Session 2: EU regulatory framework for sustainable solar: Ecodesign, Energy Label and Best-in-class solar

Thursday, December 7
11:30 – 12:30

SUSTAINABLE SOLAR EUROPE 2023

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Ecodesign and Energy labelling requirements for photovoltaic modules and inverters

Sustainable Solar Europe 2023 – 7. Dec. - Brussels

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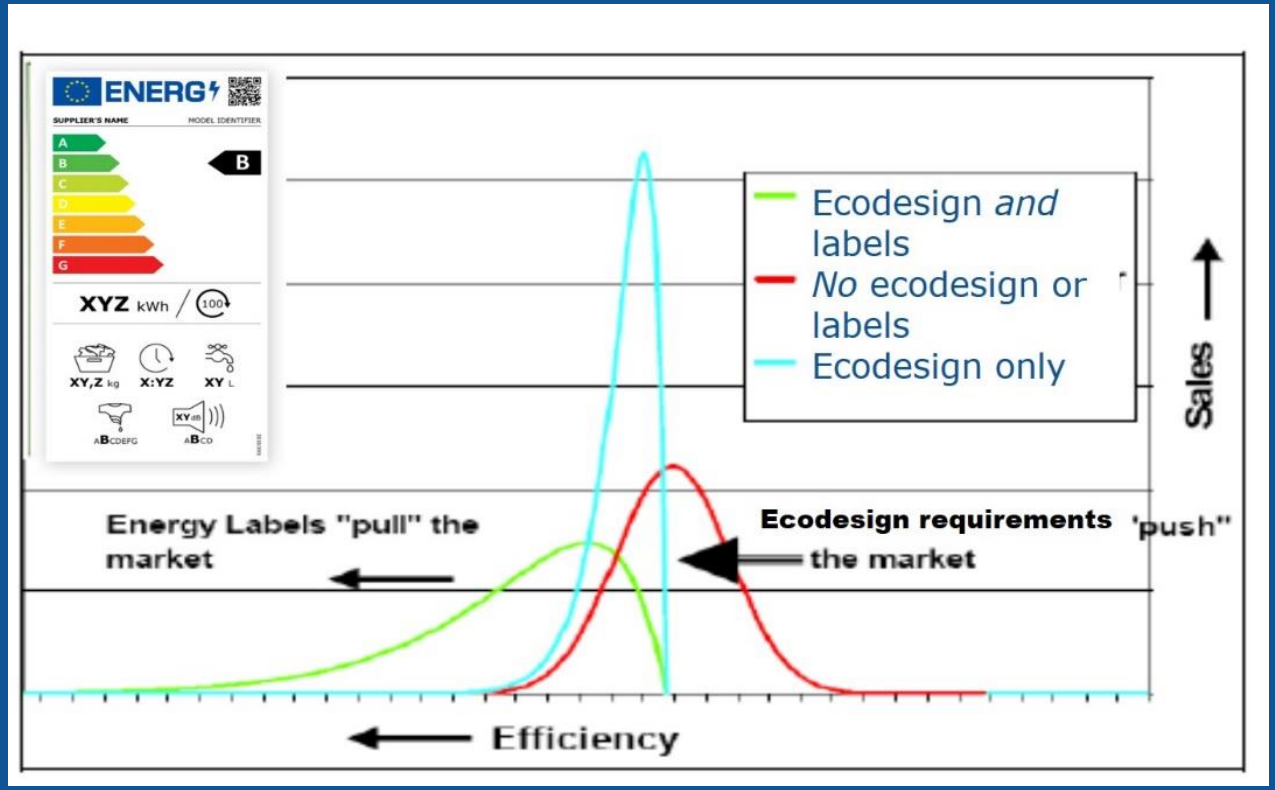
The EU Ecodesign & Energy labelling framework

An overview



Ecodesign & energy labelling

Ecodesign (ED): setting **minimum efficiency (and other) requirements** for *energy-related products*

- Current Legal basis: Directive 2009/125/EC, based on article 114 TFEU (internal market harmonisation)
- Historically, the 'focus' has been **on energy efficiency** requirements. Over the last years, **circular economy** requirements are increasingly been added.

