PV and the Circular Economy

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Abstract: Reducing the negative impact in energy by replacing fossil fuels with renewables transforms the environmental problem – huge amounts of water, energy and rare elements are used, while at the same time there are no completely environmentally friendly solutions for their recycling. The present study analyzes the results from an interview with PV module recycling companies for the ways they recycle the PVs at end of the life cycle to motivate the necessity for governmental policy for circular economy integration with green industries.

To examine the current state of PV recycling in the EU, an interview was conducted with representatives of recycling companies, participating in the INTERSOLAR exhibition in Munich in 2025. Due to the nature of the exhibition - mainly PV producers and technology suppliers - it is attended by companies that specialize in PV recycling, and those that operate in Germany or have plans to work there.

The results shows that the PV recycling companies are few, use different technologies that they have developed or adapted, and are certified for this type of activity. Some have been working in the recycling industry since before 2020, but most have recently implemented PV recycling, and there are also several that are still in the test phase. PV recycling is a new activity, which for some companies is complementary to the recycling of other products, while others focus entirely on photovoltaics.

The main activity of recycling companies is concentrated in Germany, with plans to expand to larger EU member states and a lack of interest in Eastern Europe and Bulgaria.

Silicon PVs are the most common on the market and recycling technologies are aimed at them, while new types of PVs such as perovskite are not known. Companies are developing their own methods for PV recycling, which are financed through private investors and grants.

The recycling capacity that is expected to be realized during the next years is between 3,000 and 15,000 tons of material, with only some companies extracting silver.

As a very new technology, there is still no mature practice for PV recycling and optimization of the extracted materials and the cost of processing. In Germany, the requirement for control over this waste is clearly set so that anyone who installs PV, at the end of the equipment's life cycle, is obliged to prove that the modules have been returned for reprocessing or reuse, which guarantees the absence of free dumping. At the same time new technologies are currently being developed for recycling PV systems and for producing renewable energy, that are more efficient and easier to process after the end of their life cycle. Legislative measures are also being introduced to organize the recycling process.

The main goal of photovoltaics is to produce ecological energy, with the carbon effects of the module production and recycling being minimal, not reducing the positives of the generated green electricity. At present combining the green idea with circularity in PV industry can contribute to achieving the desired positive ecological, economic, and social effects.