary fuels	RSF	MJ
	Use of non-renewable secondary fuels	NRSF	MJ
	Hazardous waste disposed	HWD	kg
	Non-hazardous waste disposed	NHWD	kg
	Radioactive waste disposed	TRWD	kg
Group 4: Flows leaving the product system	Components for re-use	CRU	kg
	Materials for recycling	MFR	kg
	Materials for energy recovery	MER	kg
	Exported energy	EE	MJ per energy carrier

Group 5: Additional impact categories and indicators	Particulate matter emissions (potential incidence of disease due to PM emissions)	PM	Disease incidence
	Ionising radiation (potential human exposure efficiency relative to U235)	IRP	kBq U235 eq.
	Ecotoxicity (freshwater, as potential comparative toxicity unit for ecosystems)	ETP-fw	CTUe
	Human toxicity, cancer effects (HTP-c)	HTP-c	CTUh
	Human toxicity, non-cancer effects (HTP-nc)	HTP-nc	CTUh
	Land use related impacts / soil quality (potential soil quality index)	SQP	dimensionless

3.10 Electricity power mix

In this EPD, the acquisition of raw materials and the production of products were carried out in Zhejiang Province, so the background data of the power unit process of the China Power Grid-East China Regional Power Grid were used for power mixing (based on the data from Ecoinvent 3.6 database value, select medium electricity of electricity country mix). Meanwhile, in the operation and maintenance stage of PV power plant construction, the above background data is also used with reference to the East China Regional Power Plant Construction Feasibility Study.

4. INVENTORY ANALYSIS

The ecoinvent V3.9 by cut-off classification system processes are used to model the background system of the processes. The raw material inputs are modelled with data from ecoinvent representing a global market (GLO) or rest-of-world (ROW) coverage. These datasets are assumed to be representative.

4.1 UPSTREAM

Raw materials extraction: Includes the acquisition of raw materials for the production of photovoltaic modules, such as cells and glass. CHINT seven products in this application are basically similar in terms of raw material acquisition, and the specific differences in the products are mainly due to the conversion efficiency of the PV modules. The main deviates for the same solar cells stem from the conversion efficiencies. Since the cells with increased efficiency are fabricated using the same process and material. For the PV module, the major difference lies in back sheet or back glass.

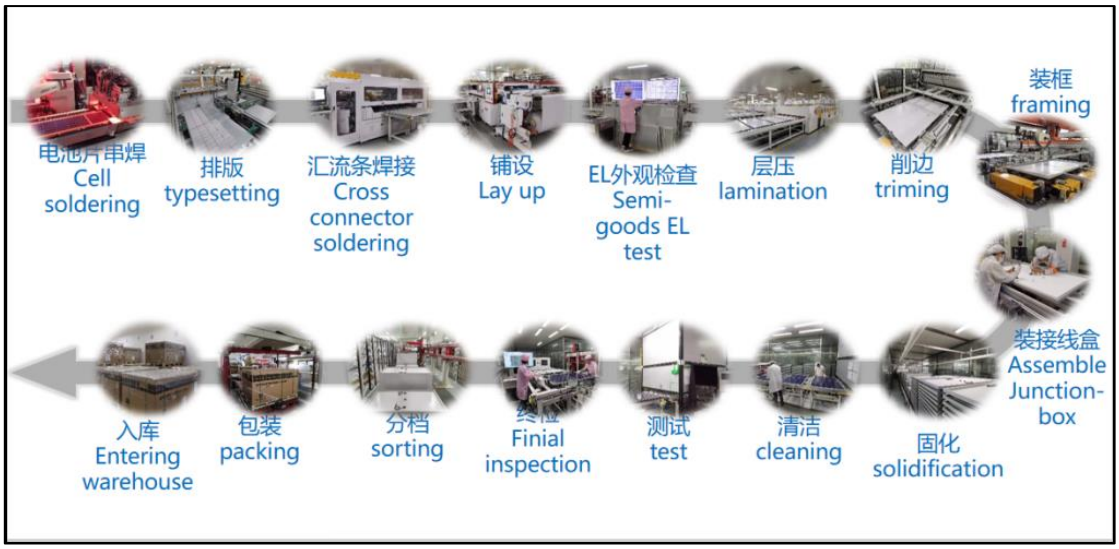
Raw materials transport: Concerning the raw material transportation, all the raw materials are

