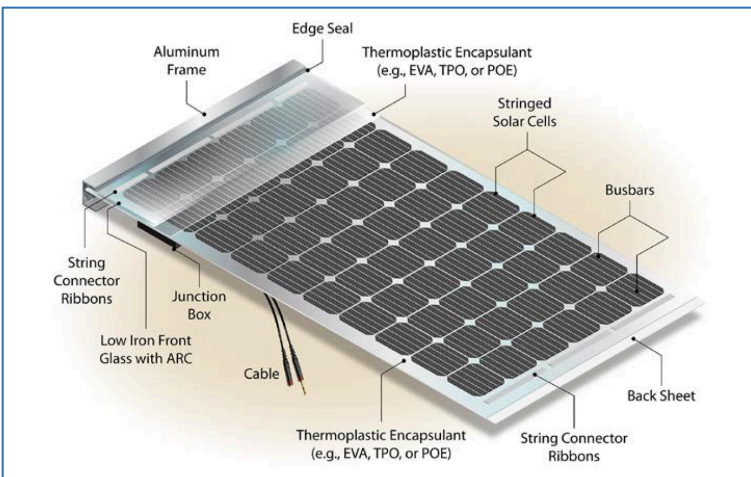


Engaging the circular economy approach

Photovoltaic equipment and options for first end-of-life stages

The falling cost of solar has made renewable energy accessible to more people than ever before and has resulted in an exponential increase in solar adoption. With more than 400 gigawatts (GWdc) of photovoltaic (PV) modules installed globally (including 62 GWdc in the U.S. through 2018), end-of-life management is important for all PV technologies to ensure clean energy solutions are a sustainable component of the energy economy for future generations.

Like many other durable products and construction materials, solar equipment can last for decades, particularly with proper maintenance. In some cases, PV modules can be reused or refurbished to have a ‘second life’ of generating electricity. The other components of solar systems can also be handled responsibly. Inverters can be recycled as e-Waste and racking equipment can be re-utilized with newer technology or recycled like other metals.



Source: NREL, *Crystalline Silicon Photovoltaic Module Manufacturing Costs and Sustainable Pricing*, 2019

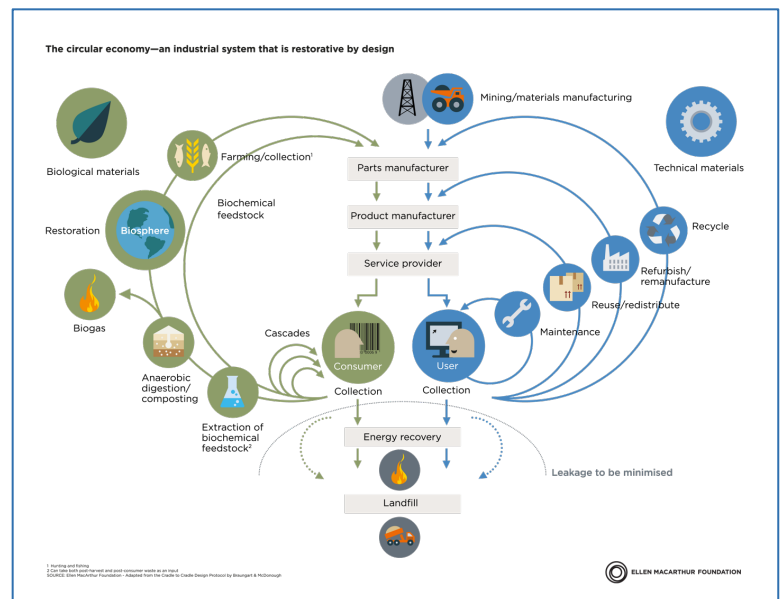
Refurbishment

PV modules can be damaged during transit, installation or moving. Some of these modules can be repaired for minor issues and there are several new organizations pursuing this option. If the product is still under warranty, the installer or manufacturer should be contacted to determine if repair is an option. Many modules that are repaired today are often reused in off-grid or non-grid connected applications. While this channel is not as developed as other end-of-life options, SEIA is actively exploring the related options with our members and other stakeholder

Reuse

PV systems may be decommissioned for several reasons. Repowering a solar system with newer technology that is more efficient or has a higher nameplate capacity can provide even more electricity from the same amount of space.

