# FuturaSun srl

# ENVIRONMENTAL PRODUCT DECLARATION

**Product name**

Monocrystalline silicon photovoltaic (PV) modules

FU XXX M Silk® Plus

**Site Plant:**

FUTURASUN ENERGY (JIANGSU) CO.,LTD.
368, YuSheng Road, Bldg 4 Hailing New Energy Park
Taizhou City, 225300 Jiangsu, China

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| **Program Operator** | EPDItaly |
| **Publisher** | EPDItaly |
| **Declaration Number** | FS001PV |
| **Registration Number** | EPDITALY0470 |
| **Issue date** | 28/08/2023 |
| **Valid to** | 28/08/2028 |

**in compliance with ISO 14025**

## GENERAL INFORMATION

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|---|---|
| **EPD OWNER** | FuturaSun srl<br>Registered office: Riva del Pasubio 14, 35013, Cittadella (PD) Italy |
| **SITE** | FUTURASUN ENERGY (JIANGSU) CO.,LTD.<br>368, YuSheng Road, Bldg 4 Hailing New Energy Park<br>Taizhou City, 225300 Jiangsu, China |
| **FIELD OF APPLICATION OF THE PRODUCT** | This document refers to the study of the monocrystalline PV module series FUXXXM Silk® Plus, 400-410 Wp. |
| **PROGRAM OPERATOR** | EPDItaly – info@epditaly.it<br>Regulation EPDItaly rev. 5.2 - 16/02/2022 |
| **VERIFICATION INFORMATION** | Independent verification of the declaration and data, carried out according to ISO 14025: 2010.<br>☐ Internal ☑ External<br>Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredia. |
| **CPC CODE** | 171 “Electrical Energy” |
| **CONTACTS for information on the EPD** | Yuliya Katsyuk < y.katsyuk@futurasun.it > |
| **PROJECT REPORT LCA** | Via Cacciatori delle Alpi 1/a, 22070 Capiago Intimiano (CO)<br>web: www.reteclima.it \| email: info@reteclima.it |
| **COMPARABILITY STATEMENT** | Environmental statements published within the same product category, but from different programs, may not be comparable. |
| **LIABILITY STATEMENT** | FuturaSun srl releases EPD Italy from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPD Italy declines any responsibility for the information, data and results of the evaluation of the life cycle assessment provided by the EPD Owner. |
| **PRODUCT CATEGORY RULES – PCR** | Core-PCR: EPDITALY014 " Electricity Produced By Photovoltaic Modules”<br>Rev. 1.1 del 08/02/2022 |

In this study, monocrystalline PV modules, series FUXXXM Silk® Plus were analyzed. The declaration covers the power peak range of 400-410 Wp.

The assessment followed the EPDItaly Program in accordance with standards (ISO 14040 and 14044) and other reference documents already cited in the introduction (PCR EPDItaly014 - Electricity Produced By Photovoltaic Modules). The PCR identifies and records: the objective and scope of LCA-based information for the product category; the rules for producing additional environmental information; the life cycle stages to be included; the parameters to consider and how the data should be collected and communicated in a report.

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|---|---|
| **EPD Type** | This EPD is an average product EPD. The declaration covers in total 1 series of PV modules: FUXXXM Silk® Plus (400-410 Wp). The EPD followed a cradle to grave approach. |
| **Geographical validity** | The assessment was carried out in relation to the production site in Taizhou (China) and the installation site Nulvi (SS) Italy. |
| **Database** | Ecoinvent 3.8 |
| **Software** | SimaPro 9.4 |

## FuturaSun srl

FuturaSun was established in 2008 by a team of managers in Veneto, Italy's hub of the photovoltaic industry. The headquarters are located in Cittadella, Padua Province. This is where its growth began, not only in Italy but in foreign markets too. Today FuturaSun sells in over 70 countries.

The main production plants are in Asia, north of Shanghai, and distribution expands into South America, Africa, Asia and 30 European countries. The company holds various certifications for its Taizhou plant, according to ISO 9001, ISO14001 and ISO45001 standards.

