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The Norwegian EPD Foundation

PRODUCT CATEGORY RULES

EN 15804

NPCR 029 version 1.0

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PCR – Part B for a photovoltaic module used in the building and construction industry, including production of cell, wafer, ingot block and solar grade silicon

REVISION LOG

This is an overview of the changes made to this PCR. Typology of changes:

- Editorial (ed): Text or layout edited, with no change in content.
- Technical (te): Existing content has been changed.
- Addendum (ad): New content has been added.

Naming convention: Version x.y, where x is a major revision and y is a minor revision.

Date (2020-XX-XX)	Type	Description of change
Version 1.0		
Original version, issued 2020-XX-XX.		

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Introduction

These product category rules (PCR) are intended for companies preparing an environmental product declaration (EPD) for a photovoltaic module used in the building and construction industry, including production of cell, wafer, ingot block and solar grade silicon.

The PCR for a photovoltaic module, cell, wafer, ingot block and solar grade silicon production consists of two parts. This document contains PCR part B for a photovoltaic module, cell, wafer, ingot block and solar grade silicon. Part A contains the requirements that are common for all construction products. When preparing an EPD for a photovoltaic module, cell, wafer, ingot block and solar grade silicon all requirements outlined in part A and part B must be followed. In PCR part B, the requirements for PCR part A are referred to in each section where they occur. The purpose of this document is to define clear guidelines for performing the underlying life cycle assessment (LCA) to ensure comparability between EPDs.

This PCR was developed from November 2019 to April 2020, by a Norwegian PCR working group (WG) with international representatives from all parts of the value chain of the photovoltaic industry and with aid from Asplan Viak and the EPD programme operator, The Norwegian EPD Foundation. This PCR has been developed in accordance with the requirements outlined in the general programme of instructions from the Norwegian EPD programme (EPD-Norway, 2014).

Members of the PCR working group (WG) for a photovoltaic module used in the building and construction industry, including production of cell, wafer, ingot block and solar grade silicon:

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1 Scope

This document complements the core rules for the product category of construction products as defined in EN 15804 and NPCR part A and is intended to be used in conjunction with those standards.

The intended application of this product category rule (PCR) is to give guidelines for the development of environmental product declarations (EPD) for a photovoltaic module, cell, wafer, ingot block and solar grade silicon; either cradle to gate with options or cradle to grave for a photovoltaic module; and to further specify the underlying requirements of the life cycle assessment (LCA). The core rules valid for all construction products are given in standard EN 15804, NPCR Part A and relevant published complementary PCR, and are expected to be known by those preparing the EPD.

For EPD which only include cell, wafer, ingot block or solar grade silicon production (not a complete photovoltaic module), the LCA results are reported in relation to a declared unit.

2 Normative references

NPCR Part A: Construction products and services. Ver. 1.0. April 2017. Oslo: EPD-Norge.

NPCR 010 - Part B for Building boards. If there are contradictions in requirements between NPCR 010 and this PCR, this PCR shall be given priority. Any differences must be described in the LCA report and the EPD.

NPCR 022 – Part B for Roof waterproofing. If there are contradictions in requirements between NPCR 022 and this PCR, this PCR shall be given priority. Any differences must be described in the LCA report and the EPD.

EN 50583: Photovoltaics in building

IEC 61215 (Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval

IEC 61730-1:2016. Photovoltaic (PV) module safety qualification

ISO 21930:2017

3 Terms and Definitions

As in PCR part A.

In addition, the following product-specific terms and definitions are given:

3.1 Photovoltaic module

Photovoltaic (PV) modules covered are standalone modules (mounted on a rooftop, façade or ground) and building integrated photovoltaics (BIPV) are integrating photovoltaic modules into the building envelope, such as the roof or the façade.

This includes the following elements for a silicon PV module, a thin-film module and other types of PV module:

- Glass
- Frame
- Back sheet
- EVA (ethylene vinyl acetate) and/or Encapsulant
- Junction box
- Cells
- Ribbons and conductors (mounted on the module)
- Cables and wiring (mounted on the module)
- Plastics
- Other materials needed to produce the module / BIPV, except microinverters

EN 50583: Photovoltaics in building

IEC 61215 (Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval

IEC 61730-1:2016. Photovoltaic (PV) module safety qualification

ISO/TS 18178: Glass in building - Laminated solar photovoltaic glass for use in buildings

3.2 Building integrated photovoltaics (BIPV)

As Photovoltaic module, chapter 3.1.

For building integrated photovoltaics (BIPV), Terms and Definitions for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

3.2 Photovoltaic cell

Photovoltaic cells are specialised semiconductor diodes that convert visible light into direct current (DC).

