

# Session 5: Sustainable End- of-life Solutions for Solar Products

Thursday, December 7  
17:00 – 18:00

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EUROPE 2023



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# David Moser

Group Leader - Photovoltaic energy systems,  
EURAC Research

7 December, Brussels, Belgium



# Maria Banti

Policy Officer,  
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# Directive 2012/19/EU on waste electrical and electronic equipment (WEEE Directive) State of play & Evaluation

**Sustainable Solar Europe 2023**

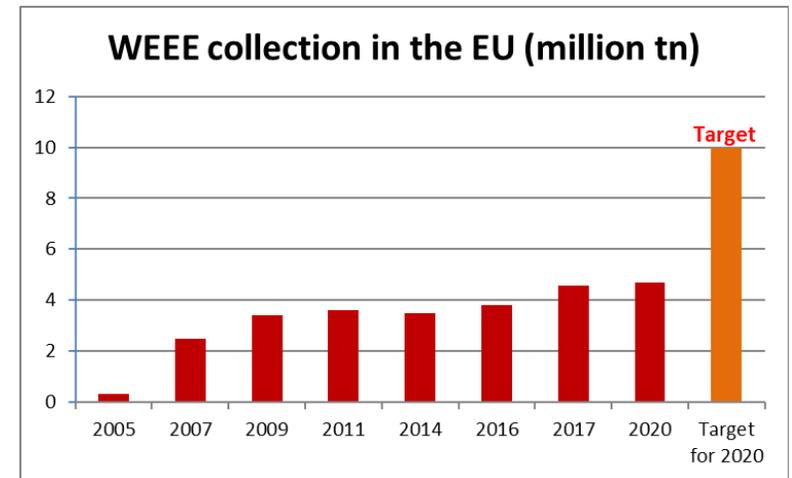
**Brussels, 7 December 2023**

*Maria Banti*

*DG ENV, Unit B3: From Waste to Resources*

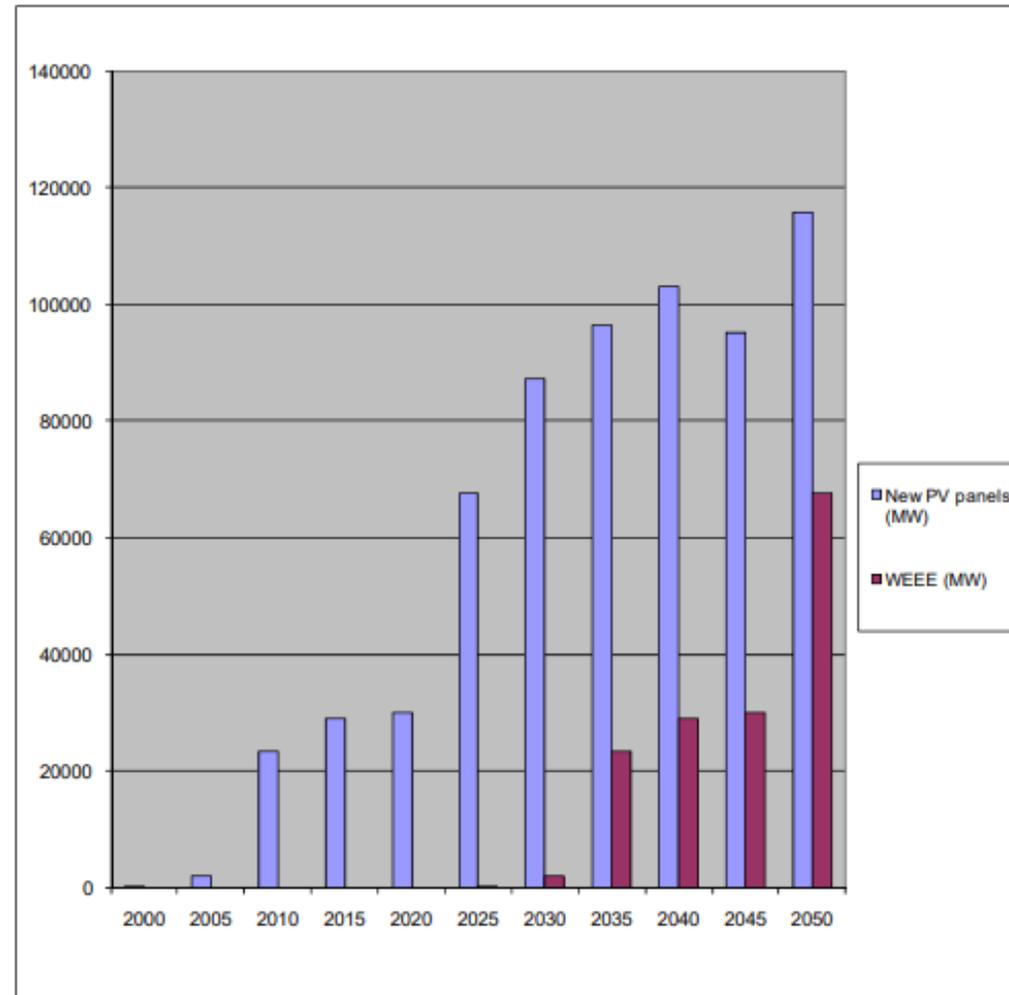
# Legislative framework for the management of WEEE in the EU