Energy labelling (EL): providing information on energy efficiency and other key performance criteria to consumers

- Current Legal basis: Regulation (EU) 2017/1369, based on article 194 (energy)

Both frameworks are based on the concept of « **placing on the market** », relying on what can be verified at that moment, either through testing on products or technical documentation (incl. design specifications)

Around 50 measures in place. Almost all big and middle sized domestic appliances (fridges, washing machines, etc.) are regulated, together with b2b products (ventilation units, etc.).

Objectives of regulatory initiatives on environmental aspects

- **Better performing and more durable PV products available on the EU market: increasing quality in manufacturing processes and facilitating their repair**
- **More circular products available on the EU market: increasing their recyclability.**
- **PV products with lower GHG impacts from the production stage.**
- **PV inverters available on the EU market that have a standardised interconnectivity.**
- **Empower consumers to make an informed and sustainable choice at the point of sale.**

Scope –ED & EL

PV modules

- **Scope exclusions**
  - PV modules with a direct current output power of less than 50 Watts under Standard Test Conditions
  - building integrated photovoltaics (BIPV)
  - PV modules with an integrated inverter in which no access to the module DC output power is possible
  - PV modules integrated into consumer electronic products, or other multifunctional applications requiring specialised designs for which energy production is not the only purpose or functionality
  - PV modules without a cell layer made of silicon semiconductor material and that are based on: single junction perovskite semiconductors, dye-sensitized cells or organic cells.
  - concentrating PV modules
  - PV modules exclusively designed for space applications

Scope - ED

Inverters

- Scope exclusions
  - **central photovoltaic inverters that are packaged with transformers as defined in Commission Regulation (EU) No 548/2014 on Ecodesign requirements for small, medium and large power transformers**.
- Special consideration for:
  - **micro-inverters**

Requirements

PV Modules

- **Ecodesign**
  - Reliability
  - Carbon footprint
  - Information requirements
- **Energy Label**

Inverters

- **Ecodesign**
  - Repairability
  - Reliability
  - Energy efficiency
  - Information requirements

DISCLAIMER: Ecodesign and Energy Labelling requirements shown in this presentation are in DRAFT

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ECODESIGN REQUIREMENTS PV MODULES

REQUIREMENTS FOR PV MODULES – DESIGN FOR RELIABILITY

Design for reliability

PV modules shall be able to withstand:

- exposure to outdoor conditions;
- hot-spot heating effects;
- thermal mismatch, fatigue and other stresses caused by repeated changes of temperature;
- effects of high temperature and humidity followed by sub-zero temperature;
- the effects of long-term penetration of humidity;
- a minimum static load;
- the impact of hail.

Design for reliability

The design of photovoltaic modules shall ensure:

- adequate insulation, including under wet operating conditions;
- robustness of termination;
- the adequacy of the thermal design;
- the long-term reliability of the bypass diodes.

Design for reliability

- Compliance with testing methods EN IEC 61215 series

Standard	Subject covered
EN IEC 61215-1	Design qualification and type approval - Part 1: Test requirements
IEC TS 62915	Retesting conditions.

Specific tests covered:
- *Thermal cycle test*, with temperature and electrical current as stressors;
- *Damp heat test*, combination of effects due to temperature and humidity;
- *Humidity freeze test*, on sealing materials and components;
- *UV test*, for polymeric components;
- *Static mechanical load test* simulates loads such as those by constant wind or homogeneous snow accumulation;
- *Hot spot test* linked to partial shading on modules;
- *Hail test*.

REQUIREMENTS FOR PV MODULES – CARBON FOOTPRINT

Carbon footprint requirements

- Aim to create transparency on the market and allow buyers / authorities to compare the carbon footprint of different modules placed on the market / allow only products above a certain threshold to be placed on the EU market

- High relevance of the production phase of PV modules on their overall life-cycle environmental impacts

- Some MS (IT, FR, ES) introduced PP schemes for PV modules requiring inter alia information – and even quantitative – requirements on the products' environmental / carbon footprint

- The carbon footprint assessment focus on emissions linked to the raw material selection, manufacturing phase, as well as distribution to a regional storage facility. The 'climate change' life cycle impact assessment method expressed in kg of CO_{2eq} per kWh produced by the PV product

Requirement on carbon footprint – regulatory approaches

- **Ecodesign requirement on a maximum admitted threshold for the carbon footprint**
- **Ecodesign information requirement**
- **Carbon footprint information to be reported in the energy label of PV modules, and/or in the related product information sheet (*legal analysis needed)**
- **Ecodesign quantitative requirements on specific relevant parameters influencing the carbon footprint, such as the silicon content or the module yield.**

Carbon footprint declaration

From 01 July 2026 - carbon footprint declaration for:

- Multicrystalline Silicon photovoltaic modules (multi-Si)
- Monocrystalline Silicon photovoltaic modules (mono-Si)
- Cadmium-Telluride photovoltaic modules (CdTe)

Including:

✓ The carbon footprint and the carbon footprint certificate

✓ A web link to the supporting study

✓ …..