EN 50461, Solar cells - Datasheet information and product data for crystalline silicon solar cells

3.3 Wafer

A wafer is a thin slice of semiconductor, such as a crystalline silicon (c-Si), used for the fabrication of integrated solar cells. The standard size (year 2019) of wafers for photovoltaics are 100mm * 100mm – 210mm * 210 mm and the standard thicknesses (year 2019) around 100 µm – 200 µm. This PCR covers all sizes and thicknesses of wafer, including future development for larger size/thinner thickness.

EN 50513, Solar Wafers - Data sheet and product information for crystalline silicon wafers for solar cell manufacturing.

3.4 Ingot block

An ingot block of crystalline silicon (c-Si) is used for the fabrication of a wafer. It is a shaped ingot ready to be sliced into wafers.

3.5 Solar grade silicon (SoG-Si)

Solar grade silicon (SoG-Si) is silicon (Si) with a purity of at least 99.9999 %, or 6N (six nines), used for the fabrication of an ingot block.

4. Abbreviations

EPD	Environmental product declaration
DU	Declared unit
FU	Functional unit
PCR	Product category rules
LCA	Life cycle assessment
LCI	Life cycle inventory
LCIA	Life cycle impact assessment
RSL	Reference service life
ESL	Estimated service life
Wp	Watt peak
PV	Photovoltaic
Si	Silicon
c-SI	Crystalline silicon
SoG-Si	Solar grade silicon
mono-Si	Monocrystalline silicon
multi-Si	Multicrystalline silicon
micro-Si	Micromorphous silicon

CdTe	Cadmium-telluride (CdTe)
CIS / CIGS	Copper-indium-selenide / Copper-indium-gallium-selenide
BIPV	Building integrated photovoltaics
PERC	Passive emitter rear contact
Al-BSF	Aluminium back surface field
IBC	Interdigitated back contact
HJT	Heterojunction technology
STC:	Standard test conditions (STC): radiation 1000 W/m^2, cell temperature 25 °C, wind speed 1 m/s, AM 1,5

5. General Aspects

5.1 Objective of PCR Part A and B

As in PCR part A.

5.2 Types of EPD in respect to life cycle stages covered

As in PCR part A including the following further clarification.

EPD for photovoltaic module:

Cradle-to-gate only EPDs are not valid according to this PCR. As a minimum, cradle-to-gate with options that include life cycle modules A1-A3, A4, A5, C1-C4 and D are required.

EPD for cell, wafer, ingot block and SoG silicon:

As a minimum, cradle-to-gate with options that also include module A4 is required according to this PCR.

5.3 Comparability of EPD of construction products

As in PCR part A including the following further clarification.

EPD for cell, wafer, ingot block and SoG silicon

The comparison of EPDs covering cell, wafer, ingot block or SoG silicon shall be carried out in the context of the products intended use.

For example, environmental performance information for cell, wafer, ingot or silicon block at gate (A1-A3) and transportation to relevant market (A4) are intended to be used as specific environmental data for the next production step for the photovoltaic supply chain. As an example, an EPD for wafer production is only intended to be used in the production of photovoltaic cell.

NOTE: EPDs that do not have similar technical properties or fulfil similar uses are not comparable.

5.4 Additional information

As in PCR part A.

5.5 Ownership, responsibility and liability for the EPD

As in PCR part A.

5.6 Communication format

As in PCR part A.

6. Product Category Rules for LCA

As in PCR part A.

6.1 Product Category

As in PCR part A including the following further clarification.

The products covered by this PCR comprise a complete PV module and BIPV produced from all types of materials, including specific products in the photovoltaic supply chain: PV cell, wafer, ingot block and SoG silicon.

6.1.1 PV module

PV modules covered are standalone modules (mounted on rooftop, façade or ground) and building integrated photovoltaics (BIPV) integrated photovoltaic modules into the building envelope, such as the roof or the façade materials.

- Silicon PV module:
  - Monocrystalline silicon photovoltaic module (e.g. mono PERC, mono Al-BSF, IBC and HJT)
  - Multi-crystalline silicon photovoltaic module (multi PERC and multi Al-BSF)
  - Other silicon PV modules (e.g. thinfilm silicon)
- Thin-film and other types of PV module:
  - Cadmium-telluride photovoltaic module (CdTe)
  - Copper-indium-selenide / copper-indium-gallium-selenide photovoltaic module (CIS / CIGS)
  - Other non-silicon PV module

For BIPV, the following product category rules (PCRs) apply for the *non-PV module* value chain.