- The first WEEE Directive 2002/96/EC entered into force in 2003 (20 years of experience)
- The revised WEEE Directive 2012/19/EU entered into force in August 2012
- Photovoltaic panels entered into the scope of the WEEE Directive from 13 August 2012.
- Significant achievements over these 20 years:
  - Increase on WEEE collection from 300 thousand tonnes in 2005 to about 4.9 million tonnes in 2021
  - BUT still a lot to be done as the target was to reach about 10 million tonnes of WEEE collected in 2020.



# Challenges in the implementation

- Inclusion of PV panels in scope – impact on collection rate
- WEEE collected and treated through unofficial channels
- Ensuring the proper treatment of WEEE, and a related level playing field
- Online sales, free-riders and authorised representatives
- Exports of second hand EEE – illegal export of waste EEE



# Evaluation of the WEEE Directive

## □ Purpose and scope:

- provide evidence on whether the Directive is still fit for purpose, and
- help determine whether a review is needed.

## □ Timeline: Q3 2024

## □ Outcome of consultation activities in relation to PV panels:

- Current classification under category 4 creates issues related to the achievement of the WEEE collection rate
- Methodology to calculate the collection rate based on quantities of EEE put on market is not efficient to take into consideration products with long lifetime
- Exports of PV panels for re-use
- Recycling/ Recovery of PV panels – critical raw materials (germanium, silicon)
- Recycling/ Recovery capacity building
- PV panels are not in scope of the RoHS Directive

# Commitments in relation to WEEE

- **Critical Raw Materials Communication (16.3.2023):**
  - **The Commission will** review the WEEE Directive to, inter alia, address CRM-rich equipment in provisions relating to information require.

# Commitments in relation to WEEE

- **Targeted amendment of the WEEE Directive (under co-decision)**
  - Purpose: to clarify the timing from when producers of photovoltaic panels and of open-scope EEE have to provide for the financing of the costs for the collection, treatment, recovery and environmentally sound disposal of WEEE.
  - European Parliament and the Council have reached political agreement:
    - Review the WEEE Directive: No later than **31 December 2026**, the Commission shall assess the need for a revision of this Directive and, where appropriate, present a **legislative proposal** in that respect, **accompanied by a thorough socio-economic and environmental impact assessment**.
    - Impact assessment to assess:
      - New EEE category for PV panels and collection targets taking into consideration expected lifetime
      - Adequate collection targets and prevention of WEEE illegal trade
      - Ensure implementation of waste hierarchy
      - Ensure legal certainty – no retroactive effect
      - No disproportionate costs to citizens and consumers
      - Mechanism to ensure producers' compliance

# Thank you!

Your WEEE contact at the Commission:

**Maria Banti** ([Maria.BANTI@ec.europa.eu](mailto:Maria.BANTI@ec.europa.eu))



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# Nicolas Defrenne

General Director,  
Soren

7 December, Brussels, Belgium

# PV second life

**Sustainable Solar Europe**

**December 7th, 2023**

**Bruxelles**

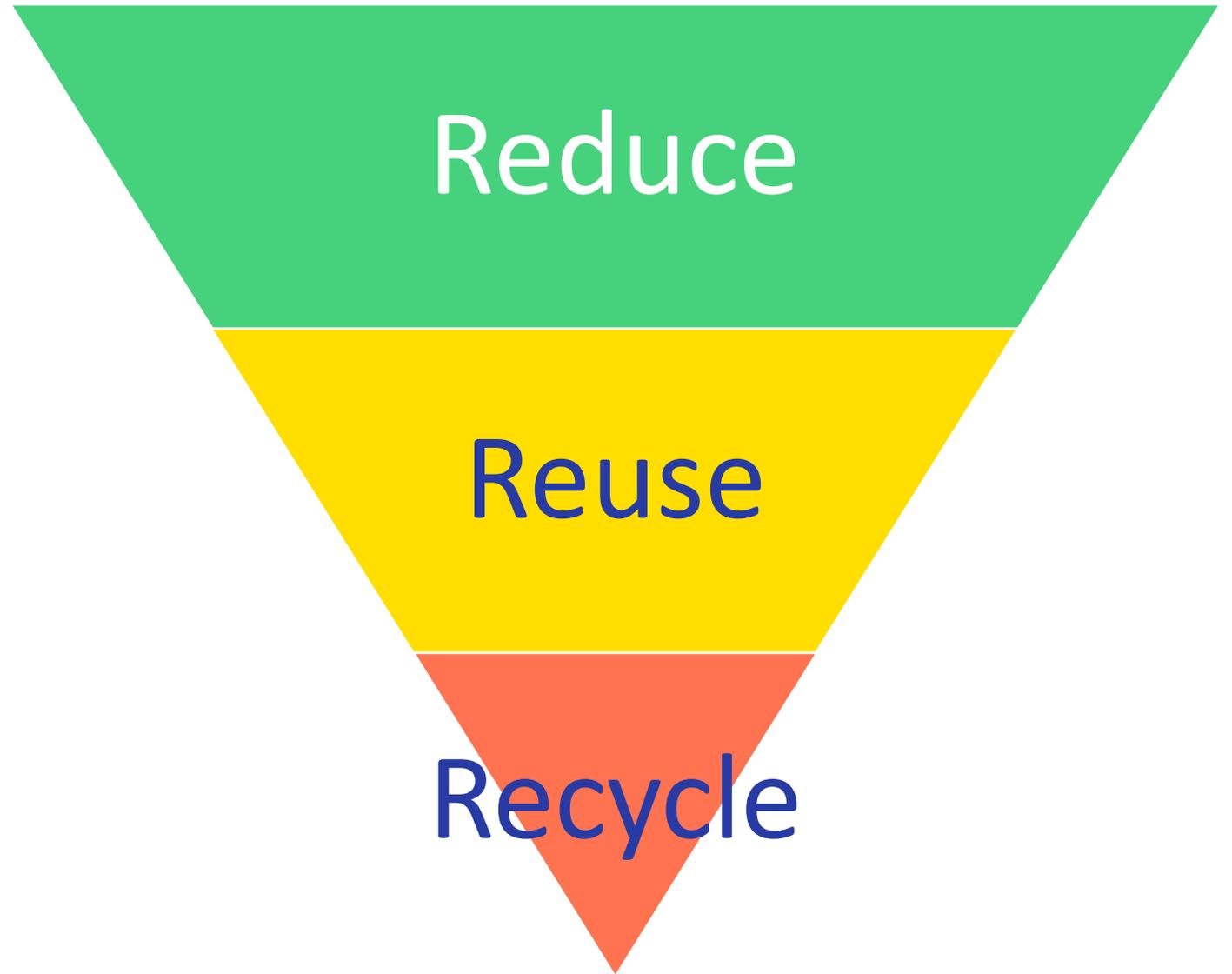
**soren**



# Reducing consumption of non-renewable resources



# Waste hierarchy





# Recertification is necessary



# Triple warranty for second life



Safety



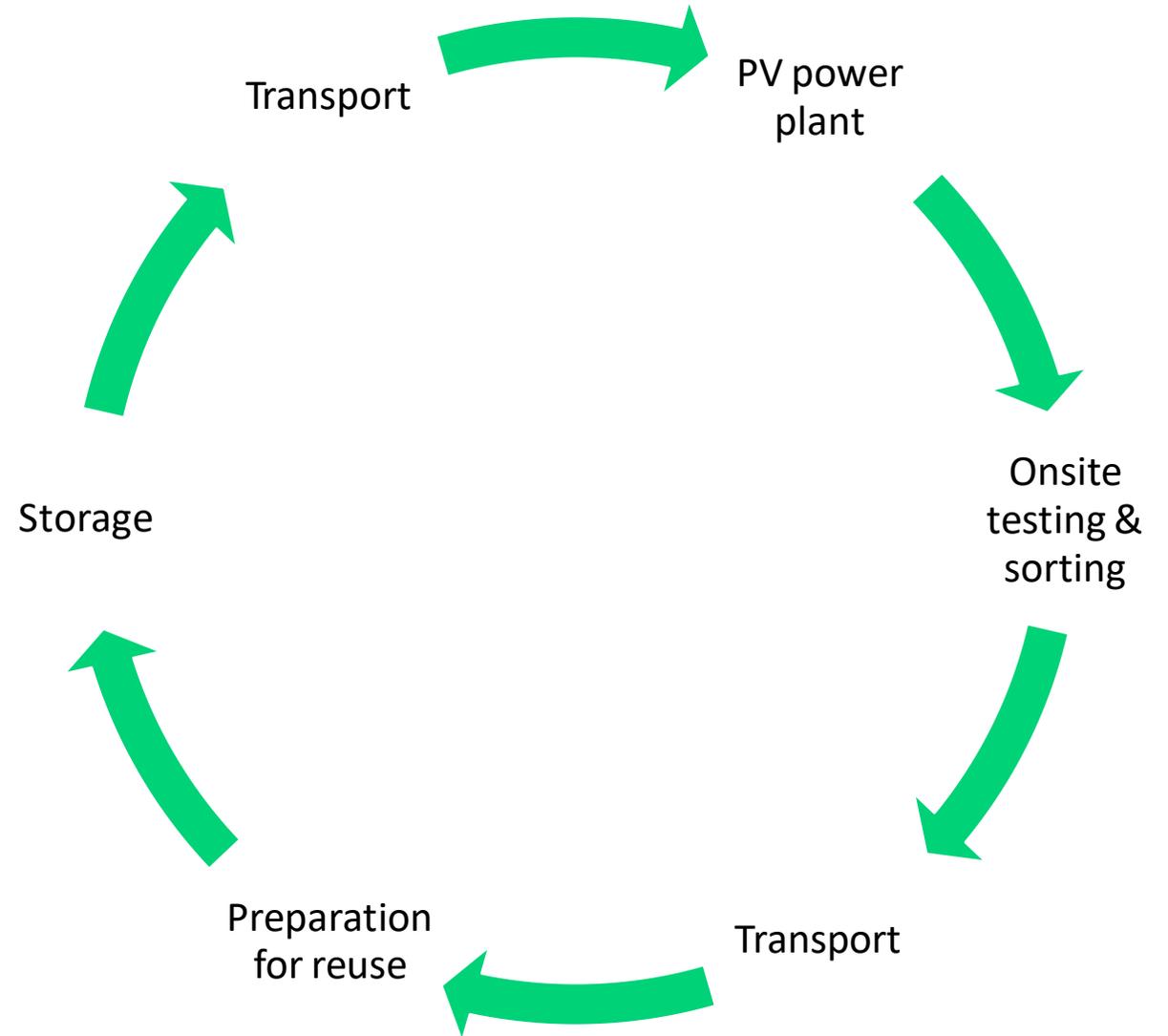
Durability



Performance



# Organization



# Preparation for reuse

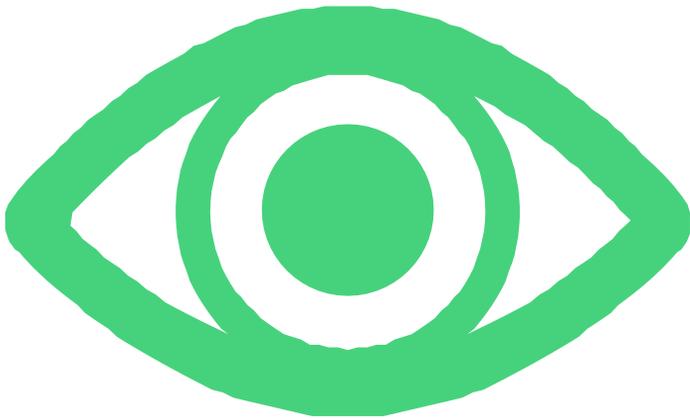