Carbon footprint calculation – functional unit

- The **functional unit** is defined as one kWh (kilowatt-hour) of the total DC electric energy generated over a photovoltaic module's service life *

- The functional unit expressed per "kWh" of generated electricity:
  - allows comparability between other electricity generation products
  - includes parameters such as panel lifetime, efficiency, degradation ratio

- The reference flow is the amount of product needed to fulfil the defined function and shall be measured in m2 of photovoltaic module per kWh of the total energy required by the application over its service life. All quantitative input and output data collected by the manufacturer to quantify the carbon footprint shall be calculated in relation to this reference flow.

* Tested in line with the EN 61853 standards

Carbon footprint verification – conformity assessment

- Ecodesign Directive (Art. 8(2)): **possibility to adapt** the conformity assessment procedure, **e.g. by involving independent third parties**

- Procedure proposed adapts a module of Decision 768 to the specificities of the carbon footprint:
  - normally MSAs can verify compliance with applicable requirements by testing individual products;
  - this does not hold for verification of the reliability of the carbon footprint declaration (especially for company-specific data).

Carbon footprint verification – conformity assessment

- The manufactures lodges an **application for verification with a notified body (NB)**

- Member States take responsibility for the **assessment, designation (notification), monitoring and supervision of NBs**
  → **NBs** must be within the jurisidiction of Member States and legally liable to them

- Accreditation (by NABs) mandatory to assess candidate bodies

Carbon footprint verification – conformity assessment

- Application includes a **supporting study** containing:
  - Documentation of info put into the calculation tool
  - Including all company-specific data + underlying documentation

- NBs verify all information, with **special attention for company-specific data** (verification of the company-specific data shall always be organised through a visit of the production site(s) the data refer to).

- Verification based on: comparing data to **underlying documentation** (provided by manufacturer or requested by NB) + assessment of **reliability of documentation** + **observation during site visit**

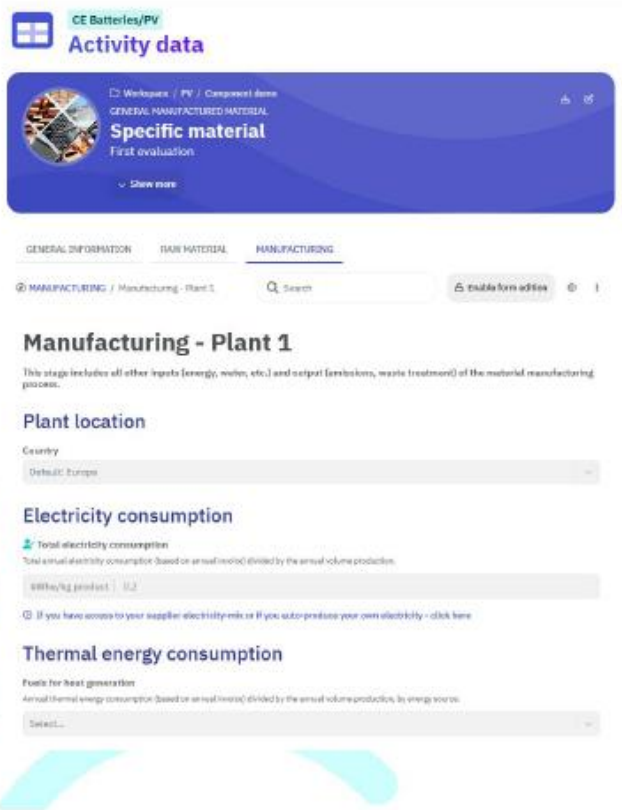
Carbon footprint – points under analysis following stakeholder feedback

- Verifiability of the information
- Accounting for recycled silicon
- More detailed/specific declaration of the module lifetime of the PV module and its degradation rate → accounting on carbon footprint
- Updated list (possibly EF 3.0 datasets)
- Preparation of a IT tool for carbon footprint calculation