sourced from domestic suppliers and are transported by truck, EURO6 is used for modelling in this study. All land transport during the transport phase is assumed to be 7.5-16 metric tons of truck transport. The study applies an aggregated approach for the raw materials transportation summarizing all the transport data through multiplying the weight and the transportation.

4.2 CORE

PV module manufacturing: The PV module products under study includes 7 models. All the products share similar manufacturing processes. The main stages of manufacturing are presented in the flowcharts below (Figure 2). Product production cycle selected from 1 November 2022 to 31 October 2023.

Figure 2. Technological process in CHINT



Product distribution: Product shipments have been selected for several regions of the country and abroad where this product is mainly sold. Foreign countries include Europe, Poland, Japan, Southeast Asia, the United States and the United Kingdom. Domestic includes Wuxi, Hebei, Kunshan, Suzhou. The mode of transport abroad is by sea and domestic transport is by land. Turnover for each product is based on the average of all turnover for that model.

Table 8. Product distributions for the PV modules

	CHSM72N-HC	CHSM72N (DG)/F-BH	CHSM54N (DGT)/ F-BH	CHSM54N-HC	CHSM54N (BL)-HC	CHSM54N (BLH)-HC	CHSM60N (DG)/F-HC
Mass(kg)	26.9	32.1	20.8	21.3	21.3	21.3	23
Mass(kg) (Packaging included)	28.806	33.5278	22.0278	22.5278	22.5278	22.5278	24.2778
Land transport Turnover (t·km)	0.11	3.97	0.18	1.01	119.25	0.03	0.07
Sea transport Turnover（t·km）	223.56	26.56	159.42	141.99	21.05	168.00	192.22

Installation: The installation phase refers to a domestic normative feasibility study for the construction of PV power plants. Taking the whole process of constructing a 30MW PV power plant using 550Wp PV modules in the study as a reference, the material use, resource and energy consumption during the construction phase of the power plant construction is allocated to 1Wp, which is then allocated according to the products declared in this declaration.

Land transport for the transport of the products to the PV plant for installation after the distribution is completed, with a distance of 300km chosen for the usual Italian case.

At the same time, the installation process takes into account the recycling and disposal of the product's waste outer packaging, and sets the transport distance for the disposal of the product's waste packaging at 50km.

Use and maintenance: The reference service life (RSL) of the PV MODULE is assumed to be 30 years. Assuming 8m³ of water per year for maintenance and cleaning of PV modules.

Table 9. Construction, operation and maintenance of PV power plants

material	Usage amount	Unit
Cable	5.5	km
300kW String Inverter	100	PCS
3000kVA Box Transformer	10	PCS
Q235B/Q355B Photovoltaic mounts	1300800	kg
C30 Concrete	2167.3	m³
C20 Concrete	1	m³
Rebar	800	kg
Diesel	58060	kg

Petrol	9450	kg
Construction water	7200	m^3
Electricity for construction	450000	kwh
Water for operations and maintenance	240	m^3
Electricity for power station generation	1372800	kwh
Operation and maintenance of household waste	2000	kg

De-construction and demolition: Assuming that the PV module dismantling phase (C1) uses the same amount of electricity as the PV module installation phase (A5). The feasibility study is also referenced.

Waste transport: It is assumed that the transport distance of the dismantled PV modules to the waste treatment plant is 50km (Typical situation in the Italian region). Land transport using 7.5-16 ton trucks.

