

Silicon is considered a critical raw material for the EU due to its high supply risk and economic importance, mainly because of heavy reliance on imports. The objective of RESiLEX is to improve the resilience and sustainability of the entire Silicon value chain and reduce EU dependence on critical raw materials for solar panel and battery production. This factsheet is based on the document "Intermediate report on sourcing end-of-life PV panels in Europe" by the partner ENVIE.

A Blueprint for Sovereignty: the recycling of End-of-Life Solar Panels



The EU solar boom

The EU-27 has experienced **exceptional acceleration** in solar energy development since 2022. Installed solar capacity in the EU surpassed **300 GW** in 2024. The installation rate jumped from approximately 41 GW in 2022 to a record 56 GW in 2023 (see [SolarPower Europe's "EU Market Outlook for Solar Power 2024-2028"](#)).

The acceleration is directly linked to the energy crisis and the dependence on Russian gas, brutally exposed by the war in Ukraine. **The REPowerEU Plan**, launched in May 2022, was the central catalyst, setting ambitious targets: 320 GW by 2025 and 600 GW by 2030.

Regulatory streamlining has played a crucial role, drastically reducing solar project development times (from 4–5 years in 2021 to less than 18 months in 2025). The introduction of the "silence is consent" principle for small and medium-sized residential installations boosted rooftop installations by 70% in 2023–2024.

- **Leading Countries:** Germany leads in installed capacity (81 GW in 2024), followed by Spain (49 GW), Italy (33 GW), and France (28 GW). However, Eastern European countries, such as Poland and Hungary, are showing the highest growth rates.

Photovoltaic Waste Projections (2025–2050)

The volume of end-of-life PV panels is set for exponential growth.

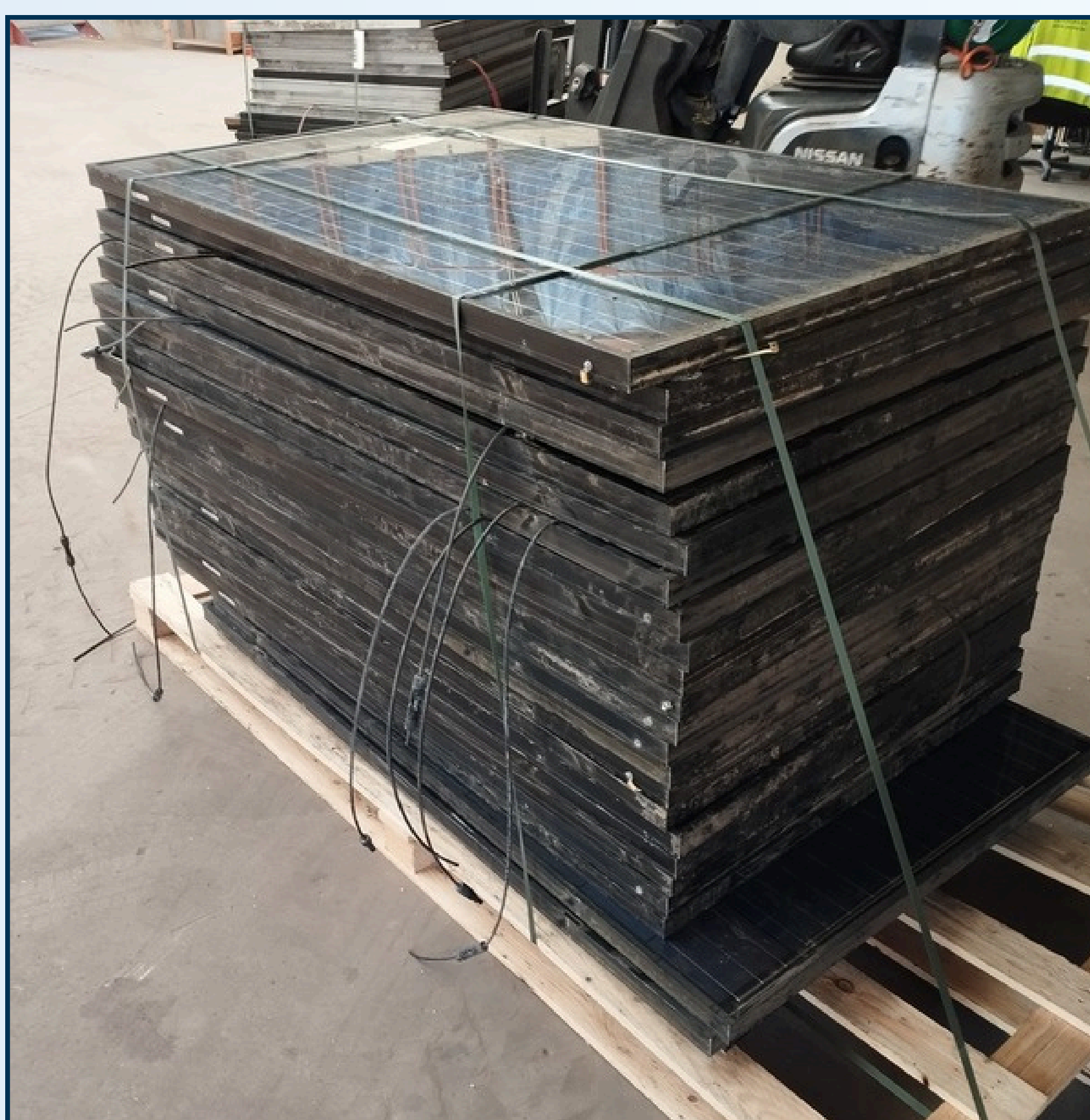
- **Tipping Point:** PV panel waste in Europe is projected to rise from about 50,000 tonnes (To) in 2025 to more than five million tonnes by 2050 (estimation). The tipping point for this rapid growth is estimated around 2035, corresponding to the end of the lifecycle for panels installed after 2010.
- **Cumulative Volumes:** By 2050, Germany is expected to generate the largest volume with 1,100 kTo of accumulated waste, followed by Italy (700 kTo) and France (650 kTo).