# Creation of a label for second life PV in 2024



# Visual inspection



**Standard:** IEC 61215 (minimum illumination 1000 lux)

**Quality objective:**

- Checklist with minor or major fault classification for each category.
- Visual analysis may depend on the operator responsible for the inspection.

**Prerequisites:**

- Prior training for all operators
- List of classic defects that are either critical or acceptable (common defect catalog)



# Electroluminescence test



No standard (based on IEC 60904-1-13), visual analysis may depend on the operator.

## Prerequisite :

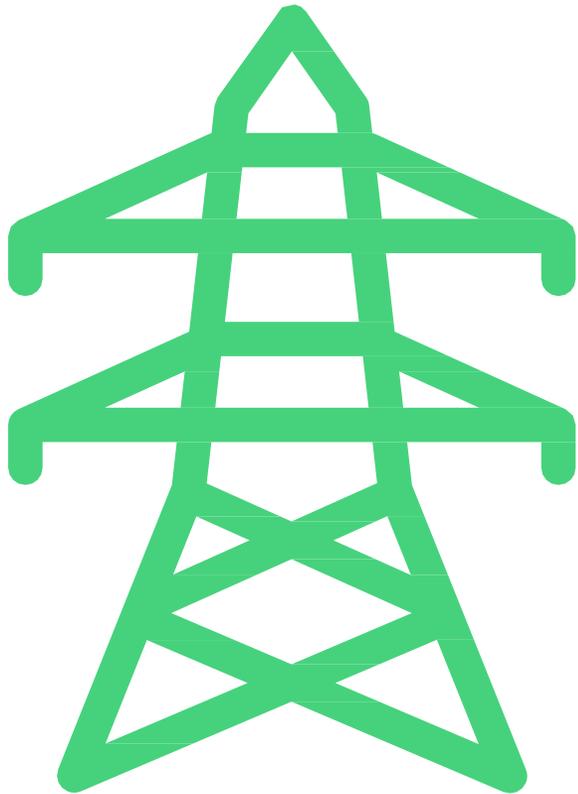
- Operator training.
- Common defect catalog.