4.3 DOWNSTREAM

Waste processing and disposal: 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 recycling rate for waste PV module is 85%. Therefore, As a result, 15 per cent of the waste PV modules end up in waste disposal and the assumption of total landfill is used.

5. IMPACT INDICATORS

This EPD follows the PCR EPDItaly014 ± Photovoltaic modules guideline and use the recommended impact method for the analysis, the EN 15804+A2:2019 (version 1.03) method was used in this report. The EN 15804 standard covers Environmental Product Declarations (EPDs) of construction products. The A2:2019 revision of this standard has aligned their methodology with the Environmental Footprint (EF) 3.1 method, except for their approach on biogenic carbon. According to the EN 15804, biogenic carbon emissions cause the same amount of Climate Change as fossil carbon, but can be neutralized by removing this carbon from the atmosphere again. Based on the model of PV module products, the EN 15804 result is calculated and the tables below shows the

results. Note that impact results are calculated based on 1 kWh electricity generated by the PV plant. The results have been demonstrated through different processes according to the PCR, namely upstream, core, and downstream processes. The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream).

Table 10: **CHSM72N-HC**- Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.33E-02	6.41E-03	6.90E-03	2.42E-05
GWP-fossil	kg CO_2 eq	1.50E-02	8.04E-03	6.92E-03	2.77E-05
GWP-biogenic	kg CO_2 eq	-1.68E-03	-1.65E-03	-3.19E-05	-3.73E-06
GWP-luluc	kg CO_2 eq	1.95E-05	1.22E-05	7.09E-06	2.37E-07
ODP	kg CFC-11 eq	3.34E-08	3.34E-08	4.61E-11	5.03E-13
AP	mol H^+ eq	1.34E-04	4.39E-05	8.96E-05	1.24E-07
EP-F	kg P^- eq	7.46E-06	2.92E-06	4.53E-06	9.76E-09
EP-M	kg N^- eq	1.70E-05	8.19E-06	8.81E-06	4.94E-08
EP-T	mol N eq	1.89E-04	8.77E-05	1.01E-04	3.61E-07
POCP	kg NMVOC eq	6.09E-05	2.73E-05	3.35E-05	1.52E-07
ADPE	kg Sb eq	8.92E-07	2.05E-07	6.87E-07	4.61E-11
ADPF	MJ	1.81E-01	9.11E-02	8.92E-02	3.20E-04
WDP	m^3	7.50E-02	6.12E-03	6.89E-02	4.27E-06
PERE	MJ	5.06E-02	4.43E-02	6.21E-03	8.24E-05
PERM	MJ	1.05E-03	1.05E-03	0.00E+00	0.00E+00
PERT	MJ	5.17E-02	4.54E-02	6.21E-03	8.24E-05
PENRE	MJ	1.79E-01	9.11E-02	8.72E-02	3.20E-04
PENRM	MJ	2.11E-03	8.07E-05	2.03E-03	0.00E+00
PENRT	MJ	1.81E-01	9.11E-02	8.92E-02	3.20E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.88E-03	2.33E-04	1.64E-03	1.46E-07
RSF	MJ	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
HWD	kg	1.19E-04	5.57E-06	1.15E-05	1.02E-04
NHWD	kg	1.99E-03	1.03E-03	7.98E-04	1.61E-04
TRWD	kg	2.23E-07	1.41E-07	8.17E-08	1.42E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	8.46E-04	0.00E+00	0.00E+00	8.46E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	9.98E-10	5.21E-10	4.75E-10	2.26E-12

IRP	kBq U235 eq.	2.08E-03	5.71E-04	1.51E-03	5.81E-07
ETP-fw	CTUe	1.50E-01	4.91E-02	1.00E-01	2.72E-04
HTP-c	CTUh	1.92E-11	7.95E-12	1.12E-11	1.36E-13
HTP-nc	CTUh	8.63E-10	1.29E-10	7.32E-10	1.85E-12
SQP	dimensionless	2.74E-01	2.39E-01	3.45E-02	5.92E-04