Regulatory Context and Technical Challenges

The management of this increasing flow is framed by European regulations.

- **Regulatory Framework:** The 2012/19/EU Directive (WEEE) explicitly includes PV panels in Category 4. It mandates the principle of Extended Producer Responsibility (EPR), obliging producers and importers to finance the collection and proper treatment of end-of-life modules.
- **Recycling Targets:** The directive sets specific minimum rates for PV panels: 85% recovery and 80% recycling/preparation for reuse.
- **Technical Challenges:** Recycling is complex due to the heterogeneity of technologies (crystalline silicon vs. thin-film) and the presence of polymeric encapsulants that are difficult to separate from valuable components. Efficient industrial processes are required for the fine separation of glass, metals, and semiconductors.

End of Life Solar panels collected by the Resilex partner Recma





Industrial Opportunities and Material Sovereignty

The increase in PV waste streams represents a logistical challenge but also a considerable source of industrial opportunities for Europe.

- **Recovery of Critical Materials:** Recycling can strengthen European sovereignty by recovering critical materials such as high-purity silicon (estimated up to 16,000 tonnes/year by 2030), silver, and copper. This would help achieving the new targets enshrined in the Critical Raw Materials Act of 2024.
- **Value Chain Creation:** The emergence of dedicated treatment facilities is anticipated in several European countries (France, Germany, Spain, Italy), along with the potential creation of 3,000–5,000 direct jobs by 2030 in the recycling sector.
- **Innovation and Upcycling:** Future prospects include developing applications for recycled materials (e.g., PV glass in construction) and integrating eco-design criteria to facilitate the dismantling and recovery of future panel generations.

The convergence between the massive deployment of photovoltaics and the structuring of a waste treatment sector represents a large-scale circular economy model, transforming an environmental challenge into an industrial opportunity for Europe's energy and strategic autonomy in raw materials. This requires sustained investment and continuous European-level coordination.

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