## Quality objective :

- Per cell: absence of macro cross cracks and absence of dark areas in EL (Electroluminescence).
- Per module: limited number of affected cells.
- Cross-reference with I/V measurement (including FF - Fill Factor).



# Power measurement I/V



Standard: IEC 61215 & IEC 60904

Methodology:

- Class A flash testing
- Power sorting within +/- 5%.
- Calibration using a reference module.
- Batch measurement.

Quality objective:

- Less than 2% power loss per year compared to nominal value or less than 20% power loss.
- Fill Factor (FF)  $\geq$  65%.



# Isolation test



**Standard:** IEC 61215. *Test to be performed last.*

**Methodology:**

Module surface submerged in a tank, except for cable entries or MC4 connections at junction boxes. Voltage applied to the output connectors - which are short-circuited - and increased to the module's maximum voltage (or 500V), applied for a duration of 2 minutes.

**Quality objective:**

Insulation resistance greater than  $40 \text{ M}\Omega \cdot \text{m}^2$  (for modules with a surface area  $> 0.1 \text{ m}^2$ ).

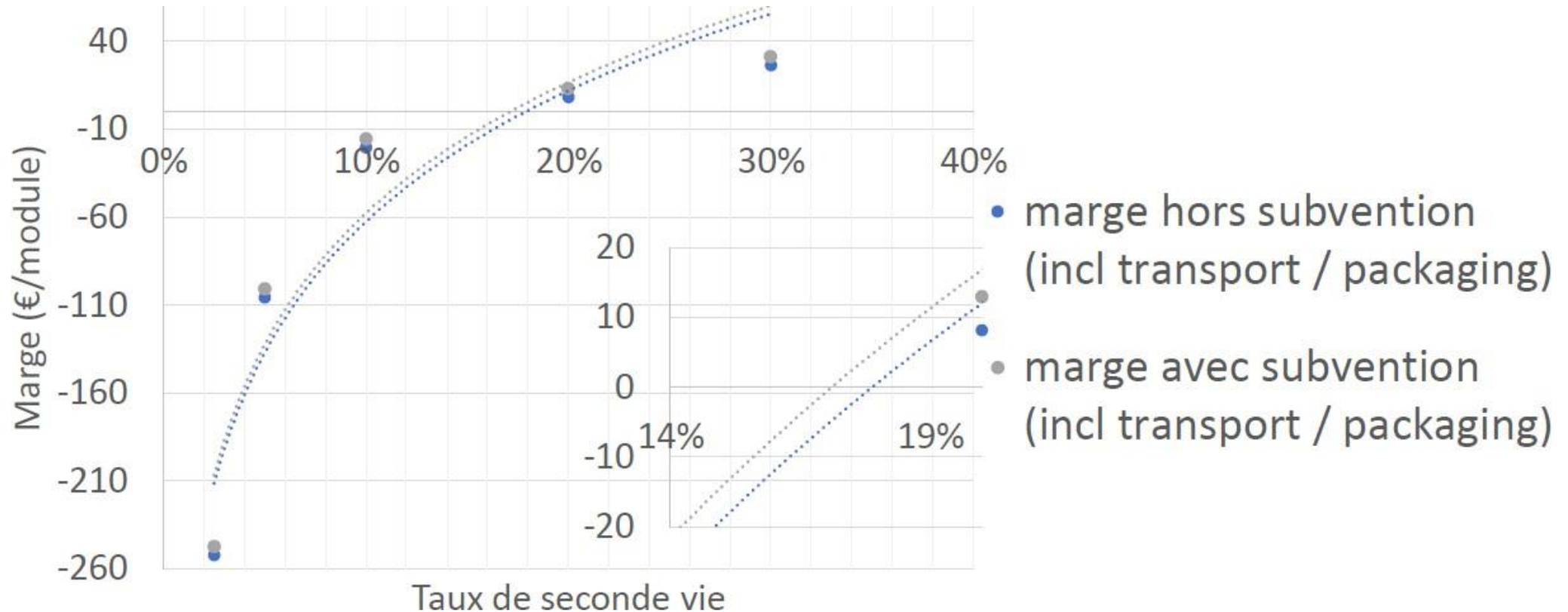


# Scoring system & module classes

	Human impact	Economic impact	Environmental impact	Acceptable class
Residential	+++	++	+	A
Schools	+++	++	+	A
ICPE installations	+	++	+++	A
Carports	++	+	+	B
Ground mounted	+	+	++	C
Floating	+	+	+	C



