



Status of PV Module Take-Back and Recycling in Germany

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Introduction and Purpose

- Germany is one of the top five countries in terms of installed PV capacity. Furthermore, PV expansion targets were significantly increased in 2023 to a cumulative installed PV power of 215 GWp in 2030 and 400 GWp in 2040, respectively.
- Current returns of end-of-life (EOL) PV modules are still comparably low in number but will start to significantly increase by the end of the decade.
- Appropriate treatment and recycling processes for returned PV waste streams are needed to ensure the circularity of used materials. Moreover, appropriate recycling capacities and a reliable take-back infrastructure are required.
- Purpose of this report is to provide insights into the current situation of PV EOL management in Germany, both its structure and the current practical experience of the stakeholders involved in the take-back and recycling system.

Approach for Evaluation of Take-Back and Recycling Situation in Germany

- Two workshops were held in 2021 and 2022 with ~20-30 experts from both industry and research representing stakeholders along the entire treatment chain of EOL PV modules, covering the whole EOL process chain of module treatment.
- Problems, challenges, and identified necessary measures for improving the current waste management system are discussed based on the current stakeholder experiences.

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Main Challenges

- Still low volumes of EOL PV modules collected through the official system and sent to suitable recycling channels
- Low transparency of EOL PV module flows, despite the reporting requirements set out in ElektroG
- High transport costs of the take-back logistics (transport from the collection sites to the treatment facilities), mainly due to low utilization rates of transports and high shares of misdirected PV modules that must be redirected to the appropriate recycling facilities (i.e., to recycling facilities that treat that PV technology)
- Different handling/coordination of the collection of EOL PV modules from commercial (B2B) and residential (B2C) applications
- Comparatively high breakage rates of intact modules caused by improper dismantling/disassembly of PV modules and by incorrect storage or load securing during transport of the collected EOL PV modules.

Workshop Attendee-Identified measures for improvement

- Implement consistent registration of PV EOL modules via the official EOL management system and transparent tracking of material streams along the treatment chain.
- Expand recycling Infrastructure and treatment methods - also for non-silicon (Si) modules.
- Improve coordination of collection and take-back system and reduce logistics costs.
- Improve information and training of actors involved in the disposal system.
- Improve initial treatment sites and recycling facilities

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Summary and Conclusion

- This report provides an analysis, stakeholder experiences, and improvement potential of the current system for end-of-life treatment of PV modules in Germany.
- It is important to analyse the situation in Germany because it is the first country to support widespread adoption of PV modules, and therefore is expected to be the first to experience larger EOL volumes.
- Although challenges to the successful implementation of a functioning take-back and recycling system have been identified, this report also found promising approaches for further improvements.
- While specific to an analysis of the situation in Germany, this report is hoped to offer useful lessons for other countries in advance of their own expected rise in EOL volumes.

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Task 12