Table 11: **CHSM72N(DG)/F-BH** - Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.20E-02	5.48E-03	6.52E-03	2.46E-05
GWP-fossil	kg CO_2 eq	1.34E-02	6.80E-03	6.55E-03	2.82E-05
GWP-biogenic	kg CO_2 eq	-1.37E-03	-1.33E-03	-3.02E-05	-3.93E-06
GWP-luluc	kg CO_2 eq	1.83E-05	1.13E-05	6.69E-06	2.49E-07
ODP	kg CFC-11 eq	8.43E-09	8.39E-09	4.35E-11	5.30E-13
AP	mol H^+ eq	1.26E-04	4.29E-05	8.35E-05	1.29E-07
EP-F	kg P^- eq	7.10E-06	2.80E-06	4.29E-06	1.02E-08
EP-M	kg N^- eq	1.60E-05	7.94E-06	8.04E-06	3.68E-08
EP-T	mol N eq	1.79E-04	8.56E-05	9.27E-05	3.77E-07
POCP	kg NMVOC eq	5.74E-05	2.63E-05	3.09E-05	1.59E-07
ADPE	kg Sb eq	8.55E-07	2.04E-07	6.50E-07	4.78E-11
ADPF	MJ	1.71E-01	8.63E-02	8.44E-02	3.35E-04
WDP	m^3	7.11E-02	5.80E-03	6.52E-02	4.37E-06
PERE	MJ	4.42E-02	3.82E-02	5.89E-03	8.67E-05
PERM	MJ	8.47E-04	8.47E-04	0.00E+00	0.00E+00
PERT	MJ	4.50E-02	3.91E-02	5.89E-03	8.67E-05
PENRE	MJ	1.69E-01	8.63E-02	8.25E-02	3.35E-04
PENRM	MJ	1.98E-03	7.09E-05	1.91E-03	0.00E+00
PENRT	MJ	1.71E-01	8.63E-02	8.44E-02	3.35E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.78E-03	2.21E-04	1.56E-03	1.54E-07
RSF	MJ	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
HWD	kg	1.23E-04	5.16E-06	1.09E-05	1.07E-04
NHWD	kg	1.95E-03	9.89E-04	7.83E-04	1.77E-04
TRWD	kg	2.11E-07	1.33E-07	7.74E-08	1.47E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.36E-04	0.00E+00	0.00E+00	9.36E-04

MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	9.52E-10	4.99E-10	4.51E-10	2.37E-12
IRP	kBq U235 eq.	1.97E-03	5.39E-04	1.43E-03	6.04E-07
ETP-fw	CTUe	1.43E-01	4.76E-02	9.51E-02	2.65E-04
HTP-c	CTUh	1.70E-11	6.33E-12	1.06E-11	1.40E-13
HTP-nc	CTUh	8.23E-10	1.28E-10	6.93E-10	1.77E-12
SQP	dimensionless	2.32E-01	1.98E-01	3.30E-02	6.22E-04