# Economic viability if >20% pass





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# Kahya Engler

Technical Lead M&A - Strategy,  
Sunrock

7 December, Brussels, Belgium



# SUNROCK

From End of Life to  
Closing the Loop

Kahya Engler  
Technical Lead M&A and Strategy

SUNROCK



# Is End-of-Life a given?

At Sunrock we believe we are part of a clean energy future

## The facts of Sunrock's current ownership

**+1,500,000** PV panels

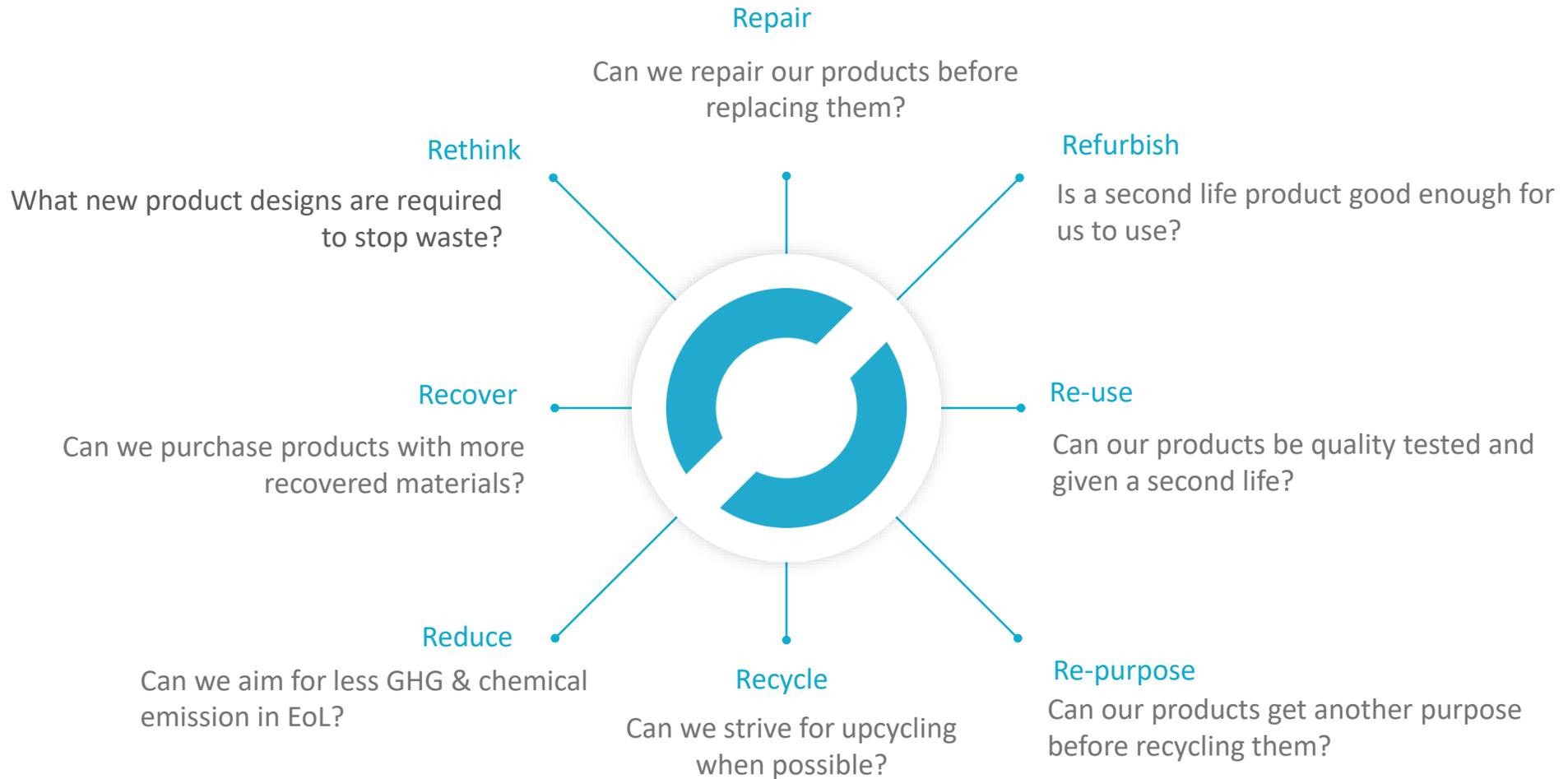
**+4000** inverters

**+870,000** mounting structure units

## Our End-of-Life vision is a path towards circularity

- Bringing **100% back** into the production / use cycle
- Increase kWh output per gram of raw material input
- **30%** EoL materials are reused / upcycled by 2030
- **Zero** EoL materials incinerated / landfilled by 2050