## GOAL AND SCOPE OF THE STUDY

The FU XXX M Silk® Plus panel is a monocrystalline silicon photovoltaic module with a peak power range varying from 400 to 410 Wp. The panel is produced in the Chinese FuturaSun factory located in Taizhou, near Shanghai, and then distributed through the various ports in Europe and in non-European countries.

In the production process the main stages are:

1. Cell cutting;
2. Soldering of the cells;
3. Soldering of strings;
4. Layup of the various layers: glass, first layer of encapsulant, soldered strings, second layer of encapsulant and backsheet
5. Lamination;
6. Trimming;
7. Framing of the laminate;
8. Junction box gluing and curing;
9. EL&IV Test;
10. Packaging.

The alluminum frame is also available in black colour. The backsheet is available in white and black colour.
In this study, after production, the modules are transported to the plant site. The system is installed on a roof, anchored with aluminum bars, made up of corrugated sheet. The end-of-life scenario includes landfill, incineration, and recycling with varying percentages for the different types of materials.

This study considers the life cycle of the product, from the extraction of raw materials to disposal and disposal at the end of its life, according to the cradle to grave approach. Table 2 and Figure 1 show the modules included in the evaluation, in accordance with the PCR and the reference technical regulations.

**Table 2:** Modules considered in the evaluation, according to the approach "*from cradle to grave*"

| Life cycle stages according to PCR EPDItaly014 | Life cycle stages according to EN50693 | Life cycle stages according to EN15804:2012+A2:2019 | | Cradle to grave |
|---|---|---|---|---|
| Upstream module | Manufacturing stage | A1 | Raw material supply | x |
| | | A2 | Transport (to the manufacturer) | x |
| Core module | | A3 | Manufacturing | x |
| | Distribution stage | A4 | Transport to installation site | x |
| | Installation stage | A5 | Construction - installation process | x |
| | Use stage | B1 | Use | MND |
| | | B2 | Maintenance | x |
| | | B3 | Repair | MND |
| | | B4 | Replacement | x |
| | | B5 | Refurbishment | MND |
| | | B6 | Operational energy use | MND |
| | | B7 | Operational water use | MND |
| | De-installation stage | C1 | De-construction and demolition | x |
| | End of life stage | C2 | Transport (to waste processing) | x |
| Downstream module | | C3 | Waste processing | x |
| | | C4 | Disposal | x |