- BIPV roof: NPCR 022 – Part B for Roof waterproofing (roof BIPV)
- BIPV façade: NPCR 010 - Part B for Building boards (façade BIPV)

6.1.2 PV cell

- Silicon PV cell
  - Monocrystalline silicon photovoltaic cell (e.g. mono PERC, mono Al-BSF, IBC and HJT)
  - Multi-crystalline silicon photovoltaic cell (multi PERC and multi Al-BSF)
  - Other silicon PV cell (e.g. thinfilm silicon)
- Thin-film and other types of PV cell:
  - Cadmium-telluride photovoltaic cell (CdTe)

  - Copper-indium-selenide / Copper-indium-gallium-selenide photovoltaic cell (CIS / CIGS)
  - Other non-silicon PV cell

6.1.3 Wafer

- Silicon wafer
  - Monocrystalline silicon wafer
  - Multicrystalline silicon wafer
- Other types of wafer (e.g. mono-like wafer)

6.1.4 Ingot block

- Silicon ingot
  - Monocrystalline silicon ingot
  - Multicrystalline silicon ingot
- Silicon block
  - Monocrystalline silicon block
  - Multicrystalline silicon block
- Other types of ingot block (e.g. mono-like ingot block)

6.1.5 Solar grade silicon

- Solar grade silicon (SoG-Si)

6.2 Life cycle stages and their information modules to be declared

6.2.1 General

As in PCR part A including the following further clarification.

EPD for photovoltaic module

The system boundary shall contain as a minimum, life cycle modules A1-A3, A4-A5, C1-C4 and D for a photovoltaic module.

EPD for cell, wafer, ingot block and SoG silicon

The system boundary shall contain as a minimum, life cycle modules A1-A3 and A4 for cell, wafer, ingot block and silicon.

Transport

Transport in all life cycle modules shall include the following:

- Direct emissions during transport (i.e. exhaust, tyres, etc.)
- Upstream emissions from fuel extraction, processing and distribution
- Life cycle emissions of vehicles (i.e. raw materials, manufacturing, maintenance and disposal)
- Life cycle emissions of infrastructure (i.e. raw materials, manufacturing, maintenance and disposal)

6.2.2 A1-A3, Product stage, information modules

As in PCR part A including the following further clarification.

It is important to clarify whether the substance entering the production process under study is classified as “waste” or as a “secondary product”, i.e. secondary material or secondary fuel. See ISO 21930:2017 for definitions.

6.2.3 A4-A5, Construction process stage, information modules

As in PCR part A including the following further clarification.

EPD for photovoltaic module

Transport A4 comprises a scenario for transportation to a relevant market for the product, not a building site.

The installation phase in A5 shall include the following:

- Waste treatment of packaging
- Energy use during installation
- Wastage of material during installation
- Where relevant, the installation scenario shall include life cycle emissions from lifting equipment

Materials for the mounting system of the module, microinverters, wiring, switches, one or many solar inverters, battery bank, battery charger and other electrical components and systems necessary to connect the photovoltaic module to the electrical grid shall not be included.

Personnel activities and transport of personnel shall not be included.

Fasteners (screws) and other additional materials are not included, these are expected to be included at building level assessments.

EPD for cell, wafer, ingot and silicon

Transport A4 comprises a scenario for transportation to a relevant market for the product, not a building site.

Transport to a relevant market can be transport to the production site of the next step in the value chain, for example, transport of silicon to the ingot production site, or transport of wafer to the cell production site.

6.2.4 B1-B5, Use stage, information modules

As in PCR part A including the following further clarification.

Life cycle module B2, maintenance shall include the following activities:

- The use of energy, water and detergent for regular cleaning of the PV module throughout the service life.
- Replacement of parts with a reference service life shorter than the declared product.

6.2.5 B6, Operational energy use

As in PCR part A including the following additions:

Energy consumption:

Generally, PV modules do not require energy to operate. Even so, energy use shall be modelled (e.g. operational energy to melt snow).

Energy production:

The energy produced by a PV module depends on the installed power peak [Wp], degradation factor, geographic location and direction/placement of the installation. Produced electricity over the lifetime of the module shall therefore not be declared in the LCA and EPD.

The total produced electricity must be calculated based on site specific details. The EPD shall in the description of module B6 include equations for the user of the EPD to be able to calculate the total produced electricity for the declared module:

Energy production in the first year of operation:

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

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

S_{rad} = Site specific annual average solar radiation on module (shadings not included), kWh/kWp/year. The annual radiation must take into consideration the specific inclination (slope, tilt) and orientation.

A = Area of module, from functional unit (FU), m^2 (stated in the EPD).

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

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

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

- Inverter losses
- Temperature losses
- DC cables losses
- AC cables losses
- Shadings
- Losses at weak radiation
- Losses due to dust, snow
- Other Losses

deg = yearly degradation rate (stated in the EPD).

Degradation

If no data is available, a default linear degradation rate of 0.7 % per year shall be applied. Product specific degradation rate may be used if based on evidence (third-party validated report like DNV or other similar third-party validated documentation/certificates).