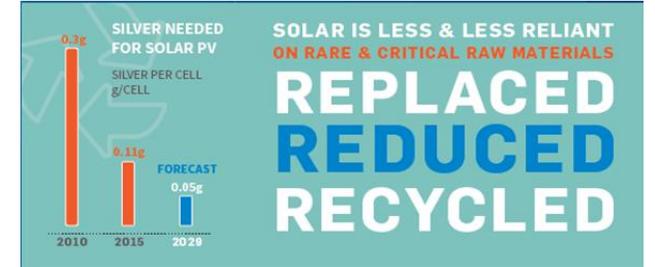
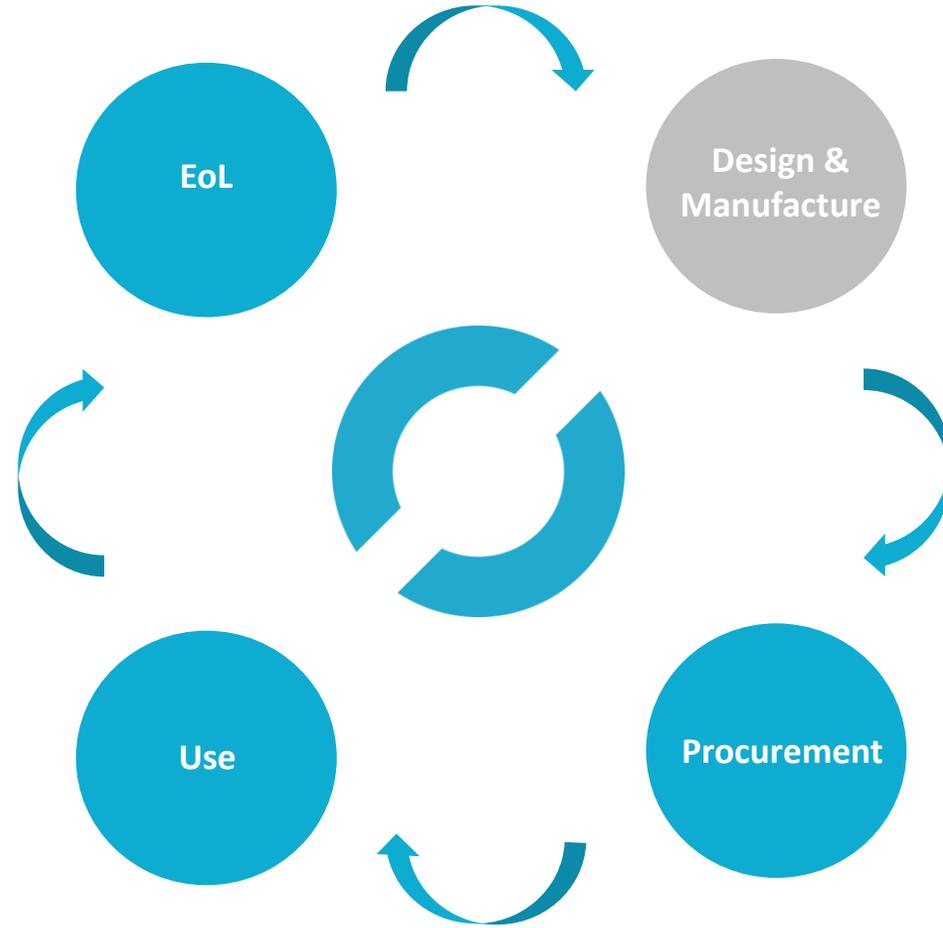
# From End-of-Life to Closing-the-Loop

**SOLAR RECYCLING IS MANDATORY**  
ACCORDING TO EU LAW

Take-back and treatment of solar panels, inverters and batteries is mandatory in the EU, leading to high collection, reuse and recycling rates.