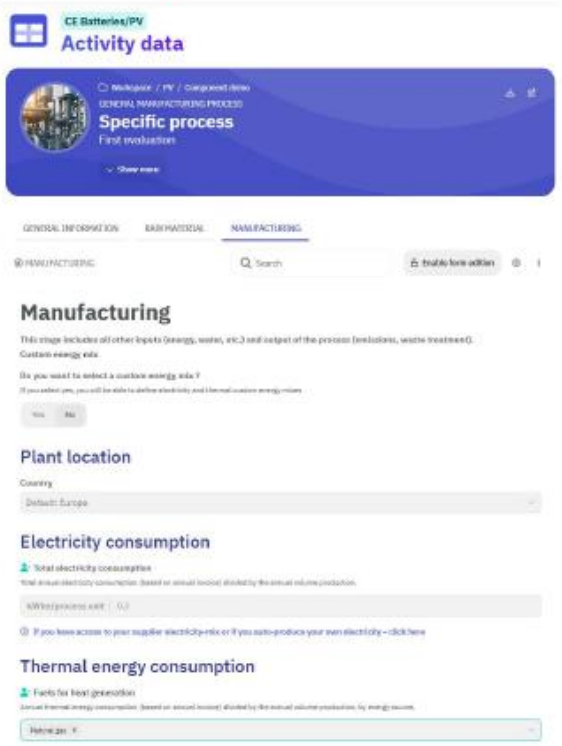
Online tool..how it could look like

Specific processes and material evaluation possibility

Specific material



Specific process



REQUIREMENTS FOR PV MODULES – INFORMATION REQUIREMENTS

Information requirements - Repairability

- **Provide in a user manual on a free access website of the manufacturer information on:**
  - how to access and replace the bypass diodes in the junction box
  - how to replace the whole junction box of the module
  - how to separate and recover the semiconductor from the frame, glass, encapsulants and backsheet
  - the feasibility of clean separation without breakage of the glass, contacts and internal layers during the dismantling operations at the end of life shall be detailed

Information requirements - Recyclability

•Provide in a QR code affixed on the PV module (feasibility?) or in a user manual on a free access website of the manufacturer information on the weight of the following CRMs:

- Cadmium
- Silicon metal
- Silver
- Aluminium
- Copper
- Indium
- Gallium
- Germanium
- Tellurium
- Lead
- Metal solder and contacts
- Glass fining agents
- Antimony
- Phthalates

from the date of placement on the market of the first unit of a model to at least 35 years after placing the last unit of the model on the market

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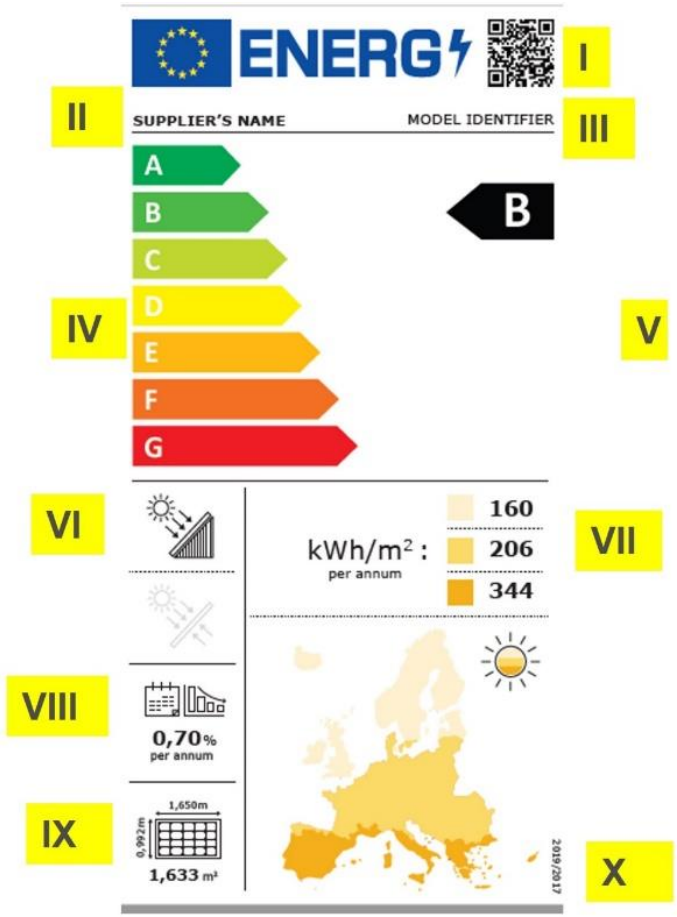
ENERGY LABEL PV MODULES

