
An Examination of Solar Waste Utilization and Reuse

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Abstract:

Solar energy is widely regarded as a clean, green, and renewable power source. While energy generation from sunlight is inherently renewable, the production and disposal of solar panels introduce sustainability challenges comparable to those of other manufacturing industries. Photovoltaic (PV) panels typically have a lifespan of 25–30 years, after which they enter the end-of-life (EoL) phase and contribute to an increasing volume of waste that is frequently landfilled or otherwise insufficiently managed. This paper examines current and emerging strategies for the reuse, recycling, and repurposing of solar panel waste. Viable approaches include repurposing certain materials for battery applications and reprocessing ptype silicon from decommissioned cells into new ingots as well as recycling aluminum frames and glass using established and cost-effective methods. However, not all materials are equally recyclable. For example, perovskite-doped silicon– an emerging technology that enhances PV efficiency– poses significant environmental and technical challenges due to the presence of toxic lead and the current lack of scalable recycling solutions. By analyzing different PV technologies and their associated waste streams, this study highlights both the opportunities and limitations of existing recovery methods. The findings underscore the need for improved recycling infrastructure, material innovation, and sustainable design practices to mitigate the long-term environmental impact of solar energy systems.

Keywords:

PV, Solar panel waste; end-of-life; silicon recycling.