Table 12**: CHSM54N(DGT)/ F-BH**- Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.21E-02	5.48E-03	6.59E-03	2.46E-05
GWP-fossil	kg CO_2 eq	1.34E-02	6.76E-03	6.61E-03	2.83E-05
GWP-biogenic	kg CO_2 eq	-1.32E-03	-1.28E-03	-2.76E-05	-3.94E-06
GWP-luluc	kg CO_2 eq	1.86E-05	1.16E-05	6.73E-06	2.50E-07
ODP	kg CFC-11 eq	9.38E-09	9.33E-09	4.36E-11	5.27E-13
AP	mol H^+ eq	1.27E-04	4.22E-05	8.48E-05	1.29E-07
EP-F	kg P^- eq	7.18E-06	2.89E-06	4.28E-06	1.03E-08
EP-M	kg N^- eq	1.62E-05	7.78E-06	8.39E-06	3.68E-08
EP-T	mol N eq	1.80E-04	8.35E-05	9.65E-05	3.75E-07
POCP	kg NMVOC eq	5.78E-05	2.58E-05	3.18E-05	1.58E-07
ADPE	kg Sb eq	8.61E-07	2.14E-07	6.47E-07	4.80E-11
ADPF	MJ	1.71E-01	8.60E-02	8.50E-02	3.33E-04
WDP	m^3	7.08E-02	5.89E-03	6.50E-02	4.40E-06
PERE	MJ	4.37E-02	3.77E-02	5.90E-03	8.70E-05
PERM	MJ	8.45E-04	8.45E-04	0.00E+00	0.00E+00
PERT	MJ	4.45E-02	3.85E-02	5.90E-03	8.70E-05
PENRE	MJ	1.69E-01	8.59E-02	8.31E-02	3.33E-04
PENRM	MJ	1.99E-03	8.79E-05	1.91E-03	0.00E+00
PENRT	MJ	1.71E-01	8.60E-02	8.50E-02	3.33E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.78E-03	2.25E-04	1.55E-03	1.50E-07
RSF	MJ	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
HWD	kg	1.24E-04	5.44E-06	1.12E-05	1.07E-04
NHWD	kg	1.90E-03	9.89E-04	7.61E-04	1.51E-04

TRWD	kg	2.15E-07	1.36E-07	7.90E-08	1.48E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	7.86E-04	0.00E+00	0.00E+00	7.86E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	9.50E-10	4.94E-10	4.54E-10	2.36E-12
IRP	kBq U235 eq.	1.98E-03	5.49E-04	1.43E-03	6.06E-07
ETP-fw	CTUe	1.43E-01	4.78E-02	9.49E-02	2.78E-04
HTP-c	CTUh	1.72E-11	6.47E-12	1.05E-11	1.44E-13
HTP-nc	CTUh	8.29E-10	1.37E-10	6.91E-10	1.97E-12
SQP	dimensionless	2.25E-01	1.92E-01	3.27E-02	6.17E-04

Table 13: **CHSM54N-HC**- Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO2 eq	1.21E-02	5.48E-03	6.98E-03	2.46E-05
GWP-fossil	kg CO2 eq	1.34E-02	6.76E-03	7.00E-03	2.83E-05
GWP-biogenic	kg CO2 eq	-1.32E-03	-1.28E-03	-2.95E-05	-3.94E-06
GWP-luluc	kg CO2 eq	1.86E-05	1.16E-05	7.13E-06	2.50E-07
ODP	kg CFC-11 eq	9.38E-09	9.33E-09	4.63E-11	5.27E-13
AP	mol H+ eq	1.27E-04	4.22E-05	8.97E-05	1.29E-07
EP-F	kg P- eq	7.18E-06	2.89E-06	4.54E-06	1.03E-08
EP-M	kg N- eq	1.62E-05	7.78E-06	8.84E-06	3.68E-08
EP-T	mol N eq	1.80E-04	8.35E-05	1.02E-04	3.75E-07
POCP	kg NMVOC eq	5.78E-05	2.58E-05	3.36E-05	1.58E-07
ADPE	kg Sb eq	8.61E-07	2.14E-07	6.87E-07	4.80E-11
ADPF	MJ	1.71E-01	8.60E-02	9.01E-02	3.33E-04
WDP	m3	7.08E-02	5.89E-03	6.89E-02	4.40E-06
PERE	MJ	4.37E-02	3.77E-02	6.26E-03	8.70E-05
PERM	MJ	8.45E-04	8.45E-04	0.00E+00	0.00E+00
PERT	MJ	4.45E-02	3.85E-02	6.26E-03	8.70E-05
PENRE	MJ	1.69E-01	8.59E-02	8.81E-02	3.33E-04
PENRM	MJ	1.99E-03	8.79E-05	2.02E-03	0.00E+00
PENRT	MJ	1.71E-01	8.60E-02	9.01E-02	3.33E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	1.78E-03	2.25E-04	1.64E-03	1.50E-07
RSF	MJ	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
HWD	kg	1.24E-04	5.44E-06	1.19E-05	1.07E-04
NHWD	kg	1.90E-03	9.89E-04	8.13E-04	1.51E-04
TRWD	kg	2.15E-07	1.36E-07	8.36E-08	1.48E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	7.86E-04	0.00E+00	0.00E+00	7.86E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	9.50E-10	4.94E-10	4.82E-10	2.36E-12
IRP	kBq U235 eq.	1.98E-03	5.49E-04	1.52E-03	6.06E-07
ETP-fw	CTUe	1.43E-01	4.78E-02	1.01E-01	2.78E-04
HTP-c	CTUh	1.72E-11	6.47E-12	1.12E-11	1.44E-13
HTP-nc	CTUh	8.29E-10	1.37E-10	7.32E-10	1.97E-12
SQP	dimensionless	2.25E-01	1.92E-01	3.48E-02	6.17E-04