The nameplate capacity of the PV module, as printed in the data sheet, shall be used as the starting point of the degradation curve. If uncertainties on performance measurements are factored in the performance tolerance provided on the data sheet, e.g. +2.5 % / -0 %, the nameplate capacity without calculating uncertainties shall be used.

Energy production second year of operation:

$$E_2 = E_1 * (1 - deg)$$

Energy production n year of operation:

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

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

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

RSL = Reference service life for energy-producing unit, from functional unit (FU), stated in the EPD

n = year of operation

6.2.6 B7, Operational water use

Generally, PV modules do not require water to operate. Even so, water use shall be modelled.

6.2.7 C1-C4 End-of-life stage, information modules

As in PCR part A.

6.2.8 Benefits and loads beyond the system boundary, information module

As in PCR part A.

6.3 Calculation rules for the LCA

The scope and variations of products must be declared according to EPD-Norway's guidelines. As of 2018, similar products in the same EPD can only be included if the variation in results for each LCIA category does not exceed +/- 10 %. The variation shall be stated in the EPD. Special care must be given to composite products.

EPD for a photovoltaic module

For declaring PV modules, a functional or declared unit can be used. The functional unit should be applied when a specific function and scenario that is typically used is known for the product. If these typical functions and scenarios are many or not know, the declared unit should be used.

EPD for cell, wafer, ingot block and silicon

For declaring a cell, wafer, ingot and silicon, a declared unit should be used.

6.3.1 Functional unit

As in PCR part A, including the following further clarification:

EPD for a photovoltaic module

The functional unit for a cradle-to-grave EPD for a PV module is defined as:

1 Wp of manufactured photovoltaic module, from cradle-to-grave, with activities needed for a study period for a defined reference service life (≥80% of the labelled power output)

The nameplate capacity of the PV module, as printed in the data sheet, shall be used for Wp.

Results shall be displayed both per declared unit (cradle-to-gate, A1-A3) and per functional unit based on scenarios for life cycle modules A4-A5, B1-B7, C1-C4 and D.

A converting factor shall be reported in the EPD to convert the results related to the functional unit (FU) to 1 m^2 photovoltaic module.

For BIPV the FU will differ from NPCR 022 – Part B for Roof waterproofing (roof BIPV) and NPCR 010 - Part B for Building boards (façade BIPV). Where relevant, a converting factor shall be reported in the EPD to convert the results related to the functional unit (FU) in NPCR 022 and NPCR 010.

6.3.2 Declared unit

As in PCR part A, including the following further clarification:

EPD for a photovoltaic module

The declared unit (cradle to gate with options: A1-A3, A4, A5, C1-C4 and D) is defined as:

1 Wp of manufactured photovoltaic module, with processes at construction and end-of-life stage.

The nameplate capacity of the PV module, as printed in the data sheet, shall be used for Wp.

Results shall be displayed both per declared unit (cradle to gate, A1-A3) and per functional unit based on scenarios for modules A4-A5, C1-C4 and D.

A converting factor shall be reported in the EPD to convert the results related to the declare unit (DU) to 1 m^2 photovoltaic module.

For BIPV the DU will differ from NPCR 022 – Part B for Roof waterproofing (roof BIPV) and NPCR 010 - Part B for Building boards (façade BIPV). Where relevant, a converting factor shall be reported in the EPD to convert the results related to the declared unit (DU) in NPCR 022 and NPCR 010.

EPD for cell

The declared unit used for EPDs for PV cell production does not cover the full life cycle of the product. The system boundary is defined as 'Cradle to Gate'. The declared unit (cradle to gate with options: A1-A3, A4) is defined as:

1 Wp of manufactured photovoltaic cell.

A converting factor shall be reported in the EPD to convert the results related to the declared unit to 1 m^2 of photovoltaic cell.

EPD for wafer

The declared unit used for EPDs for wafer production does not cover the full life cycle of the product. The system boundary is defined as 'Cradle to Gate'. The declared unit (cradle to gate with options: A1-A3, A4) is defined as:

1 m^2 of manufactured wafer.

EPD for ingot block and solar grade silicon

The declared unit used for EPDs for ingot block and solar grade silicon production does not cover the full life cycle of the product. The system boundary is defined as 'Cradle to Gate'. The declared unit (cradle to gate with options: A1-A3, A4) is defined as:

The declared unit (cradle to gate with options: A1-A3, A4) is defined as:

1 kg of manufactured ingot/block/solar grade silicon (SoG-Si).

6.3.3 Reference service life (RSL)

As in PCR part A, including the following additions:

The reference service life of the PV module shall be stated for both the declared and functional unit.

