

# End-of-Life Management for Solar Photovoltaics: Recycling

## SEIA PV Recycling Partner Network

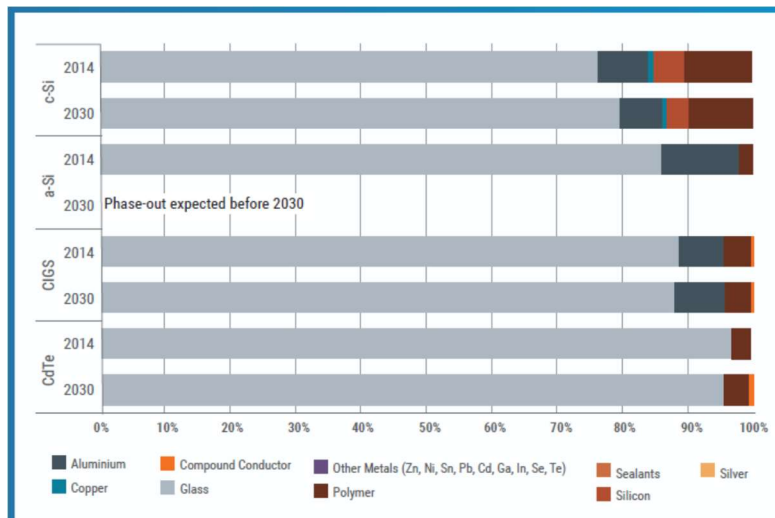
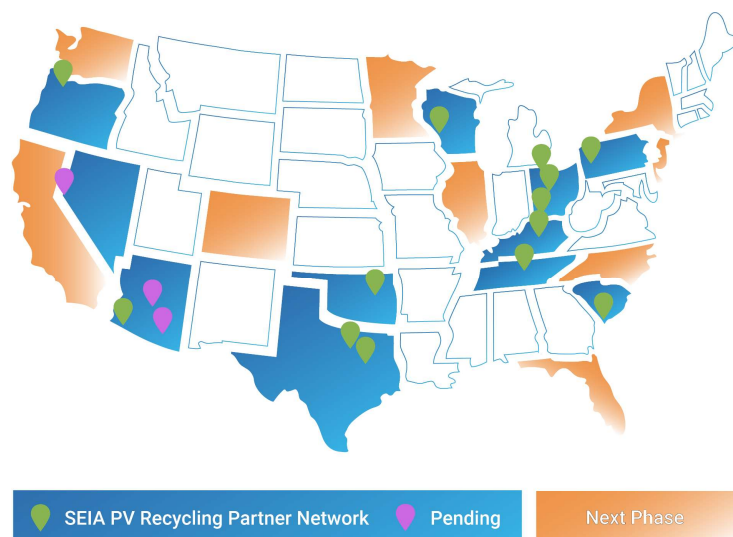
SEIA's PV Recycling Working Group has been actively seeking and developing recycling partners across the U.S since 2016. Over 95% of PV modules deployed in the U.S have been installed since 2012, and such modules will stay in service for more than 25+ years. Nonetheless some waste is generated when panels are damaged during production, shipment or installation, determined to be defective, by weather events, and for warranty-related claims.

SEIA's National Recycling Program is preparing now for larger volumes of waste to come in future years. Already SEIA's recycling partners have processed >4M pounds of PV modules and related equipment since the program launched.

While they offer specific benefits to SEIA members, the recyclers provide their services to interested installers, project and system owners, developers, distributors and other parties.

SEIA's current partners have prior expertise in recycling glass, polymerics, aluminum, scrap metal, and electronics; all of which provide a good foundation for recycling PV modules, inverters, racking systems and other components of a PV system. Our current network partners offer and provide services to SEIA members and industry throughout the U.S. SEIA is continually working to find new partners in more geographies to make recycling more accessible in areas where solar is installed.

The graphic below shows where SEIA's current partners are located and where we are in process of adding new partners. As we expand our network to more areas, we help partner companies to develop their processes and equipment for our technology. Overall, we aim to add 2-4 new partners yearly and for both new and existing partners to expand their collection and processing locations.



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

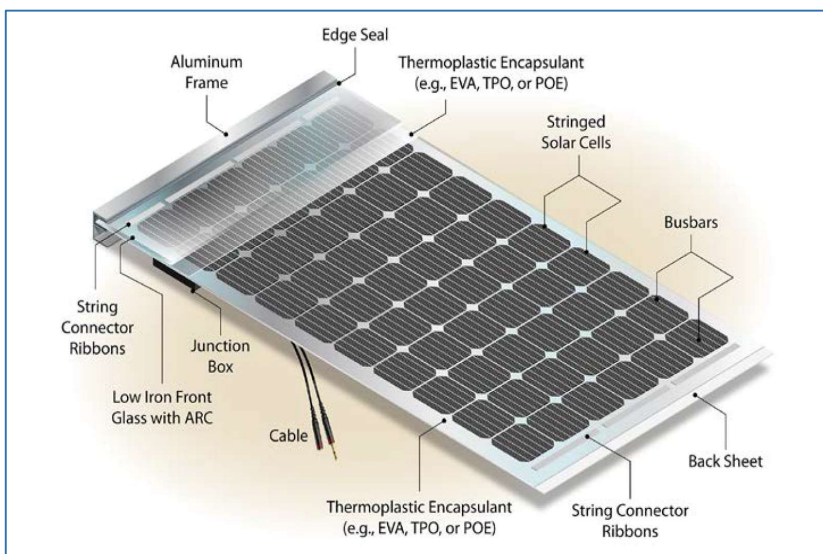


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## Photovoltaic equipment and options for first end-of-life stages

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’ 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.

SEIA advises manufacturers, system and project owners to consider reuse, refurbishment and / or recycling of first end-of-life PV modules, inverters, racking equipment and associated components when possible.



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

## Recycling

While most PV panels produced today will have a useful life for decades, there is inevitable waste created during production, 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 lifecycle impacts and recover valuable and energy-intensive materials, thereby increasing sustainability within the PV industry.

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. Recycling of solar equipment is increasingly possible as more recyclers accept modules.

## 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 and its members participate in research studies and projects, white papers, collaborative programs and present information, findings and research at stakeholder meetings, conferences and events to keep industry and others updated on our progress in developing end-of-life solutions.

| R&D Organizations, Producers, Academia                                                                                                                              | Repair/Re-use/ Refurbishment Services                                                                                                                                                                                                                                   | Recycling and Waste Management                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Public institutions</li><li>• Private organizations</li><li>• OEM Manufacturers</li><li>• Component Manufacturers</li></ul> | <ul style="list-style-type: none"><li>• Manufacturers</li><li>• Service providers</li><li>• Contractors</li><li>• Installers and EPCs</li><li>• Operations &amp; Maintenance companies</li><li>• Waste management companies</li><li>• Pre-treatment companies</li></ul> | <ul style="list-style-type: none"><li>• Public waste agencies</li><li>• Regulators</li><li>• Waste management companies</li><li>• Pre-treatment companies</li><li>• Manufacturers</li></ul> |