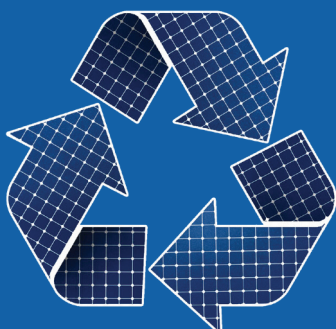


Solar Panel Reuse & Recycling

Quick Facts

- Solar components (racking, inverters and solar panels) can be reused or recycled
- Solar panels can be reused or refurbished to have a 'second life' of generating electricity
- Almost 85% of a solar panel including glass, aluminum, and copper wire have well established recycling in the U.S.
- The solar panel recycling market is expected to reach \$80 billion by 2050

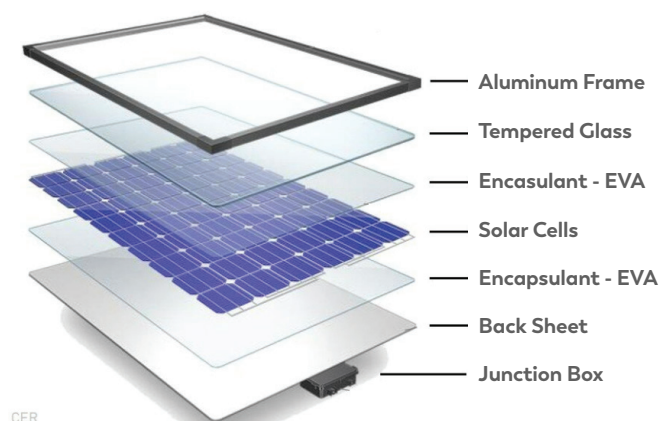


Solar Panel Reuse & Recycling

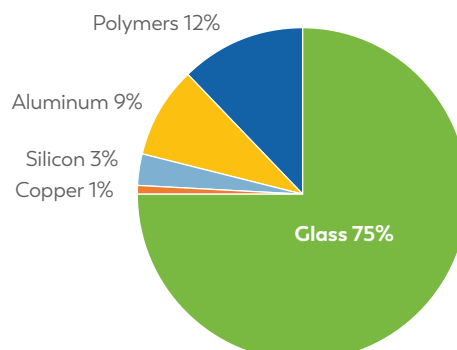
The main material components of a solar development include solar photovoltaic (PV) modules, racking to hold the modules, and inverters. Systems across the United States are in place to either reuse or recycle both the racking systems and inverters. The first and best use for PV panels is to reuse or refurbish them whenever possible. The typical lifespan for PV panels falls into the range of 30 to 35 years on average with some expanding to 40 years. For panels that are no longer useable on a project but are not broken, they can be resold to continue to produce power. For panels that have been damaged, they can be refurbished and then resold for continued use. When the panels have met the end of their useable life then recycling can occur.

The image below illustrates the various layers that sandwich together to create a typical PV module:

The primary components that make up a typical PV module



Of these sandwiched layers, the majority (approximately 96%) of the PV module is made up of glass, aluminum, and polymers.



Materials in a typical PV module with distribution of materials by mass

Note – there is copper in the wiring not noted and there are also <1% of various metals



Glass, aluminum, and copper wire have robust recycling programs throughout the U.S. and this type of recycling covers almost 85% of typical solar panel components.

The remaining compressed 'sandwich' after the glass and aluminum are removed, includes polymer coated solar cells (i.e. plastic and silicon) which commonly contain metals such as silver, tin, etc. Recycling of this plastic and silicon sandwich is more complex as it needs to be disassembled to be broken down into each individual material and the robust, weatherproof design of this sandwich is what keeps the modules working well for decades but it also makes them difficult to disassemble. Given the limited number of solar sites that have reached their useful life; researchers, companies, and regulators continue to advance new methods for recycling of materials.

PV Recycling Market

Rystad Energy estimates that the solar panel recycling market will be worth \$2.7 billion dollars by 2030 and up to \$80 billion by 2050. This is a huge market which creates big incentives to create better recycling processes to recover valuable materials such as silver and silicon. Research has shown that recycling up to 99.998% is possible and that doing so would be profitable. There are startup companies that are beginning to develop commercial scale processes and could be running within a couple of years.

National PV Recycling Program

In 2016, the Solar Energy Industries Association (SEIA) developed a national PV recycling program. Recycling partners include Echo Environmental, First Solar, Green Century Recycling, ERI, Cleanlites Recycling, and Zeep. SEIA's partners have prior expertise in recycling glass, polymerics, aluminum, scrap metal, and electronics which provides a good foundation for recycling PV modules, inverters, racking systems and other components of a PV system.

On a broader scale, companies such as Veolia in conjunction with PV Cycle have been recycling solar panels since 2017 and in 2020 they recycled nearly 95% of the solar module content in France.

References:

<https://www.rystadenergy.com/news/reduce-reuse-solar-pv-recycling-market-to-be-worth-2-7-billion-by-2030>

<https://www.seia.org/initiatives/seia-national-pv-recycling-program>

<https://www.hindawi.com/journals/ijp/2021/5530213/>