The reference service life of the PV module is set at the latest year where the actual power output will be no less than 80% of the labelled power output. The reference service life and the latest year where actual power output will be no less than 80% of the labelled power output must be provided and documented by a third-party validated report such as DNV or other similar third-party validated documentation/certificates.

If the reference service life (≥80% of the labelled power output) differs based on how and where the module is installed (façade, roof, etc), different reference service liftimes can be stated in the EPD. The most common use of the module shall be used related to the functional unit.

If no third-party report is provided, a standard reference service life of 25 years for ≥80% of the labelled power output should be used.

For building integrated photovoltaic (BIPV) the reference service life for the module as a building skin product can be longer than the reference service life for the module as an energy-producing unit. Both reference service lifetimes shall be stated in the EPD. The reference service life related to the functional and declared unit for the module shall be according to the energy-producing unit.

For BIPV, the reference service life may differ from NPCR 022 – Part B for Roof waterproofing (roof BIPV) and NPCR 010 - Part B for Building boards (façade BIPV). Where relevant, the reference service life according to NPCR 022 and NPCR 010 for the module as a building skin product can be stated in the EPD, but shall not be used for calculations in module B1-B5, B6 and B7.

6.3.4 System boundaries

As in PCR part A, including the following additions:

Mounting systems, microinverters, switches, one or many solar inverters, battery banks, battery chargesr or other electrical components or systems necessary to connect the photovoltaic module to the electrical grid shall not be included.

Cable wiring not mounted on the module shall not be included.

6.3.5 Criteria for the exclusion of inputs and outputs (cut-off)

As in PCR part A, including the following further clarification:

The cut-off criteria in EPD-Norway's general program of instructions (GPI) shall also be followed. As of 2018, the key points of the requirements are that:

- processes and activities that do not contribute more than 1 % to the total environmental impact in some of the environmental impact categories may be left out.
- the production of capital, buildings and equipment that are not included shall also be justified according to the GPI. This requirement is interpreted so that justification shall be based on quantitative assessments to the cut-off criteria. Conservative assumptions can be used when data is missing and is always better than leaving out activities in the inventory.

6.3.6 Selection of data

As in PCR part A, including the following additions:

For transport data in life cycle modules A2 and A4, the data representativeness of the vehicle type, fuel use and load factor must be shown to be realistic and conservative for the actual use and scenario.

This PCR makes it possible to use EPD data or specific data/adjusted generic data for upstream processes. Each value chain stage must reflect all upstream processes

If EPDs for upstream processes (e.g. cell, wafer, ingot block and/or SoG silicon production) is not available, specific data/adjusted generic data form databases (such as Ecoinvent) can be used as a proxy. As a minimum, the electricity mix used in the production of a cell, wafer, ingot block or SoG silicon must be adjusted to the national grid mix from the relevant country of production, including imports, direct emissions, infrastructure and transmission losses. Electricity source based on a guarantee of origin shall not be used as electricity for the PV value chain.

Transport distances and modes of transportation in the value chain, from SoG silicon production to PV module, must be adjusted to relevant distances and modes of transportation.

Detailed descriptions of specific data/adjusted generic data form databases must be justified in the LCA report.

For upstream processes, EPD's are preferable, followed by specific data. Generic data should only be used if the other two categories are not available

Wafer, ingot and SoG silicon are not part of the value chain of thin-film modules. Thin-film cells are the furthest upstream component in the value chain covered by this PCR.

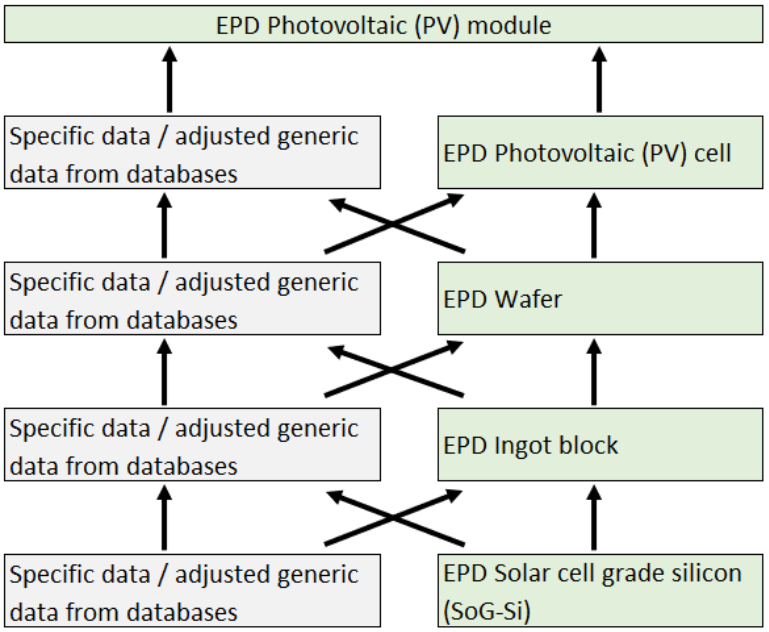

Figure 1: Overview of data selection criteria. Each individual EPD can feed into any EPD further down-stream; for example: an EPD for ingot block can be used in an EPD for a cell or module.