Table 14: **CHSM54N(BL)-HC**- Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.52E-02	6.89E-03	8.26E-03	2.51E-05
GWP-fossil	kg CO_2 eq	1.66E-02	8.25E-03	8.28E-03	2.87E-05
GWP-biogenic	kg CO_2 eq	-1.41E-03	-1.37E-03	-2.90E-05	-3.88E-06
GWP-luluc	kg CO_2 eq	2.05E-05	1.24E-05	7.81E-06	2.46E-07
ODP	kg CFC-11 eq	3.33E-08	3.33E-08	6.59E-11	5.24E-13
AP	mol H^+ eq	1.39E-04	4.64E-05	9.24E-05	1.29E-07
EP-F	kg P^- eq	7.81E-06	3.12E-06	4.68E-06	1.02E-08
EP-M	kg N^- eq	1.79E-05	8.44E-06	9.40E-06	5.06E-08
EP-T	mol N eq	1.98E-04	9.06E-05	1.07E-04	3.76E-07
POCP	kg NMVOC eq	6.55E-05	2.81E-05	3.72E-05	1.58E-07
ADPE	kg Sb eq	9.29E-07	2.33E-07	6.96E-07	4.79E-11
ADPF	MJ	2.02E-01	9.39E-02	1.08E-01	3.33E-04
WDP	m^3	7.58E-02	6.32E-03	6.95E-02	4.45E-06
PERE	MJ	4.70E-02	4.04E-02	6.54E-03	8.58E-05
PERM	MJ	9.05E-04	9.05E-04	0.00E+00	0.00E+00
PERT	MJ	4.79E-02	4.13E-02	6.54E-03	8.58E-05
PENRE	MJ	2.00E-01	9.38E-02	1.06E-01	3.33E-04
PENRM	MJ	2.13E-03	9.40E-05	2.04E-03	0.00E+00
PENRT	MJ	2.02E-01	9.39E-02	1.08E-01	3.33E-04

SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.90E-03	2.41E-04	1.66E-03	1.52E-07
RSF	MJ	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
HWD	kg	1.24E-04	5.84E-06	1.25E-05	1.06E-04
NHWD	kg	2.92E-03	1.06E-03	1.70E-03	1.68E-04
TRWD	kg	2.35E-07	1.47E-07	8.80E-08	1.48E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	8.84E-04	0.00E+00	0.00E+00	8.84E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	1.12E-09	5.38E-10	5.79E-10	2.36E-12
IRP	kBq U235 eq.	2.14E-03	5.91E-04	1.55E-03	6.06E-07
ETP-fw	CTUe	1.64E-01	5.22E-02	1.11E-01	2.89E-04
HTP-c	CTUh	1.99E-11	7.90E-12	1.18E-11	1.45E-13
HTP-nc	CTUh	9.03E-10	1.49E-10	7.51E-10	2.17E-12
SQP	dimensionless	2.52E-01	2.06E-01	4.58E-02	6.17E-04