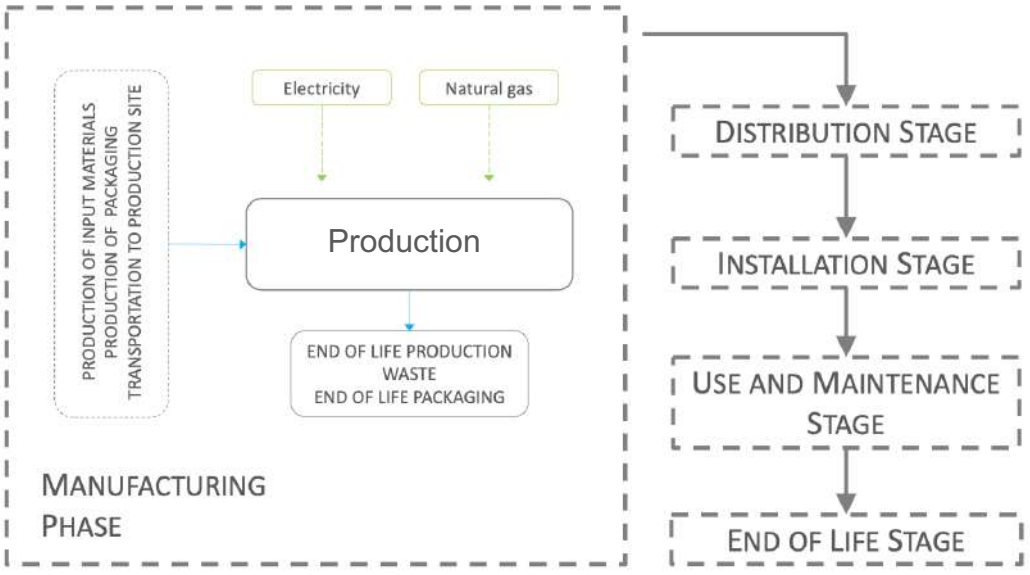


**Figure 1:** System boundaries flowchart

## PRODUCT FEATURES AND COMPONENTS

The construction, dimensions and technical parameters of the modules are detailed below (all data provided by Futurasun srl).

Table 1 shows components and total weight of the module.

**Table 1** Components and total weight

| Material | FUXXXM Silk® Plus | Unit |
|---|---|---|
| Solar cell | 0,59 | kg/panel |
| Tempered glass | 14,45 | kg/panel |
| EVA | 1,71 | kg/panel |
| PET | 0,86 | kg/panel |
| Aluminium frame | 2,00 | kg/panel |
| Junction box | 0,21 | kg/panel |
| Other | 0,98 | kg/panel |
| Module total weight | 20,8 | kg/panel |

Table 2 shows the module technical parameters and specifically the mechanical and electrical parameter.

**Table 2** Mechanical and technical parameter

| Parameter | FUXXXM Silk® Plus |
|---|---|
| Power output range | 400-410 $W_p$ |
| Power Tolerance of $P_{max}$ | +/- 3% |
| Module Efficiency (STC) | 20,48 - 21,00% |
| Maximum Power Voltage $V_{mpp}$ | 31,01 - 31,36 V |
| Maximum Power Current $I_{mpp}$ | 12,90 – 13,08 A |
| Dimensions | 1722 x 1134 x 30 mm |
| Cells | 108 monocrystalline half-cut MBB PERC cells 182 x 91 mm |

## METHODOLOGY

The methodology followed as a reference standard is that of the Life Cycle Assessment, which considers all environmental aspects and potential environmental impacts along the life cycle of the product, from the extraction and transport of raw materials through manufacture and use, up to at the end of life.

### FUNCTIONAL UNIT

The functional unit of the study is 1 kWh of electricity generated as output from the solar photovoltaic plant, as determined by the PCR. For the calculation of the total energy produced by the panel, the following data are considered (Table 3).

To obtain the value of energy produced annually by the plant, the efficiency of the panel and the following losses were considered:

- system, i.e. the energy used by the equipment present in the system (inverter, transformer and distribution losses);
- due to aging of the panel, which lead to a decrease in the efficiency during the useful life.

The value relating to the system losses was extrapolated from the technical report carried out for the construction of the photovoltaic system and is equal to 20%, while the losses due to aging of the panel were taken from the technical data sheet of the panel, which declared a maintenance of the performance of 87% for the first 25 years.

The total medium energy produced by the plant during its useful life (30 years) is equal to 4.144.785,71 kWh.

**Table 3** Power plant informations

| Parameter | Value | Unit |
|---|---|---|
| Peak power of the plant | 99,75 | kW |
| Plant latitude and longitude | 40.784, 8.744 | ° |
| Plant altitude | 478 | m |
| Nominal solar irradiance | 1.896,65 | kWh/m$^2$/year |

The phases used in the definition of the average impact for Silk® Plus panels with a peak power range of 400-410 Wp are summarized below:

1. Life cycle modeling of single 400-405-410 Wp panels;
2. Calculation of the impact of the individual panels using Simapro software;
3. Arithmetic mean calculated for each impact category.

## ALLOCATION AND CUT-OFF

The primary and secondary data used to calculate the results were allocated to the functional unit of 1 kWh of electricity produced on the basis of the producibility of the panel over the useful life considered (30 years).

The calculation relating to electricity consumption for the production of panels and company waste was carried out considering the total m$^2$ of panels produced and the surface area of the module, equal to 1,95 m$^2$.

