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Using Life Cycle Assessment (LCA) to foster the renaissance of the European photovoltaic (PV) manufacturing industry

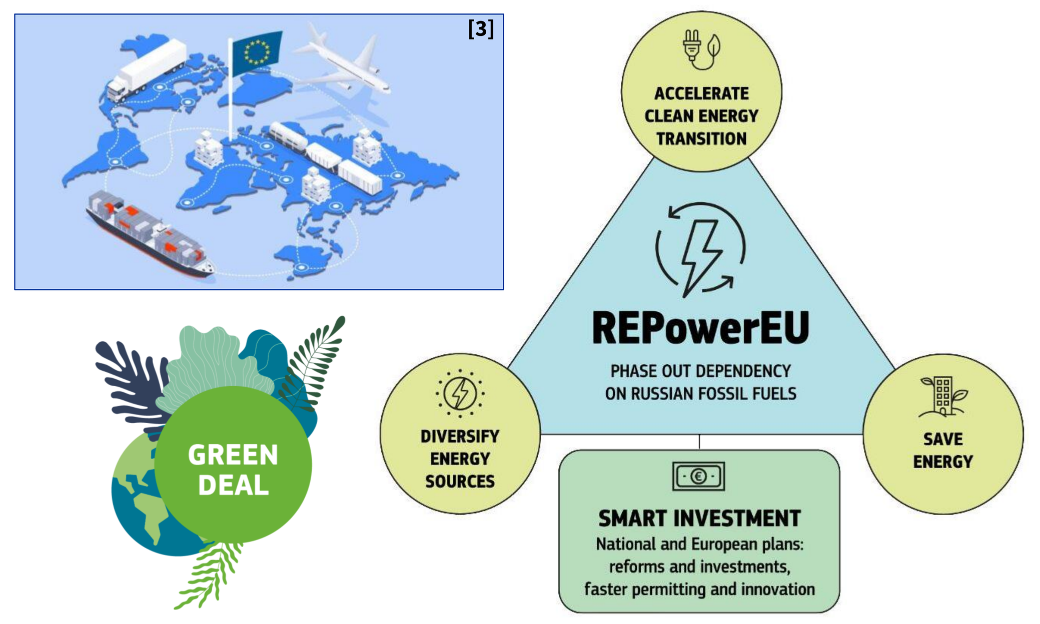
Sabela Teixeira Taboada, Angélique Léonard
Liège Université , Belgium - Chemical Engineering – PEPs
(steixeirataboada@uliege.be)