Table 15: **CHSM54N(BLH)-HC**- Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.38E-02	6.91E-03	6.90E-03	2.50E-05
GWP-fossil	kg CO_2 eq	1.52E-02	8.26E-03	6.92E-03	2.86E-05
GWP-biogenic	kg CO_2 eq	-1.40E-03	-1.36E-03	-2.93E-05	-3.85E-06
GWP-luluc	kg CO_2 eq	1.97E-05	1.24E-05	7.10E-06	2.44E-07
ODP	kg CFC-11 eq	3.48E-08	3.47E-08	4.49E-11	5.20E-13
AP	mol H^+ eq	1.36E-04	4.61E-05	8.98E-05	1.28E-07
EP-F	kg P^- eq	7.64E-06	3.10E-06	4.53E-06	1.01E-08
EP-M	kg N^- eq	1.73E-05	8.39E-06	8.86E-06	5.12E-08
EP-T	mol N eq	1.92E-04	9.00E-05	1.02E-04	3.73E-07
POCP	kg NMVOC eq	6.16E-05	2.79E-05	3.35E-05	1.57E-07
ADPE	kg Sb eq	9.17E-07	2.31E-07	6.86E-07	4.76E-11
ADPF	MJ	1.83E-01	9.34E-02	8.90E-02	3.31E-04
WDP	m^3	7.52E-02	6.28E-03	6.89E-02	4.42E-06
PERE	MJ	4.64E-02	4.00E-02	6.25E-03	8.51E-05
PERM	MJ	8.98E-04	8.98E-04	0.00E+00	0.00E+00
PERT	MJ	4.73E-02	4.09E-02	6.25E-03	8.51E-05

PENRE	MJ	1.81E-01	9.33E-02	8.69E-02	3.31E-04
PENRM	MJ	2.12E-03	9.32E-05	2.02E-03	0.00E+00
PENRT	MJ	1.83E-01	9.33E-02	8.90E-02	3.31E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.88E-03	2.39E-04	1.64E-03	1.51E-07
RSF	MJ	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
HWD	kg	1.23E-04	5.79E-06	1.19E-05	1.05E-04
NHWD	kg	1.97E-03	1.05E-03	7.55E-04	1.67E-04
TRWD	kg	2.29E-07	1.46E-07	8.36E-08	1.47E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	8.80E-04	0.00E+00	0.00E+00	8.80E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	1.01E-09	5.35E-10	4.76E-10	2.34E-12
IRP	kBq U235 eq.	2.10E-03	5.87E-04	1.52E-03	6.01E-07
ETP-fw	CTUe	1.52E-01	5.19E-02	1.00E-01	2.87E-04
HTP-c	CTUh	1.92E-11	7.91E-12	1.11E-11	1.44E-13
HTP-nc	CTUh	8.82E-10	1.48E-10	7.32E-10	2.15E-12
SQP	dimensionless	2.39E-01	2.04E-01	3.41E-02	6.12E-04

Table 16: **CHSM60N(DG)/F-HC** - Impact indicators

Categories	Unit	Total	Upstream	Core	Downstream
GWP-total	kg CO_2 eq	1.26E-02	5.60E-03	6.93E-03	2.59E-05
GWP-fossil	kg CO_2 eq	1.39E-02	6.90E-03	6.96E-03	2.98E-05
GWP-biogenic	kg CO_2 eq	-1.35E-03	-1.32E-03	-3.04E-05	-4.17E-06
GWP-luluc	kg CO_2 eq	1.92E-05	1.18E-05	7.10E-06	2.65E-07
ODP	kg CFC-11 eq	9.24E-09	9.19E-09	4.61E-11	5.56E-13
AP	mol H^+ eq	1.33E-04	4.31E-05	8.97E-05	1.36E-07
EP-F	kg P^- eq	7.48E-06	2.95E-06	4.52E-06	1.08E-08
EP-M	kg N^- eq	1.68E-05	7.95E-06	8.85E-06	3.88E-08
EP-T	mol N eq	1.88E-04	8.53E-05	1.02E-04	3.95E-07
POCP	kg NMVOC eq	6.01E-05	2.63E-05	3.36E-05	1.67E-07
ADPE	kg Sb eq	9.04E-07	2.18E-07	6.85E-07	5.06E-11
ADPF	MJ	1.78E-01	8.80E-02	8.95E-02	3.51E-04
WDP	m^3	7.48E-02	6.05E-03	6.87E-02	4.64E-06