6.3.7 Data quality requirements

As in PCR part A.

6.3.8 Scenarios at the product level

As in PCR part A, with the following additions:

EN 15978:2011 provides additional guidance on developing scenarios.

Building integrated photovoltaic, scenarios at the product level for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.8.1 A4 Transport to the building site

EPD for PV module: transport to the building site (A4) comprises of a scenario for transportation to a construction site or market.

EPD for cell, wafer, ingot and silicon: transport in life cycle module A4 comprises of a scenario for transportation to a relevant location for the next step (down-stream) in the value chain (see Figure 1).

Transport-specific data from the manufacturing site to the relevant location, construction site or market should be considered and should be estimated based on information from the manufacturer and the intended location, construction site or market relevant for the product. Data shall be justified and documented in the LCA report.

If no specific data are available, the following generic default values can be used for developing scenarios at the product level:

- For domestic production, the default travel distance from the manufacturing site to a relevant market for the product is 500 km.
- For imported modules, the distance is measured from the manufacturing site to a specific storage location, plus a transport distance (500 km if not specified) from the storage location to a relevant market. If no specific storage location is given, then the capital city of the country that the product is being stored at may be used as an approximate location.

If relevant, several scenarios for A4 can be included in the EPD, if the relevant location, construction site or market can be several places (e.g. transport to Oslo, Norway and transport to Paris, France etc.)

For building integrated photovoltaics (BIPV), scenarios for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.8.2 A5 Installation

As in PCR part A, including the following additions:

PV module material wastage at the building site should be estimated based on information from the manufacturer and be relevant for the intended market.

If no estimate is available, then the amount of waste from the PV module is set to 0% by product weight since there will normally be no waste during installation.

Installation of modules should be carried out according to the manufacturer's guidance for installation, international standards and regulations or national standards and regulations.

Waste treatment of packaging shall be included.

For building integrated photovoltaics (BIPV), scenarios for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.8.3 B1-B7 Use phase

As in PCR part A, including the following additions:

Module B2-B5, Maintenance, repair, replacement and refurbishment scenarios are provided by the manufacturer, and shall be relevant for the intended market and intended area of application.

For building integrated photovoltaics (BIPV), scenarios for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.8.4 C1-C4 End-of-life

As in PCR part A, including the following additions:

The end-of-life life cycle modules C1, C2, C3 and C4 shall be calculated based on information provided by the manufacturer and be relevant for the intended market.

Default scenarios for life cycle module C2 transport to waste processing should be based on representative data, e.g. national statistics. A standard transport distance of 50 km may be assumed.

Any deviations from the scenario described above shall be justified and explained.

More than one scenario for waste treatment and disposal should be included if there are several relevant common practices, but the most conservative scenario shall always be included. Default conservative scenarios for life cycle modules C3 for waste processing and C4 for waste disposal are listed in Table 1. Data shall be justified and documented in the LCA report.

Non-silicon PV modules may require special semiconductor removal technology and insulation /separation/recovery of toxic heavy metals. The relevant scenario for waste treatment shall be justified and documented in the LCA report.

Table 1: Default conservative scenarios for life cycle modules C3 and C4 for silicon-based modules.

Product types	C1	C3	C4
PV module	Energy use for onsite dismantling.	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.	Landfilling of ashes from incineration. Landfilling of refused parts.
Glass	Energy use for onsite dismantling.	Central sorting of mixed construction waste. Recycling of glass.	Landfilling of refused parts.
Frame	Energy use for onsite dismantling.	Central sorting of mixed construction waste. Recycling of metals.	Landfilling of refused parts.
Ribbon (string + busbar)	Energy use for onsite dismantling.	Central sorting of mixed construction waste. Recycling of metals.	Landfilling of ashes from incineration. Landfilling of refused parts.
Insulation material, labels, back sheet.	Energy used for onsite dismantling.	Municipal incineration with energy recovery.	Landfilling of ashes from incineration.
Junction box (plastic part).	Energy used for onsite dismantling.	Municipal incineration with energy recovery.	Landfilling of ashes from incineration.
EVA and silicone paste.	Energy used for onsite dismantling.	Municipal incineration with energy recovery.	Landfilling of ashes from incineration.
PV cells	Energy used for onsite hdismantling.	Cells consisting of silicon can be melted down and re-used but recovering silicon from solar cells may not always be cost-efficient. For waste treatment, assume central sorting of mixed construction waste and recycling of cells.	Landfilling of refused parts.

