

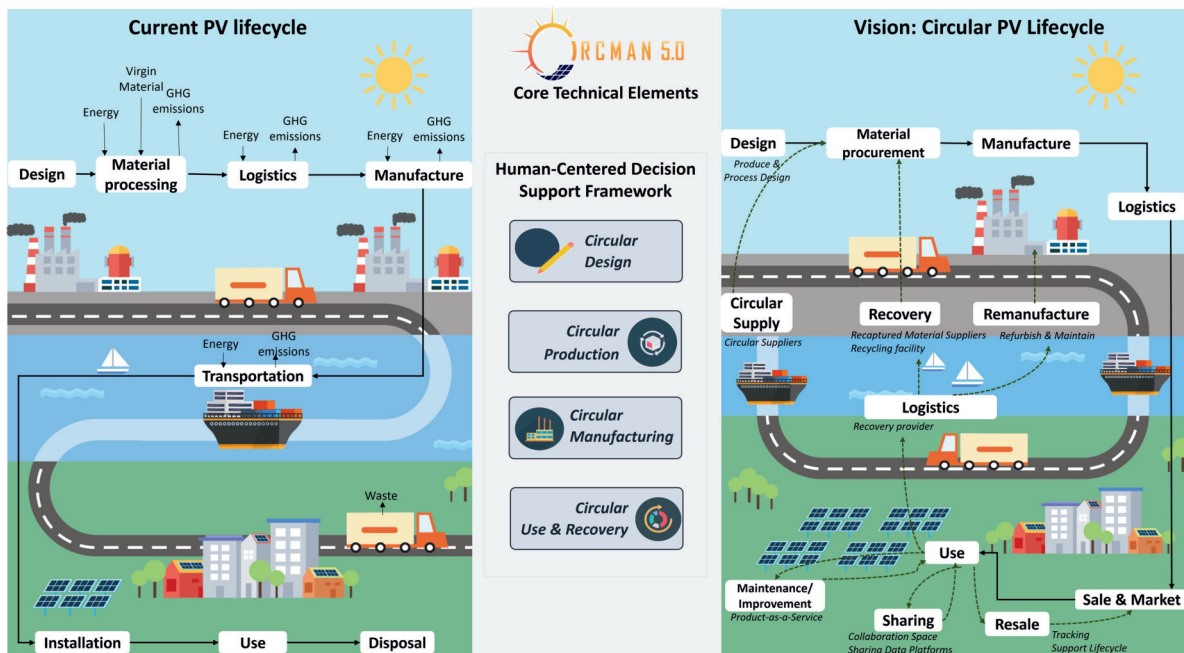


# CIRCULAR MANUFACTURING 5.0

HUMAN-CENTRED AI-AIDED DIGITAL FRAMEWORK FOR CLOSED-LOOP PHOTOVOLTAIC (PV) PRODUCTS VALUE CHAINS

TOWARDS A CIRCULAR MANUFACTURING FOR THE PHOTOVOLTAICS (PV) INDUSTRY

CIRCMAN5.0 focuses on circular design principles that shift away from the traditional "take-make-dispose" model, prioritizing reusability, reparability, and recyclability. Through this approach, we aim to foster sustainable practices that contribute to a more resilient and resource-efficient future



CIRCMAN5.0 is an innovative ecosystem of cutting-edge technologies designed to revolutionize the manufacturing of sustainable and circular photovoltaic (PV) products. It supports the entire modeling and simulation pipeline while evaluating the environmental sustainability of PV systems.



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# CIRCULAR MANUFACTURING 5.0

At its core, **CIRC MAN5.0** introduces a **Human-Centred AI-aided Digital Framework** tailored for the PV manufacturing industry. This transformative solution empowers value chain stakeholders to:

- Increase product circularity
- Reduce environmental impact
- Minimize material waste in products and processes
- Optimize manufacturing circularity

The **CIRC MAN5.0** framework seamlessly integrates advanced tools and methodologies, driving innovation and sustainability across the PV manufacturing sector.

## Technology

Aligned with the EU's guidelines on sustainable production, **CIRC MAN5.0** emphasizes a strategic approach to circularity at each stage of the product lifecycle, with key objectives focusing on:

- **AI-driven Modelling and Simulation Parametric Techniques** for product design
- **Machine Learning-Assisted Algorithms** for dynamic production reconfiguration
- **Cognitive Digital Twin Simulation Environment** for optimized manufacturing processes
- **Circularity and Life Cycle Assessment (LCA)** Framework
- **Human-in-the-Loop (HITL)** Recommendation Engine
- **Digital Product/Material Passport (DPP)**, enabled by Distributed Ledger Technologies

## Pilots



Showcasing **Product Design** by identifying and evaluating alternative raw materials to enhance circularity.



Highlighting **Production Planning and Manufacturing** through production line environmental assessments and the development of a circular digital registry.



Focusing on **Product Design and Manufacturing** with innovative organic PV circular design alternatives, including EoL (End-of-Life) disassembly strategies and AI-aided production processes.



Demonstrating the **End-of-Life Phase** of PV panels with optimized R-strategies tailored for multi-PV typologies.



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