Energy Label PV modules – draft version



I. QR code

II. trade mark

III. supplier's model identifier

IV. scale of energy efficiency classes from A to G

V. module energy efficiency class attained by at least two of the three values of EEI_M under 'temperate coastal', 'temperate continental' and 'subtropical arid' climate conditions

VI. icon specifying whether the module is monofacial or bifacial

VII. module energy efficiency index value EEI_M under 'temperate coastal', 'temperate continental' and 'subtropical arid' climate conditions, calculated according to Annex IV, expressed in kWh/m^2 and rounded to the unit

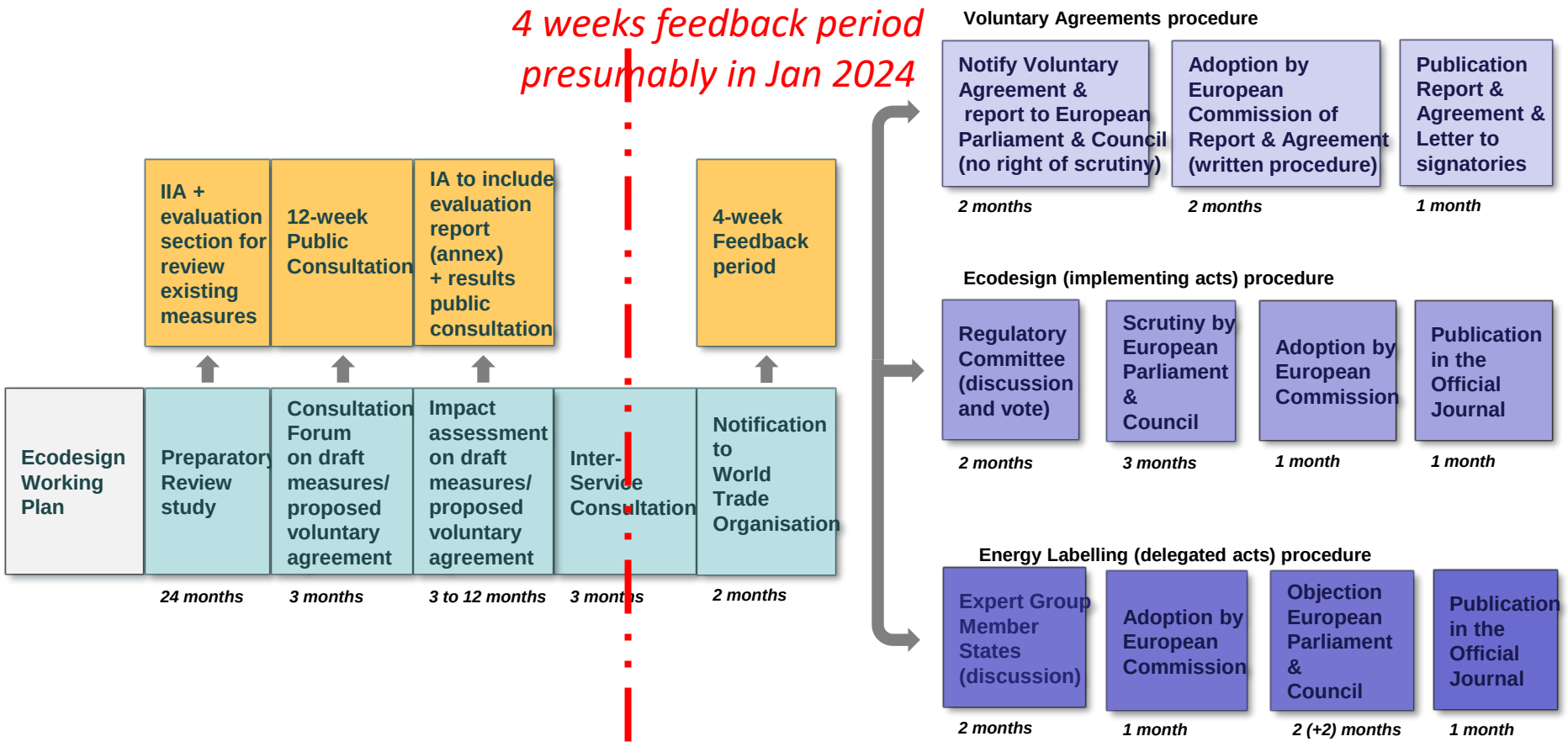
VIII. lifetime performance degradation rate

IX. the photovoltaic module area (AM)

X. number of the Regulation

The policy implementation process

Process for adoption of Implementing Measures under Ecodesign & Energy labelling - Alignment with Better Regulation



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Thank you!