The following cut-offs were made in the present study:

- production of buildings, machinery, equipment;
- in the production phase the paper used in the panels and the alcohol used for the final cleaning of the panel were not considered since they are insignificant quantities;
- electricity consumption was not considered during the installation and uninstallation phase as it was carried out manually.

## DATA QUALITY

In the context of this study, the activity data are mainly of “primary type”, i.e., collected with the support of the Company for the specific production site. Secondary data refer to specific databases or to the most updated technical reference literature, to ensure a good level of reliability. In this study the secondary data that were used concern the energy for installation phase, maintenance and the end of life of the product

## REFERENCE PERIOD

The primary data collected in the context of this study refer to the year 2022.

## STAGE

**Upstream module:**

- Extraction of raw materials and production of materials / semi-finished / accessory products;
- Packaging production;
- Transport of materials / semi-finished products / accessory products.

**Core module:**

- Manufacturing and assembling of the product. The electricity mix used for production was modeled with the Ecoinvent dataset relating to the average Chinese mix (Chinese consumption mix, in absence of data about residual mix);
- Production waste disposal and recycling;
- Distribution: transport of the product to the installation site;
- Installation: The activities included in this phase of the life cycle concern the construction of the photovoltaic system, including structural elements and connection to the electricity grid and disposal of packaging;

- Use and maintenance: the activity of ordinary maintenance of the system is considered, for the whole duration of their life cycle (30 years). The maintenance of the system consists in washing the panels once a year and in replacing the inverters at the end of their life after 15 years;
- End of life: The activities included in this phase are the decommissioning the solar system, including the transport of the modules to the disposal site (distance assumed 100 km); transportation of final flows to the disposal or recovery site.

**Downstream module:**

- End of life: The activities included disassembling the photovoltaic modules, including material and energy consumption required for this purpose.

In the module disposal scenario, the recycling percentages of the individual materials were obtained from the ENEA report, relating to the end of life of the photovoltaic panels. (recycling rate: 85% for silicon; 97% for glass, 100% for aluminium, 78% for copper).

### REFERENCE SERVICE LIFE (RSL)

In this LCA study, functional to obtaining the EPD certification, a useful life was considered 30 years, in accordance with the provisions of the reference PCR.

## IMPACT ASSESSMENT

The impact assessment follows the requirements of PCR EPDItaly 014 and uses the recommended impact analysis method for the calculation. Environmental impact indicators follow the characterization factors as reported in EN 15804:2012+A2:2019.

**Table 12:** Environmental impacts for PV module FUXXXM Silk® Plus

| IMPACT ASSESSMENT | | | | | |
|---|---|---|---|---|---|
| **INDICATOR** | **UM** | **TOTAL** | **UPSTREAM** | **CORE** | **DOWNSTREAM** |
| GWP – total | kg $CO_2$eq | 1,68E-02 | 1,43E-02 | 2,21E-03 | 2,14E-04 |
| GWP – fossil | kg $CO_2$eq | 1,66E-02 | 1,41E-02 | 2,25E-03 | 1,96E-04 |
| GWP – biogenic | kg $CO_2$eq | 1,44E-04 | 1,69E-04 | -4,18E-05 | 1,73E-05 |
| GWP – luluc | kg $CO_2$eq | 2,35E-05 | 2,00E-05 | 3,58E-06 | 1,43E-08 |
| ODP | kg CFC-11eq | 1,65E-09 | 1,51E-09 | 1,15E-10 | 2,84E-11 |
| POCP | kg NMVOC eq | 5,74E-05 | 4,26E-05 | 1,43E-05 | 4,36E-07 |
| AP | mol $H^+$eq | 1,24E-04 | 8,28E-05 | 4,02E-05 | 8,79E-07 |
| EP- freshw | kg P eq | 8,40E-06 | 5,91E-06 | 2,45E-06 | 4,11E-08 |
| WDP | $m^3$ depriv. | 1,43E-02 | 1,35E-02 | 7,23E-04 | 1,27E-04 |
| ADP – fossil | MJ | 2,03E-01 | 1,74E-01 | 2,56E-02 | 3,02E-03 |
| ADP- min&met | Kg Sb eq | 8,70E-07 | 2,78E-07 | 5,92E-07 | 2,73E-12 |