**85% RECOVERY TARGET**

**80% PREPARATION FOR REUSE & RECYCLING TARGET**



**Solar Best Practices**





# Moving from vision to action

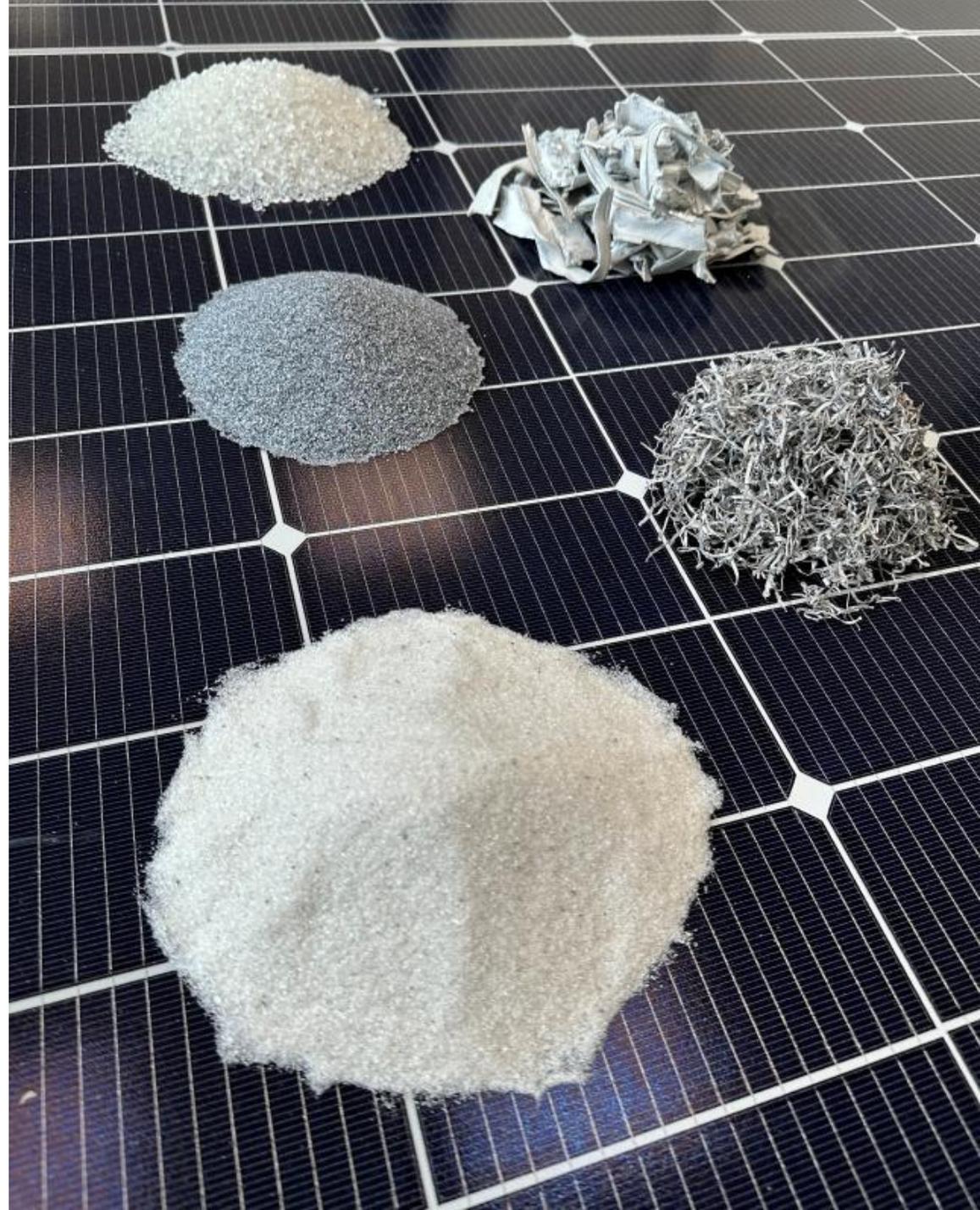
## Closing the solar loop

### NOW

- ❑ Construction phase - PV breakages – EPC starts recycling process (WEEE)
- ❑ Operation / AM phase – using refurbished inverters
- ❑ Contracting with **upcycling and Second Life companies** for damaged or low performance modules

### ROADMAP

- Supplier transparency on **raw materials** (Bill of Materials) to understand material impact & recycled content
- **Recycled content** of components in Request for Proposal phase with EPC partners
- Engaging with banks on financing of **cradle-to-cradle** PV modules / inverters / PV plants
- Working with **Solar Power Europe** on the **EoL Best Practice & Eco Design Guide**



**SUNROCK** Your energy  
just got smarter

Thank you



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**Nicolas Defrenne**

General Director,  
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# Closing Ceremony

Thursday, December 7

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# Dries Acke

Policy Director,  
SolarPower Europe

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# PHOTO COMPETITION

Solar and nature in harmony

Congratulations Greenvolt Group!



**And the winner  
of the Solar  
Sustainability  
Award is...**