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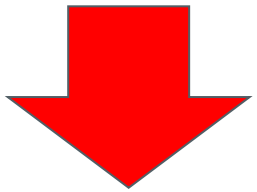
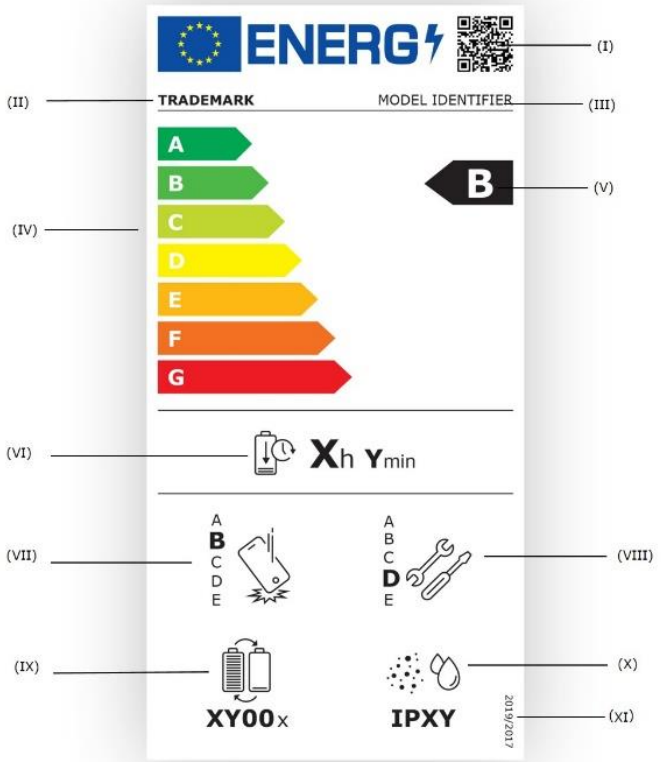
BACK UP SLIDES

Can more be made, to regulate the recyclability of PV modules?



A recyclability index for photovoltaic modules!

‘Precedent’: reparability index for smartphones & tablets



Conceptual process to develop the rep. index:

- Selection of priority parts
- Selection of scoring parameters
- Definition of scoring criteria
- Definition of weighting factors
- Aggregation

Energy Labelling Regulation 2023/1669, applicable as of 20/06/2025

Priority Parts (for rep score) – Selection & Weighting

Relevance value		Failure Likelihood		
		Low	Medium	High
Functional relevance	Low			
	Medium		Front-facing camera Rear-facing camera	Back cover (assembly)
	High	External charging ports Mechanical button(s) Microphone Speaker(s)	Hinge assembly or mechanical display folding mechanism	Battery Display assembly

Scoring parameters (for rep. score)- Selection

JRC General Method 2019	Min requirement in regulation	JRC Repair Score 2021	Weighting
Disassembly depth	(none)	**Disassembly depth**	**25%**
Fasteners	removable	**Fasteners (type)**	**15%**
Tools	commercially available	**Tools (type)**	**15%**
Disassembly time	(none)	(via other proxies)	
Diagnosis support and interfaces	Via repair info	(not selected)	
Type and availability information	Professionals; comprehensive	**Info (target group; cost)**	**15%**
Spare parts (target group, duration of availability, delivery time, price)	Professionals; Smartphone: 5 years Tablets: 6 years	**Spare parts (target group)**	**15%**
Software and Firmware updates	Security: 5 years Functionality: 3 years	**Software Updates**	**15%**
Safety, skills and working environment	Generalist; Workshop environment	(not selected)	
Data transfer and deletion	Data user encryption	(not selected)	
Password reset and factory settings restoration	Factory settings reset	(not selected)	

How to proceed for a recyclability index? 1#

A 'CONCEPTUAL SWITCH'