GWP-total = Global Warming Potential; GWP-fossil = Global Warming Potential - fossil; 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; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water deprivation potential, deprivation weighted water consumption

**Table 13:** Use of resources

| USE OF RESOURCES | | | | | |
|---|---|---|---|---|---|
| **INDICATOR** | **UM** | **TOTAL** | **UPSTREAM** | **CORE** | **DOWNSTREAM** |
| PENRE | MJ | 1,98E-01 | 1,70E-01 | 2,51E-02 | 3,02E-03 |
| PERE | MJ | 3,49E-02 | 3,12E-02 | 3,00E-03 | 7,49E-04 |
| PENRM | MJ | 4,72E-03 | 4,29E-03 | 5,36E-04 | 0,00E+00 |
| PERM | MJ | 1,04E-03 | 0,00E+00 | 1,04E-03 | 0,00E+00 |
| PENRT | MJ | 2,03E-01 | 1,74E-01 | 2,56E-02 | 3,02E-03 |
| PERT | MJ | 3,59E-02 | 3,12E-02 | 4,04E-03 | 7,49E-04 |
| FW | $m^3$ | 4,66E-04 | 4,43E-04 | 2,01E-05 | 3,38E-06 |
| MS | kg | - | - | - | - |
| RSF | MJ | - | - | - | - |
| NRSF | MJ | - | - | - | - |
| PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PENRM = Use of nonrenewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; PERT = Total use of renewable primary energy resources; FW = Use of net fresh water; MS = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels. | | | | | |

**Table 14:** Waste production and output flows

| WASTE PRODUCTION AND OUTPUT FLOWS | | | | | |
|---|---|---|---|---|---|
| **INDICATOR** | **UM** | **TOTAL** | **UPSTREAM** | **CORE** | **DOWNSTREAM** |
| HWD | kg | - | - | - | - |
| NHWD | kg | 7,50E-05 | - | 2,51E-05 | 4,99E-05 |
| RWD | kg | - | - | - | - |
| MER | kg | - | - | - | - |
| MFR | kg | 1,56E-03 | - | 6,19E-05 | 1,50E-03 |
| CRU | kg | - | - | - | - |
| ETE | MJ | - | - | - | - |
| EEE | MJ | - | - | - | - |
| HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; MER = Materials for energy recovery; MFR = Materials for recycling; CRU = Components for reuse; ETE= Exported thermal energy; EEE= Exported electricity energy. | | | | | |

