

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. 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

Circular solutions in the PV industry

Takeaways and recommendations for policy makers from the Resilex workshops series



On the 23rd of May 2024, Resilex and the EverPV project organized a highly participatory workshop in Brussels. Several speakers discussed the challenges and opportunities for advancing circular technologies and value chains relevant for the PV industry.

Main takeaways of the workshop

Stakeholder engagement: engaging the right stakeholders is crucial to bridge the gap between research and industry, and to identify synergies across sectors. This is essential due to the limited number of companies in Europe capable of taking recovered materials, especially Silicon.

Cost and profitability: the high costs of the recycling process, managing small quantities of certain materials (Indium and Gallium), and ensuring sufficient waste flows need to be addressed, to enhance the sector's profitability. **Standardisation and policy:** standardisation should be implemented at multiple stages, including with eco-design rules to make it easier to recycle PV modules and exclude certain materials, such as fluoropolymers. Recycling processes across the industry should be harmonised. Policy support can help increase the sustainability of the PV industry.

Panel discussion on Critical Raw Materials and PV circularity



The workshop panel

Speakers:

Nouha Gazbour, PV Sustainability Manager, **Commissariat à l'énergie atomique et aux énergies alternatives (CEA)**.

Francisco J. Luque, Senior Project Manager, **Iberian Sustainable Mining Cluster**.

Emma Dominici, Policy Advisor on Supply Chains, **SolarPower Europe**.

The event started with input presentations from the speakers. Nouha Gazbour, from CEA, presented the EVERPV project, its expected outcomes, objectives, added value and the different technologies being developed. Francisco J. Luque, coordinator of the ReSi lex project, presented ReSi lex's objectives and progresses, especially focusing on silicon recycling.

Emma Dominici from SolarPower Europe delivered a comprehensive overview of the Critical Raw Materials Act, emphasising its practical implementation and relevance for the solar sector. She delved into the topic of recycling, discussing EU targets, strategic projects and the role of polysilicon in the PV industry.

Workshop discussions

Workshop attendees were divided into groups to discuss how the projects can contribute to EU policy objectives. The audience was divided in 3 topical groups: (1) scaling up the technology, (2) closed loop recycling (within the PV industry), (3) open loop recycling (with other industries).

Topic 1 Scaling up the technology

Discussion questions:

- What are the challenges in scaling up the technologies developed in EVERPV and ReSiLex and other EU-funded projects?
- How to ensure synergies between different HE-funded projects?

Economic challenges

The lack of incentives for upcycling is diminishing the sector's profitability and introducing potential risks. Engaging with the right stakeholders and identifying synergies between industries are crucial steps. Implementing a targeted tax on downcycling could enhance sector profitability, provided the secondary materials are of high quality. Upscaling technologies developed in Horizon Europe projects requires highly skilled employees. Establishing specific education programmes would help address this need.

Technological challenges

Several technical aspects need to be addressed, notably regarding specific components, such as backsheet. The creation of a "material passport" would contribute to solving this issue. The lack of standard for PV panel design is another challenge. Though financing, banks can introduce standards.

Legal and regulatory challenges

Collection rules for e-waste are not the same in each EU Member State. Unclear definitions and restrictive rules for the circulation of waste to research purposes is another challenge to test and develop recycling technologies within EU-funded projects. Developing recycling processes for technologies which are not yet on the market is another challenge, as PV technology is evolving rapidly. Excluding certain materials with eco-design rules would contribute to scaling up technologies developed at R&I project level.

Topic 2 Closed loop recycling within the PV industry

Discussion questions:

- What are the challenges to using recovered materials in the PV industry ?
- How to ensure the use of recovered materials in the PV industry?

Material challenges

Reaching high levels of purity with the current recycling processes is challenging, especially for Si. Recycled materials might also have low levels of performance.

Damaged materials also pose a challenge for recycling. Especially for glass damaged during handling. Material degradation, notably of polymers, is another challenge.

Some materials are challenging to recover, especially fluoropolymers.

The complexity of the PV supply chain is a challenge for closed-loop recycling.

Another challenge is the fact that a low number of companies are available to take back the material in Europe, with little manufacturers present on the continent.

Other challenges.

Another challenge is the high cost associated with reuse and recycling, compounded by the lack of harmonisation of recycling processes at the EU level. The high carbon footprint of recycling processes poses a significant issue. The rapid pace of innovation in the PV sector means that recycling processes must continually adapt to evolving technologies.

Opportunities

Standardisation and robust legal frameworks are crucial for enabling the closed-loop recycling of PV systems. Standardisation efforts should include comprehensive data access to facilitate efficient recycling processes.

Implementing incentives and deterrent measures can significantly enhance recycling efforts. For instance, adopting a polluter-pays system with landfill fees can discourage waste disposal and promote recycling. Additionally, creating incentives for on-site recycling facilities can further encourage sustainable practices within the industry.



The working groups

Recycling initiatives should also target niche markets beyond standard PV systems to ensure comprehensive and effective recycling solutions across the entire industry.

Topic 3 Open loop recycling (with other industries)

Discussion questions:

- What are the challenges to using recovered materials from PV in other industries?
- How to ensure the use of recovered materials from PV in other industries?

Challenges per materials

- Challenges for Si applications: purity. To re-use the recovered Si in batteries, the Si needs to be 99.8% pure. Metal industries require less purity of Si, can use alloy AlSi. Another challenge is the fact that a low number of companies are available to take back the material in Europe and the amount of recovered material is still low. A solution would be to upscale the technologies developed in R&I projects and bridge the R&I and industrial upscaling gap through pilots and investments.
- Indium and Gallium: too small quantities in PV.

Increasing public awareness of the PV industry's efforts to reduce its environmental footprint is essential. Highlighting and supporting recycling initiatives will increase social acceptance and support for PV. Optimising recycling processes will contribute to the domestic sourcing of secondary materials in Europe, reducing dependency on external sources and promoting a circular economy.

- Glass: presence of antimony in PV glass not compatible with the flat glass process. Alternative use of recovered glass can be found in road applications, however this will not represent a viable output in the future due to a too high quantity of glass. The EVERPV project is working on defining the maximum acceptable level of antimony for the recovered glass to be reused in flat glass application. A regulatory solution and a change of mind of consumers would allow for glass and other recovered materials be re-used.
- Backsheet: lack of output.
- Cables, junction box and metals do not represent an issue for open-loop recycling.
- Overall, using less components in PV panels would make them easier to recycle. Research should promote eco-conception of panels to be put in place at policy level.

R&I and industry gap

- A significant challenge is the lack of connection with industry, which hinders the identification of customers for newly developed technologies and recovered materials. Additionally, finding investors is challenging due to the extended timelines for return on investment.
- Another issue is the absence of a coherent project pipeline across various European Commission funding programs, which results in missed opportunities for project exploitation once initial funding phases are completed. This gap prevents continuous development and commercialisation of innovative solutions, stalling progress and economic benefits.



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RESiLEX Project



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