FROM:

'Disassembly': means a process whereby a product is separated into its parts and/or components in such a way that it could subsequently be reassembled and made operational (→ REPARABILITY SCORE)

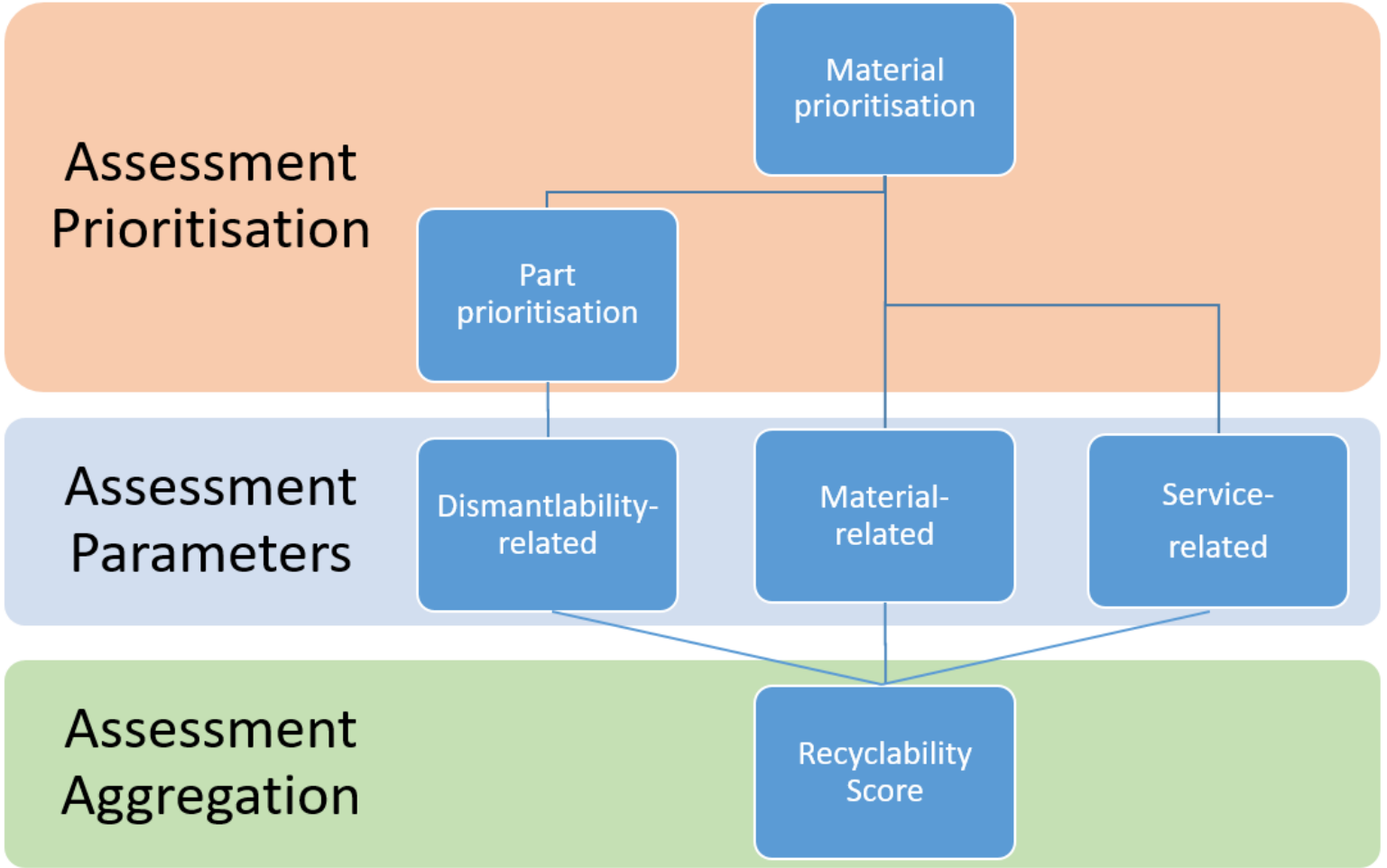
[Definition from EU Regulation 20123/1669]

TO

'Dismantling': means a process whereby a product is separated into its parts and/or components, in a way that could be irreversible, and with the aim to scavenge materials/components (→ RECYCLABILITY INDEX)

[Draft definition]

How to proceed for a recyclability index? 2#



Activities are starting!