For building integrated photovoltaics (BIPV), scenarios for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.8.5 Benefits and loads beyond the product system boundary in module D

As in PCR part A.

For building integrated photovoltaics (BIPV), scenarios for non-PV module materials are described in the following PCRs:

- BIPV roof: NPCR 022 – Part B for Roof waterproofing apply for non-PV module materials
- BIPV façade: NPCR 010 - Part B for Building boards apply for non-PV module materials

6.3.9 Units

As in PCR part A, including the following additions:

PV module is measured by installed peak power [Wp].

6.4 Inventory analysis

As in PCR part A.

6.5 Impact assessment

As in PCR part A.

7. Content of the EPD

7.1 Declaration of general information

As in PCR part A, including the following additions:

The material composition of the product shall be listed with specific weights of the main components as it is installed. This information shall be included in the LCA report. Usage areas and conditions must be specified in the EPD. The harmonised standard for which the product is produced according to must be specified in the EPD.

The scope of products declared in an EPD must be specified so that the product range can easily be identified by the customer. The ability of scaling LCA results to other dimensions must also be specified.

The technical properties for the products covered by the EPDs include, but are not limited to:

EPD for photovoltaic module

- Total mass of 1 photovoltaic panel related to the FU/DU, excluding packaging

- Total mass of 1 photovoltaic panel related to the FU/DU, including packaging
- Rated output: 1 Wp, related to the FU
- Area, m^2, related to the FU
- Number of photovoltaic cells related to the FU
- Converting factor to convert results related to the FU to 1 m^2 photovoltaic module
- Reference service life of the module
- Yearly degradation rate. If product specific degradation rate is used, then reference to the third-party validated report such as DNV or other similar third-party validated documentation/certificates should be stated.
- Type of technology (e.g. mono-Si, multi-Si)

EPD for cell

- Total mass of photovoltaic cell related to the DU, excluding packaging
- Total mass of photovoltaic cell related to the DU, including packaging
- Rated output: 1 Wp, related to the DU
- Area, m^2, related to the DU
- Reference service life of the cell
- Yearly degradation rate. If product specific degradation rate is used, then reference to the third-party validated report such as DNV or other similar third-party validated documentation/certificates should be stated.
- Type of technology (e.g. mono-Si, multi-Si)
- Wafer consumption related to DU (area of wafer, m^2, used per cell, related to the DU)

EPD for wafer

- Total mass of wafer related to the DU, excluding packaging
- Total mass of wafer related to the DU, including packaging
- Type of technology (e.g. mono-Si, multi-Si)
- Area, m^2, related to the DU
- Ingot block consumption related to the DU (kg ingot block per m^2 wafer)

EPD for ingot block

- Total mass of ingot block, excluding packaging
- Total mass of ingot block, including packaging
- Consumption of silicon related to DU (kg SoG-silicon per kg ingot block)
- Recycling rate

EPD for SoG-silicon

- Total mass of SoG-silicon, excluding packaging
- Total mass of SoG-silicon, including packaging
- Silicon purity

7.2 Declaration of environmental parameters derived from LCA

7.2.1 General

As in PCR part A.

7.2.2 Rules for declaring LCA information per module

As in PCR part A.

7.2.3 Parameters describing environmental impacts

As in PCR part A.

7.2.4 Parameters describing resource use

As in PCR part A.

7.2.4.1 Water use

As in PCR part A.

7.2.4.2 Electricity used in A3 Manufacturing

As in PCR part A, including the following further clarification:

Electricity sources based on a guarantee of origin shall not be used as an input in the PV value chain.

7.2.5 Other environmental information describing waste categories and output flows

As in PCR part A.

7.2.6 Accounting of biogenic carbon during the life cycle

As in PCR part A, including the following additions:

If no specifications are given in PCR part A, biogenic carbon shall be declared according to ISO 21930.

7.2.7 Greenhouse gas emissions from land use change

As in PCR part A, including the following additions:

If no specifications are given in PCR part A, greenhouse gas emissions from land use change shall be declared according to ISO 21930.

7.2.8 Carbonation

As in PCR part A, including the following additions:

If no specifications are given in PCR part A, carbonisation shall be declared according to ISO 21930, EN 16757:2017 and NPCR 020 Concrete Products.

7.3 Scenarios and additional technical information

7.3.1 General

As in PCR part A.

7.3.2 Construction process stage

7.3.2.1 A4, Transport from the production site to the construction site.

As in PCR part A, including the following additions:

Transport from the production gate to the construction site is typically carried out using boat and trucks. The distance, type of vehicle, fuel consumption and degree to which the transport capacity is utilised may have a large impact on transport emissions, thus these factors must be stated. Capacity utilisation is calculated as a percentage (%) of the total load capacity of the vehicle. The percentage given shall be the average of the capacity utilisation including the return trip.