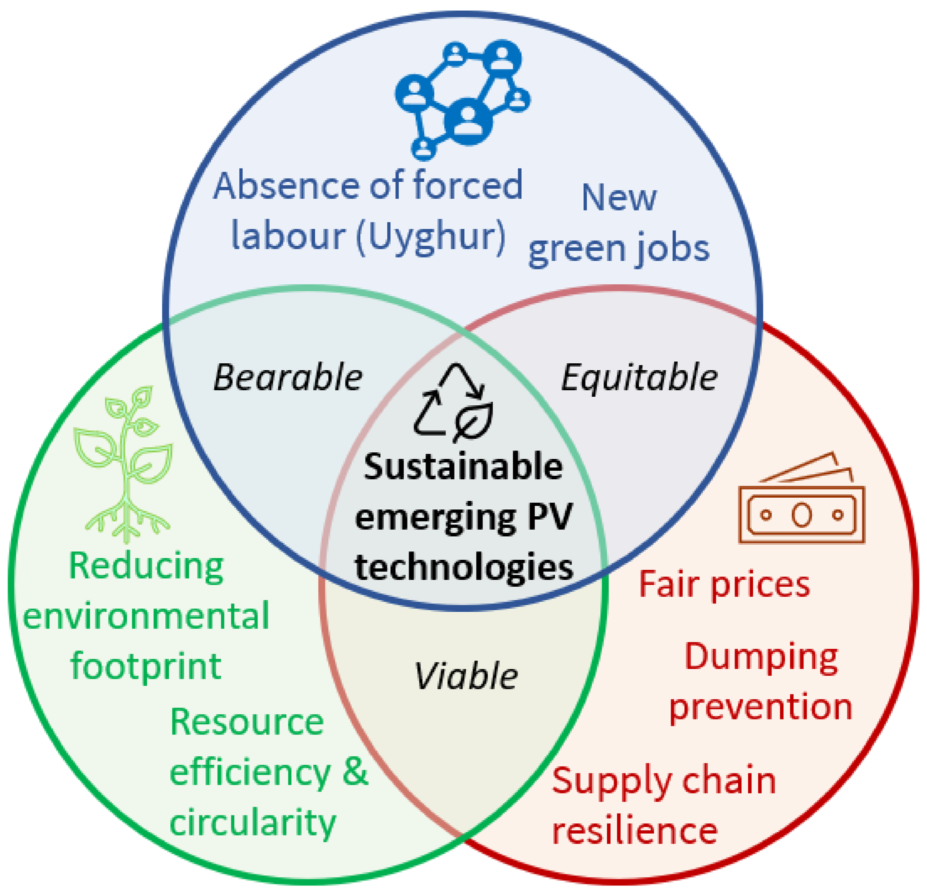
Current situation. *Challenges of the European PV industry*

According to the **REPowerEU** plan, solar energy is a key player in the transition towards a cleaner energy system and its deployment is essential to achieve the climate targets set by the Green Deal.

Most of the solar energy products installed in Europe are **imported**, 96% of which from a single country (China) [1]. This high level of supply chain concentration weakens EU's ability to withstand global or country-specific events. Current **European PV industry** is **at risk** due to fierce competition and unsustainably ultra-low prices of PV modules coming to Europe from China. Without prompt action, the exodus of the European solar industry could soon become a reality [2].

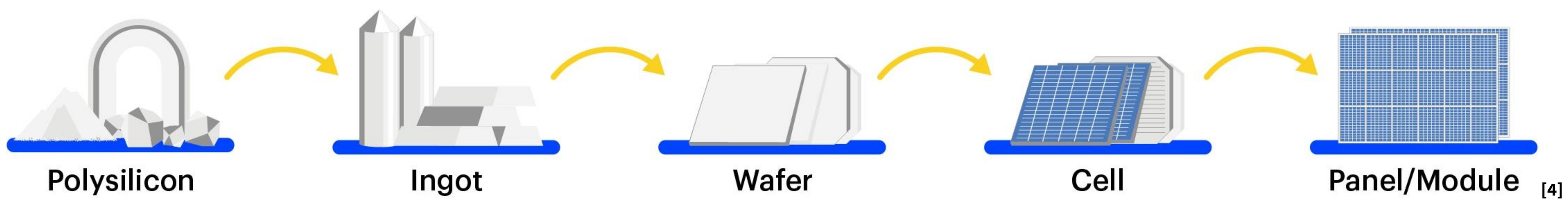
Among other policies, supporting research and innovation is critical to strengthen the sector's resilience and ensure more **sustainable** solar panels. Among these new technologies are heterojunction cells.





PILATUS. *Development of 3 pilot lines*

PILATUS project aims to demonstrate 3 digitalized pilot lines (**wafer**, **cell** and **module**) for the production in Europe of silicon wafers, solar cells, and modules by 2025. PILATUS will leverage on the back-contacted silicon heterojunction "tunnel-IBC" technology (SHJ-IBC). PILATUS will contribute to re-building a **"made in Europe"** competitive and leading-edge PV industry with the entire value chain retained in Europe and compliant with the latest environmental standards.