Data | Document Library | Questions & answers

Information

Tender reference number	CINEA/2023/OP/0007
Title	Development of a Recyclability Index for Photovoltaic Products
Description	This action aims at developing a recyclability index for photovoltaic modules, to be built up starting from the general methods laid down in the horizontal standards developed under M/543 and under eco-design and energy labelling regulatory framework.
Contract type	Services
Procedure type	Open procedure
Status	Closed
Published on TED	✔
Submission Method	Electronic
Information about a public contract, a framework agreement or a dynamic purchasing system (DPS)	Public contract
Address of the buyer profile: (URL)	
Award method	Best price-quality ratio
Estimated total value	300,000.00 EUR
Estimated value	300,000.00 EUR
Main CPV	73200000

Help

- Help on this page

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ECODESIGN INVERTERS

REQUIREMENTS FOR PV INVERTERS – DESIGN FOR REPAIRABILITY

Design for repair

Make available to profesional repairers the following spare parts:

- Inductor(s)
- Transformers
- Power supply/ section boards
- Control board (including the main microprocessor(s))

- ***At least those proprietary and specifically designed components*** *parts*
- *From 6 months after placing the first unit of a model on the market until at least fifteen years after placing the last unit of the model on the market*
- *The list of spare parts and the procedure for ordering them shall be publicly available on the free access website of the manufacturer*
- *Spare parts shall be delivered within 5 working days after having received the order*

- Power semiconductors: transistor(s), diode(s),
- Safe and protection components
- Capacitor(s)
- Input/Output connectors
- Power supply when not proprietary designed

- *The **technical characteristics***
- *From 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts*

Design for repair

Provide access to repair and maintenance information:

- The repair and maintenance information shall include:
  - the unequivocal photovoltaic inverter identification information
  - a disassembly map or exploded view
  - technical manual of instructions for repair
  - list of necessary repair and test equipment
  - component and diagnosis information (such as minimum and maximum theoretical values for measurement)
  - wiring and connection diagrams
  - diagnostic fault and error codes (including manufacturer-specific codes where applicable)
  - instructions for installation of relevant software and firmware including reset software
  - information on how to access data records of reported failure incidents stored on the device (where applicable).

- From 6 months after placing on the market the first unit of a model of a photovoltaic inverter until seven years after placing the last unit of the model on the market

Design for repair

Disassembly requirements:

PV inverters of nominal power **lower than 30kW**

- ✓ Fasteners and connectors shall be reusable
- ✓ Repairs shall be feasible either without the use of tools, with a tool or set of tools that is supplied with the product or spare part, or with basic tools
- ✓ Repairs shall be feasible at least in the use environment
- ✓ Repairs shall not require a higher skill level than ‘Generalist’

PV inverters of nominal power **equal or higher than 30kW**

- ✓ Fasteners and connectors shall be reusable
- ✓ Repairs shall at least be feasible with product specific tools
- ✓ Repairs shall be feasible at least in a workshop environment
- ✓ Repairs shall not require a higher skill level than ‘Expert’

Design for repair

Disassembly requirements:

Control board

- ✓ Shall be replaceable and detachable
- ✓ At the end of the reparations, the control board shall be able to communicate with the rest of sections (communications, power components etc.)

REQUIREMENTS FOR PV INVERTERS – DESIGN FOR RELIABILITY

Design for reliability

PV inverters shall be able to withstand:

- exposure to outdoor conditions
- mechanical impacts
- the penetration of dust, water and foreign bodies
- vibrations during shipping
- shocks from handling
- exposure to ultra-violet radiation
- thermal mismatch, fatigue and other stresses caused by repeated changes of temperature;
- the effects of high temperature and humidity followed by sub-zero temperature;
- the effects of long-term penetration of humidity; and
- conditions of high humidity when combined with cyclic temperature changes.

Design for reliability

The design of photovoltaic inverters shall ensure:

- adequate insulation
- robustness of terminals

REQUIREMENTS FOR PV INVERTERS – INFORMATION REQUIREMENTS

Information requirements - Recyclability

- **Provide in the form of a user manual on a free access website of the manufacturer information on the weight of the following CRMs:**

  - Cadmium
  - Lead
  - Silicon carbide
  - Silver
  - Indium
  - Gallium
  - Tantalum
  - Phthalates