Table 4 shows which information shall be provided in the EPD when module A4 is included.

Table 4. Information on the transport to the construction site (A4) required in the EPD.

Type	Capacity utilisation (incl return) %	Type of vehicle, incl emissions class	Distance km	Fuel/energy consumption pr tkm	Fuel energy consumption pr km
Truck					
Railway					
Other transport mode					

7.3.2.2 A5, Installation

As in PCR part A, including the following additions:

The EPD shall specify the following information about the installation scenario:

- The consumption of additional materials within the scope of the LCA.
- The amount of energy per energy carrier.
- Guidance for installation, international standards and regulations or national standards and regulations in which the scenario is based on.
- If the EPD deviates from the predefined scenarios, this shall be clearly stated and justified.
- Usage areas and conditions must be specified in the EPD.

7.3.3 Use stage

As in PCR part A.

7.3.4 End of life

As in PCR part A, including the following additions:

It should be mentioned in the EPD if the manufacturers take part in a national or international collection and recycling scheme.

Capacity utilisation shall be calculated as % of the mass carried of the total load capacity of the vehicle. The number given shall be the average of the capacity utilisation on the trip to the construction site and the capacity utilisation on the return trip.

7.3.5 Benefits beyond the system boundary (D)

The EPD shall include a short text description of how the modelling has been performed based on the LCA report. Specific focus shall be given to how net new scrap has been calculated and assumptions for the substitution. The values for gross scrap input and output shall be quantified in a table and include the net scrap output.

7.4 Additional information

As in PCR part A, including the following further clarification:

This clause includes all significant environmental and health impacts not included in the impact categories of this PCR. See section 7.2.3.

The EPD shall include content of toxic chemicals. If the product does not contain one or more of the following toxic chemicals, this shall be stated.

- Cadmium (Cd)
- Tellurium (Te)
- Indium (In)
- Gallium (Ga)
- Selenium (Se)
- Lead (Pb)

7.4.1 Additional information on release of dangerous substances to indoor air, soil and water

7.4.1.1 Indoor air

As in PCR part A, including the following additions:

Indoor air emissions are not relevant for a PV module.

7.4.1.2 Soil, ambient air and water

As in PCR part A.

7.4.2 Additional Norwegian requirements

As in PCR part A.

7.4.2.1 Greenhouse gas emissions from electricity use in A3 Manufacturing

As in PCR part A, including the following further clarification:

Electricity sources based on a guarantee of origin shall not be used as an input in the PV value chain.

7.4.2.2 Dangerous substances and content declaration

As in PCR part A, including the following additions:

Specification of materials and substances that can adversely affect human health and environment shall be reported.

A detailed list of the product's substances (i.e. chemicals included in the final product), including CAS number and health class (according to risk phrases or CLP Regulation (EC) No. 1272/2008) when these are in force, shall be included in the product content declaration. The content of substances shall be declared in terms of weight percentages. Only substances that are mentioned in the raw material safety declaration sheets (SDS) shall be included. The EPD owner has no obligation to investigate the content of ingredients used in raw material production, except for products on the REACH candidate list and the Norwegian Priority List.

In cases where information about contents could affect patent or company secrets, a qualitative list of chemicals and their expected functions is enough, including the risk phrases. This does not apply to substances registered under the REACH directive.

Other types of Dangerous substances and content of toxic chemicals shall be declared. The EPD shall include content of toxic chemicals. If the product does not contain one or more of the following toxic chemicals, this shall be stated.

- Cadmium (Cd)
- Tellurium (Te)
- Indium (In)
- Gallium (Ga)
- Selenium (Se)
- Lead (Pb)
- Other relevant toxic chemicals

7.4.2.3 Emission classification of building materials

As in PCR part A.

7.4.2.4 Carbon footprint of products

As in PCR part A.

7.5 Aggregation of information modules

As in PCR part A.

8. Project Report

As in PCR part A.

9. Verification and Validity of an EPD

As in PCR part A.

Approved XX.XX.2020, valid until XX.XX.2025.

Norwegian EPD Foundation, Technical committee

Christofer Skaar
Leader of the Technical committee

10 Bibliography

As in PCR part A, including the following additions:

ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

EN 15978. Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method

EPD-Norway (2014). General program instructions for the Norwegian EPD program

EN 50583: Photovoltaics in building

IEC 61215 (Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval

IEC 61730-1:2016. Photovoltaic (PV) module safety qualification

ISO 21930:2017

Ecoinvent, Swiss Centre of Life Cycle Inventories. www.ecoinvent.ch