## REFERENCES:


- ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
- UNI EN ISO 14025:2010, Etichette e dichiarazioni ambientali - Dichiarazioni ambientali di Tipo III - Principi e procedure
- EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems
- UNI EN 15804:2012+A1:2013+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- Regolamento EPDItaly rev. 5.2 del 16/02/2022
- PCR EPDItaly014 – Electricity produced by photovoltaic modules – Rev.1.1 08/02/2022
- Report LCA, Technical report_EPD_FuturaSun_FUxxxM Silk Plus, edizione 1
- Ecoinvent, 2021, The Swiss Centre for Life Cycle Inventories, Ecoinvent v3.8
- SimaPro, https://simapro,com/
- EPDItaly. Mono-crystalline silicon photovoltaic (PV) modules. JinKO Solar
- EPDItaly. JAM72S10-XXX/MR, JAM72S20-XXX/MR, JAM72S30-XXX/MR . JA SOLAR TECHNOLOGY Co Ltd
- IEA, 2020, Life Cycle Inventories and Life Cycle Assessments of Photovoltaic Systems. PVPS Photovoltaic Power Systems Programme
- RSE- Ricerca Sistema Energetico. Analisi LCA di un impianto fotovoltaico piano con moduli PERC e confronto con altre tecnologie innovative. Progetto 1.1 Fotovoltaico ad alta efficienza. Piano triennale di Realizzazione 2019-2021 della Ricerca di Sistema Elettrico Nazionale. 2021
- Ecoinvent, 2022, The Swiss Centre for Life Cycle Inventories, Ecoinvent v3.8
- SimaPro, https://simapro,com/
- European Commission. EU Science Hub. PVGIS Photovoltaic Geographical Information System, https://joint-research-centre.ec.europa.eu/pvgis-photovoltaic-geographical-information-system_en
- Padovani L.M. e Carrabba P. Il modulo fotovoltaico, una miniera di risorse se il fine vita è virtuoso. Energia, ambiente e innovazione 2/2020 ENEA. DOI 10.12910/EAI2020-055
- Padovani L.M. e Carrabba P. I pannelli fotovoltaici a fine vita. Considerazioni sull'impatto ambientale e sulla salute dei processi di smaltimento/riciclo/riuso. RT/2020/7/ENEA
- ISPRA. Rapporto Rifiuti Urbani - Edizione 2021
- D.L. 14 marzo 2014 n. 49. Attuazione della Direttiva 2012/19/UE sui rifiuti di apparecchiature elettriche ed elettroniche (RAEE).
- D.L. 6 novembre 2021 n.152. Gestione del fine vita degli impianti fotovoltaici.

# CONVALIDA DELLA EPD
*Validation of EPD*

**ATTESTATO N°** **CERTIFICATE N°**

# ICMQ – 23459EPD

**Si convalida che la seguente Dichiarazione Ambientale di Prodotto (DAP):**
*It validates that the follow Environmental Product Declaration (EPD):*

**Product EPD, Declaration "FS001PV" del 28/08/2023**

emessa da:
*issued by:*

## FuturaSun S.r.l.

Riva del Pasubio, 14 - 35013 Cittadella (PD)

unità operativa:
*operational unit:*

**368, YuSheng Road, Bldg 4 Hailing**
**New Energy Park Taizhou City, 225300 Jiangsu, China**

relativa ai seguenti prodotti:
*relative to following products:*

**Serie di moduli fotovoltaici monocristallini FUXXXM Silk® Plus, 400-410 Wp**
*(Monocrystalline PV module series FUXXXM Silk® Plus, 400-410 Wp)*
***(UN CPC 17)***

è conforme ai seguenti documenti:
*is in compliance with the following document:*

**Regolamento EPDItaly rev. 5.2 del 16/02/2022**
**Core PCR EPDItaly014 rev. 1.1 del 08/02/2022**
**ISO 14025**

L'uso e la validità del presente attestato sono soggetti al rispetto del Regolamento ICMQ per la convalida della Dichiarazione Ambientale di Prodotto
*Use and validity of this reference are subject to ICMQ rules for EPD validation*

La validità del presente attestato è subordinata alla sua verifica periodica.
*Validity of this attestation is subject to its periodic verification.*

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO
DAP N° 012H
Membro di MLA EA per gli schemi di accreditamento SGQ, SGA, PRD, PRS, ISP, GHG, LAB, LAT, PTP e RMP, di MLA IAF per gli schemi di accreditamento SGQ, SGA, SSI, FSM, PRD e PRS e di MRA ILAC per gli schemi di accreditamento LAB, MED, LAT, ISP e PTP.
Signatory of EA MLA for the accreditation schemes QMS, EMS, PRD, PRS, INSP, GHG, TL, CL, PTP and RMP, of IAF MLA for the accreditation schemes QMS, EMS, ISMS, FSMS, PRD and PRS, and of ILAC MRA for the accreditation schemes TL, ML, CL, INSP and PTP.

| PRIMA EMISSIONE | EMISSIONE CORRENTE | SCADENZA |
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| *11/09/2023* | *11/09/2023* | *28/08/2028* |

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