FACTSHEET #3

Photovoltaic Waste Management in Europe: Challenges and Opportunities

Growth of Photovoltaic waste

The increasing adoption of photovoltaic (PV) panels in the European Union (EU) is leading to the challenge of managing the waste generated at the end of their lifecycle, estimated to be between 20 and 35 years. Although the current amount of PV waste is limited, forecasts indicate a significant increase by the end of 2020, particularly in Germany, the EU's largest photovoltaic market.

- Germany: the country is estimated to produce over 100,000 tons of PV waste by 2030, with a nearly 16-fold increase by 2050.

- European Union: The EU is expected to generate over 1 million tons of PV waste per year between 2035-2037 and 2044-2050. By 2050, this figure will reach 5.34 million tons per year, with a total cumulative amount exceeding 33 million tons.

Recycling Capacity in Europe

The EU has adopted legislation classifying PV panels as waste electrical and electronic equipment (WEEE), establishing specific requirements for material recovery. Directive 2012/19/EU promotes recycling as the preferred approach for managing PV waste, in line with the principles of the circular economy.

- **Upcycling**: Upcycling is an advanced recycling process aimed at recovering high-quality materials from end-of-life PV panels for reuse in the production of new panels or other applications.

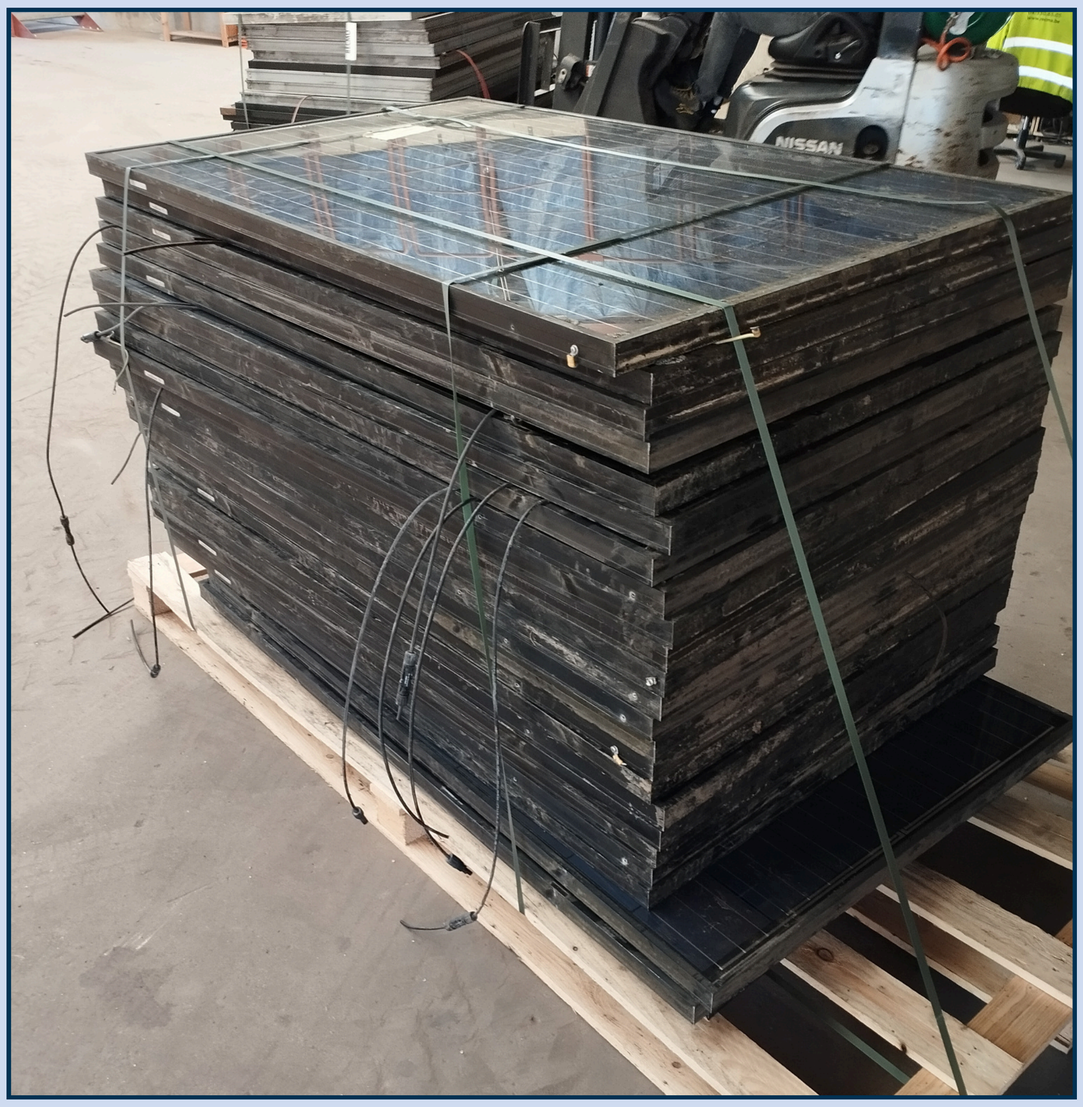
- **Recycling Techniques**: Various techniques are employed for upcycling PV panels, including:

  Mechanical delamination: Separation of glass from solar cells through processes such as grinding and crushing.

  Thermal delamination: Thermal decomposition of the EVA (ethylene-vinyl acetate) layer through pyrolysis.

  Chemical delamination: Use of solvents to dissolve the EVA layer. Currently, recycling facilities for PV panels are limited, mainly due to low waste volumes and the resulting lack of profitability.

End of Life Solar panels collected by the Resilex partner RECMA



Case studies

- **France**: the consortium Comet Traitements, Recma, and Envie 2E Occitanie recycles end-of-life French panels, including those from overseas French departments and territories. The SolarCycle consortium, composed of Comet Traitements and Recma, has over 12 years of experience in research and development in the field of photovoltaic panel recycling.

- **Germany**: Loser Chemie and SolarWorld are two German companies active in PV recycling. Loser Chemie has several collection points and uses patented processes that combine mechanical and chemical techniques to recycle solar cells. SolarWorld, on the other hand, has developed a unique method for recycling crystalline silicon. However, both companies primarily recycle their own PV panels.

Conclusions and outlook

- Efficient management of PV waste is essential for the transition to a circular economy. The increase in waste volumes in the coming years will make recycling economically more sustainable in several EU countries.

- **Profitability**: Germany is expected to reach profitability in PV recycling by 2028, followed by other countries such as Spain, Italy, and Belgium in the 2030s, and Hungary, Poland, and Sweden in the 2040s.

- **Extended Producer Responsibility (EPR) System**: The EU's EPR system plays a crucial role in financing the management of PV waste, even when it is not profitable. However, some countries may require additional funding.

- **Unified Market**: The creation of a unified EU market for PV waste could be a solution to improve the efficiency and profitability of recycling, enabling collective waste management rather than individual state-level approaches. The growth of the photovoltaic market will offer new opportunities for the development of more efficient and cost-effective recycling technologies, helping to reduce the environmental impact of the sector and promote a more sustainable future.

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