Material & Method

- Primary data from technology developers & literature and secondary data from Ecoinvent 3.9.1 & IEA LCI 2020
- Software Simapro 9.5; EF 3.1 as impact assessment method
- ISO standard 14040/44:2006
- **Cradle-to-gate** LCA; F.U: **kWh** of DC produced

Life Cycle Assessment. *Opportunities*

Objectives

- **Eco-design** and **hotspots analysis** of the components and systems (cradle-to-gate)
- Environmental footprint of the final designed solution (cradle-to-grave)
- Environmental assessment of different **end-of-life scenarios**
- **Environmental advantages** of pushing for a resilient solar industry in Europe: **comparison** of SHJ-IBC LCA results with some current PV technologies (PERC)

Results*

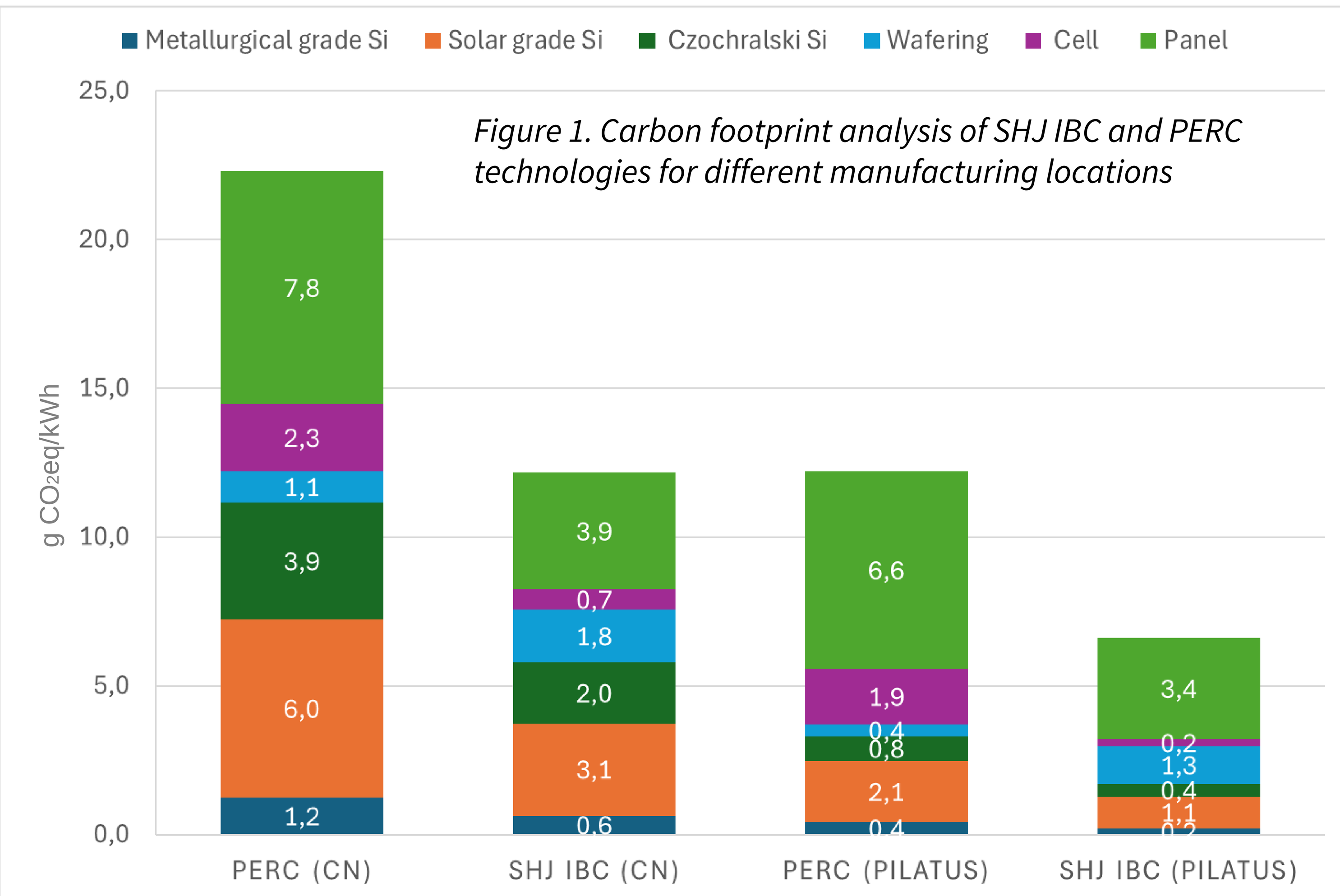
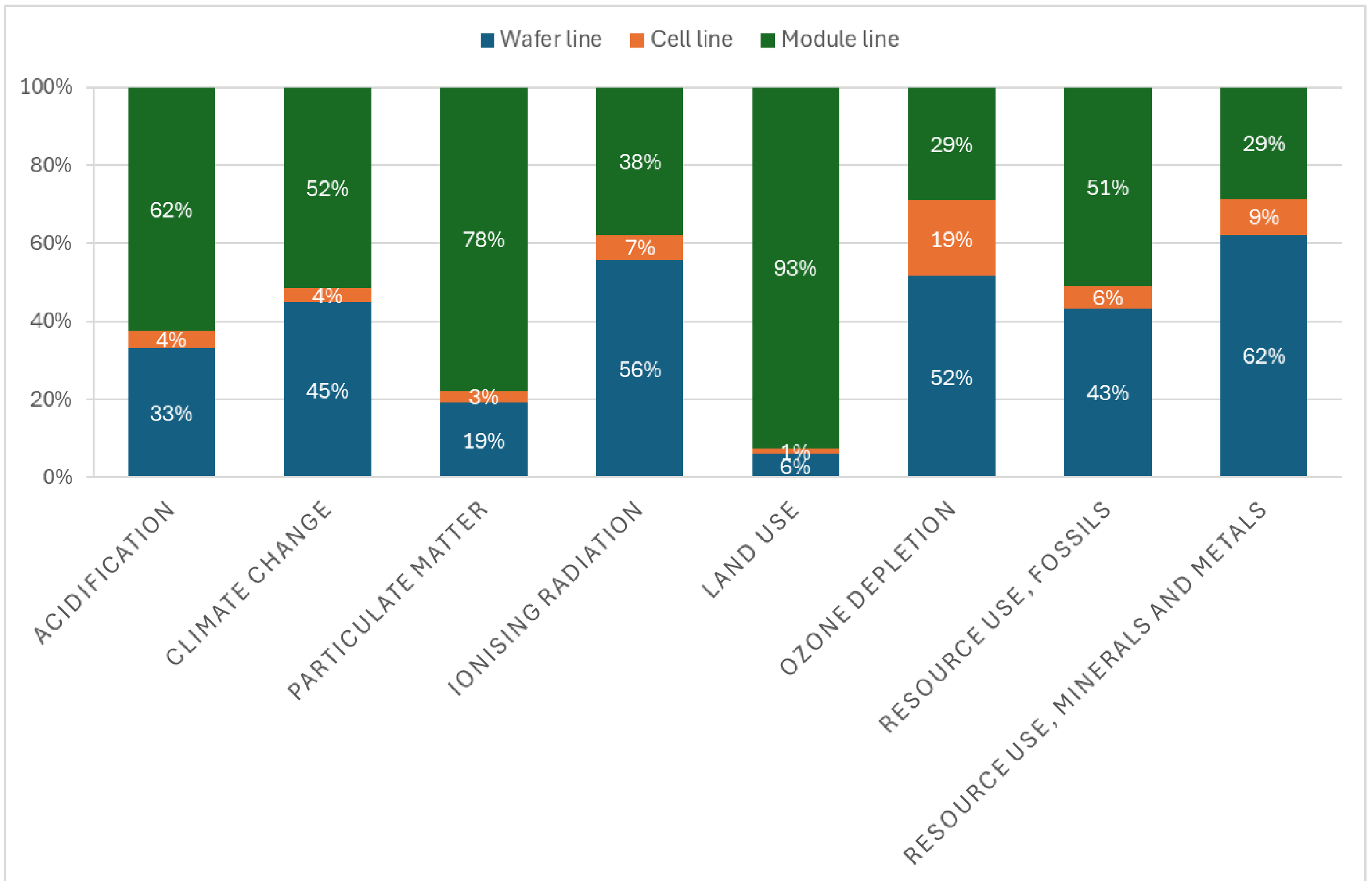