The replaced PV modules can be reused in other projects as they may still have plenty of useful life left. Often these modules can find new opportunities in charitable, off-grid or even grid-connected projects, provided they continue to meet the appropriate building codes and safety standards.

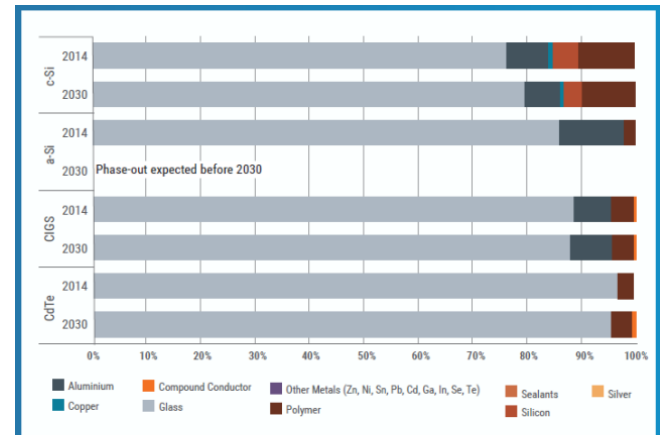


End-of-Life Considerations for Solar Photovoltaics

Recycling

Although most PV panels produced today will have a useful life for decades, there is inevitable waste created when panels are damaged during shipment or installation, determined to be defective, become obsolete or reach their end-of-life. High-value recycling can help minimize life-cycle impacts and recover valuable and energy-intensive materials, thereby increasing sustainability within the PV industry.

Recycling of solar equipment is increasingly possible as more recyclers accept modules. PV panels typically consist of glass, aluminum, copper, silver and semiconductor materials that can be successfully recovered and reused. By weight, more than 80 percent of a typical PV panel is glass and aluminum – both common and easy-to-recycle materials.



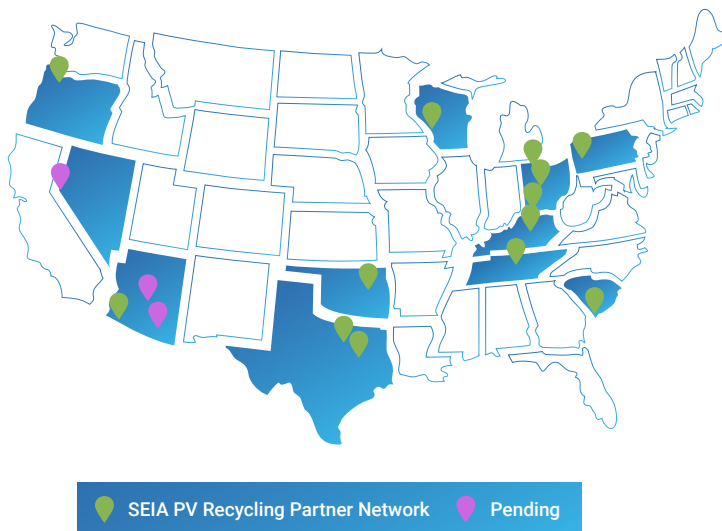
Source: IRENA and IEA-PVPS (2016), "End-of-Life Management: Solar Photovoltaic Panels," International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems.

Cooperation throughout the value chain



Research and development of PV-specific recycling equipment can optimize the recoverability and purity of reclaimed materials. The start-up and support of new organizations will help the industry extend the useful life of existing products while maintaining the quality and safety of the equipment. Working together with stakeholders from all these areas will help inform and develop policy appropriately so that end-of-life management solutions complement the deployment of solar.

SEIA PV Recycling Partner Network



SEIA's PV Recycling Working Group actively seeks and develops recycling partners across the U.S. While the majority of PV modules installed today will stay in service for more than 20+ years, some waste is generated from weather events, manufacturing scrap and warranty-related claims. The recyclers provide their services to installers, project and system owners, developers, distributors and other parties.