

What Happens When a Solar Facility is Decommissioned?

Background

In general, solar projects receive an approval for construction, and operate between thirty and forty years. Upon completion of the economic life of a project or, potentially permit expiration, the project owner will determine to apply for a new permit or remove the facility. Solar panels can operate past thirty years - albeit at lower efficiency - the owner can keep the panels, or "repower" the site by upgrading the panels with more efficient solar technology.

Otherwise, the project owner can decommission the facility. Decommissioning refers to removal of equipment and restoration of the site. Unlike some other forms of development, a decommissioned solar project site can be repurposed for other uses, such as agricultural production. Often solar project permits define how a solar project is to be decommissioned. For an industry-suggested policy framework for decommissioning, including plan submittal, requirements, and financial security, please visit [Renewable Energy Facility Decommissioning: Industry Recommendations](#).

Panels

Solar panels are guaranteed to produce at least 80% of their original power rating after 25 years¹. Panels may be re-used or re-sold: There is an emerging market for second generation panels, often for off-grid applications or electrification in developing countries^{1,2}.

Panels may also be refurbished or recycled. Eighty-five percent of the weight of a solar panel is glass and aluminum: materials commonly recycled. There is a growing network of waste management firms in the United States that offer options for panel recycling³. Some manufacturers, such as Ohio-based First Solar, have a take-back program to refurbish panels⁴.

Can solar panels be sent to a landfill? In the U.S., waste is separated into hazardous (not accepted at ordinary landfills) and solid waste (generally accepted at ordinary landfills) based on a series of tests. A solar panel's waste status is determined based on the outcome of the Toxic Characteristic Leaching Procedure (TCLP) test. This Environmental Protection Agency test is designed to simulate landfill disposal and determine the risk of hazardous substances leaching out of the landfill. Most modern solar panels pass the TCLP test. However, some older panels (i.e., from the 1990s) and potentially some newer models may not pass some of the leachate limits to the TCLP test⁵.

Racking

Racking systems are used to mount solar panels, and in some cases, slowly track the path of the sun to capture as much energy as possible. Pile-driven posts are placed several feet below ground to ensure the system is secure and can withstand severe weather. During decommissioning, these posts are pulled from the ground using back hoes or other tools. However, if a post cannot be removed, it is typically cut at a depth specified by the community approval and covered with soil. Posts are made from galvanized steel and racking system components are mostly aluminum or galvanized steel. These components are easily recyclable and sold as scrap.



¹ IEA and IRENA. 2016. End-of-life management: solar photovoltaic panels. Available at: <https://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels>

² Ndzibah, et al. 2021. End of life analysis of solar photovoltaic panel: roadmap for developing economies. Available at: <https://www.emerald.com/insight/content/doi/10.1108/JJESM-11-2020-0005/full/pdf?title=end-of-life-analysis-of-solar-photovoltaic-panel-roadmap-for-developing-economies>

³ NREL. Solar Photovoltaic Module Recycling: A Survey of U.S. Policies and Initiatives. March 2021. <https://www.nrel.gov/docs/fy21osti/74124.pdf>

⁴ First Solar. Recycling. Accessed August 2021. Available at: <https://www.firstsolar.com/en/Modules/Recycling>

⁵ End-of-Life Solar Panels: Regulations and Management. Accessed August 2023. <https://www.epa.gov/hw/end-life-solar-panels-regulations-and-management>

Wires

Wires connect the solar system and ultimately deliver the electricity to the grid. Aboveground wires and wires shallower than 3 feet underground are removed, copper and/or aluminum wiring and associated electronic equipment are sold as scrap or recycled to the extent practical use.

Inverters & Transformers

Inverters convert direct current generated from the panels into alternating current; transformers step up the voltage of the project to match that of the nearby transmission line. During the decommissioning process, this equipment is dismantled, and various parts are refurbished, recycled, or landfilled as appropriate.

Foundations

Inverters and transformers are typically bolted onto steel or concrete foundations. Upon decommissioning the foundations are broken up and removed to be recycled, sold as scrap, and/or landfilled. Once debris is removed, the area is backfilled with native or similar soils.

Fencing

Fence posts can be pulled out using skid-steer loaders or other light equipment. All fence parts and foundations are removed from the site and reconditioned and reused, recycled, or landfilled as appropriate.

Vegetation

Any portions of the site with compacted soil will be de-compacted and any excavations backfilled with soils to restore the site for future use. As a final step of decommissioning, the site will be revegetated to help with erosion and dust control as required or returned to agricultural use.

Access Roads

Unless agreed upon by the landowner and allowed by permit, access roads will be removed by excavating aggregate for reuse elsewhere, replacing soils to level the terrain, and de-compaction.

Decommissioning Costs

The costs of decommissioning do not fall upon the community or landowners, rather they are the responsibility of the project owner. While costs vary by region and project size, third party engineering estimates may forecast a negative cost of project decommissioning. This is because the salvage value of modules, PV racking, steel posts and copper wiring can exceed the costs of⁶ equipment removal and land restoration.



Photo credit: Nextracker

⁶ DNV GL – Energy. Decommissioning Costs Analysis. Prepared for Wisconsin Public Service Commission. Available via <https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=388211>, 32-page attachment within file.

For more information,
email David Murray at
dmurray@cleanpower.org