Figure 1. Carbon footprint analysis of SHJ IBC and PERC technologies for different manufacturing locations



Key parameters	PERC	SHJ IBC
Wafer thickness (µm)	145	110
Wafer size (cm²)	M6: 276	
Kerf loss (µm)	54	
Efficiency	22,4%	24%
PR	0,85	
Solar irradiance (kWh/m²/y)	1391**	
Lifetime (yr)	30	40

- *Wafer, cell and module line modelled with primary data*
- ***Average EU*

Limitations & threats

- Comparability with other studies (different key parameters)
- Internal recycling of silicon offcuts
- High vulnerability of ingot and wafer manufacturing in the EU (only one company remaining in Europe)

Main outcomes

- Manufacturing location has a big impact in the carbon footprint of solar panels
- SHJ IBC technology presents clear advantages compared to the mainstream technology today (PERC)
- Most of the impact comes from the wafer and module line

Further research

- Cradle-to-grave analysis including end-of-life scenarios
- Potential benefits of using bio-based components for the module
- To include primary data from outdoor monitoring
- Contribution to 17 SDGs

Project and Partnership

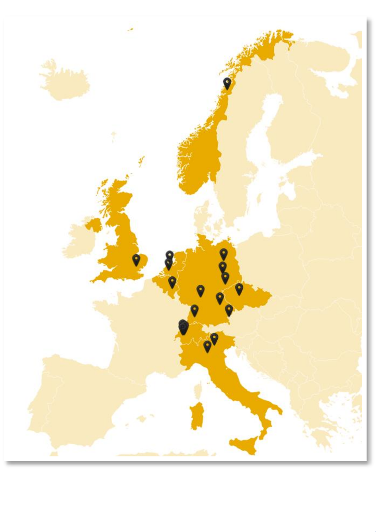
✓ Duration: **36 months** project (November 2022 – November 2025)

✓ Total Budget: 21.3 M€ (EU, Swiss and UK funded)- EU funding under the **Horizon Europe programme**

More info about the project here

✓ **Workplan**

WP1- Project Management and Coordination
WP2-Wafer and Cell Pilot line
WP3-Module Pilot Line
WP4 –Metrology and Reliability of SHJ tunnel-IBC Technology
WP5-Digitalisation, Automation, Industry 4.0
WP6-Sustainability, circularity & environmental impact
WP7-Bankability, Business Model & Roadmap towards GW-fabs
WP8-Communication, Dissemination and preliminary Exploitation



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[1] Eurostat, <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Extra-EU_trade_in_solar_panels,_2022.png>
[2] Record-low solar PV prices risk EU's open strategic autonomy <https://www.solarpowereurope.org/press-releases/record-low-solar-pv-prices-risk-eu-s-open-strategic-autonomy>
[3] Supply Chain, BIIA, <https://www.biia.com/eu-supply-chain-law-obliges-companies-to-operate-in-a-fair-and-sustainable-manner/>
[4] Executive summary – Solar PV Global Supply Chains Analysis - IEA , <https://iea.imgix.net/a4699714-568b-4e25-bbf9-d3a4d7afb406/SolarPV.png?auto=compress%2Cformat&fit=min&q=80&rect=0%2C112%2C2272%2C380>