PERE	MJ	4.50E-02	3.87E-02	6.23E-03	9.20E-05
PERM	MJ	8.36E-04	8.36E-04	0.00E+00	0.00E+00
PERT	MJ	4.58E-02	3.95E-02	6.23E-03	9.20E-05
PENRE	MJ	1.76E-01	8.79E-02	8.75E-02	3.51E-04
PENRM	MJ	2.10E-03	8.86E-05	2.01E-03	0.00E+00
PENRT	MJ	1.78E-01	8.80E-02	8.95E-02	3.51E-04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.87E-03	2.31E-04	1.64E-03	1.58E-07
RSF	MJ	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
HWD	kg	1.31E-04	5.47E-06	1.17E-05	1.14E-04
NHWD	kg	1.95E-03	9.96E-04	8.00E-04	1.54E-04
TRWD	kg	2.22E-07	1.39E-07	8.26E-08	1.56E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	8.04E-04	0.00E+00	0.00E+00	8.04E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM	Disease incidence	9.81E-10	5.01E-10	4.78E-10	2.49E-12
IRP	kBq U235 eq.	2.07E-03	5.63E-04	1.51E-03	6.38E-07
ETP-fw	CTUe	1.49E-01	4.83E-02	1.00E-01	2.85E-04
HTP-c	CTUh	1.79E-11	6.57E-12	1.12E-11	1.51E-13
HTP-nc	CTUh	8.71E-10	1.38E-10	7.31E-10	1.98E-12
SQP	dimensionless	2.32E-01	1.97E-01	3.45E-02	6.51E-04

6.Additional Environmental Information

An additional indicator is the Return On Energy (RoE). This parameter gives an estimate of the efficiency of the photovoltaic park's solar energy production. The RoE may be expressed in various ways; in order to make it easier to compare results, calculated using the formula specified by PCR:

$$RoE_{year} = \frac{E_{invested}}{E_{produced,annual}}$$

Where: $E_{invested}$ = total amount of energy (thermal and electrical) required to produce the photovoltaic module (or solar park). This number is the sum of the indicators PENRT + PERT. $E_{produced,annual}$ = total amount of electricity generated in a year by the photovoltaic module (or solar park).

Table 17: RoE for different PV modules

	CHSM72N-HC	CHSM72N(DG)/F-BH	CHSM54N(DGT)/ F-BH	CHSM54N-HC	CHSM54N(BL)-HC	CHSM54N(BLH)-HC	CHSM60N(DG)/F-HC
RoE	**1.9282**	**1.7942**	**1.7916**	**1.8938**	**2.0775**	**1.9082**	**1.8568**

7.REFERENCES

1.ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedure

2. ISO 14040:2006/Amd 1:2020Environmental management — Life cycle assessment — Principles and framework

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4. EN 50693:2019 - Product category rules for life cycle assessments of electronicand electrical products and systems

5. EN 15804:2012+A2:2019, Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

6. EPD Italy 007- CORE-PCR-EN-50693

7. EPD Italy 014 - CORE PCR - PV panel

8. Ecoinvent V3.9

9. SimaPro versione 9.5

10. WEEE Directive(2012/19/EU)

11. LCA report - Photovoltaic Module, Chint New Energy Technology Co., Ltd. v.4, 2024/08/09 (LCA report based on this study)