

Option for PV Landfill Disposal

sPower maintains the position that recycling the PV module at the end of their commercial life would yield a net credit, which has been supported by third party industry experts such as DNV-GL and Dr. Vasilis Fthenakis, and would prefer recycling to landfill disposal; however, should Spotsylvania County decide to penalize PV recycling and exclude recycling credits from the decommissioning cost analysis, sPower would reconsider the cost of decommissioning to incorporate landfill disposal rather than recycling.

The following is a brief summary for disposal of PV Panels in landfills as permissible activity under RCRA and documentation that both silicone and Cadmium Telluride panels pass the EPA's TCLP analysis and therefore classify as non-hazardous solid waste.

(Language and cited sources are derived from the “Health and Safety Impacts of Solar Photovoltaics” (2017) report produced by the NC Clean Energy Technology Center and North Carolina State University, which was originally included in the “Cadmium Telluride Panel Integrity and Safety Executive Summary” provided by sPower to Spotsylvania County.)

Like many silicon-based panels, CdTe panels are reported (as far back as 1998¹) to pass the EPA's Toxic Characteristic Leaching Procedure (TCLP) test, which tests the potential for crushed panels in a landfill to leach hazardous substances into groundwater² Passing this test means that they are classified as non-hazardous waste and can be deposited in landfills.^{3,4}

In the United States, end-of-life disposal of solar products is governed by the Federal Resource Conservation and Recovery Act (RCRA). RCRA separates waste into hazardous (not accepted at ordinary landfill) and solid waste (generally accepted at ordinary landfill). According to RCRA, the way to determine if a PV panel is classified as hazardous waste is the Toxic Characteristic Leaching Procedure (TCLP) test. This EPA test is designed to simulate landfill disposal and determine the risk of hazardous substances leaching out of the landfill.^{5,6,7} Research comparing TCLP conditions to conditions of damaged panels in the field found that simulated landfill conditions provide overly conservative estimates of leaching for field-damaged panels⁸

The test begins with the crushing of a panel into centimeter-sized pieces. The pieces are then mixed in an acid bath. After tumbling for eighteen hours, the fluid is tested for forty hazardous substances that all must be below specific threshold levels to pass the test. Multiple sources report that most modern PV panels (both crystalline silicon and cadmium telluride) pass the TCLP test.^{9,10}

Therefore, testing shows that silicon and CdTe panels are both safe to dispose of in landfills and are also safe in worst case conditions of abandonment or damage in a disaster. Additionally, analysis by local engineers has found that the current salvage value of the equipment in a utility scale PV facility generally exceeds general contractor estimates for the cost to remove the entire PV system.^{11,12,13}

Currently, landfill tipping fees are approximately \$40/ton. Meaning 1.8 million panels at approximately 40 pounds each would cost \$1,440,000 to dispose at a landfill. Although sPower maintains the position that recycling the PV modules at the end of their commercial life would yield a net credit, which has been supported by third party industry experts such as DNV-GL and Dr. Vasilis Fthenakis, landfill disposal provides a viable alternative for panels at decommissioning and should be considered as such in decommissioning cost calculations.

Citations

- 1 Cunningham D., Discussion about TCLP protocols, Photovoltaics and the Environment Workshop, July 23-24, 1998, Brookhaven National Laboratory, BNL-52557
- 2 Parikhith Sinha, et al. Evaluation of Potential Health and Environmental Impacts from End-Of-Life Disposal of Photovoltaics, Photovoltaics, 2014. Accessed May 2016
- 3 Practical Handbook of Photovoltaics: Fundamentals and Applications. T. Markvart and L. Castaner. *Chapter VII-2: Overview of Potential Hazards*. December 2003. Accessed August 2016. https://www.bnl.gov/pv/files/pdf/art_170.pdf
- 4 Norwegian Geotechnical Institute. *Environmental Risks Regarding the Use and End-of-Life Disposal of CdTe PV Modules*. April 2010. Accessed August 2016. <https://www.dtsc.ca.gov/LawsRegsPolicies/upload/Norwegian-Geotechnical-Institute-Study.pdf>

- 40 C.F.R. §261.10. *Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste*. November 2016. Accessed November 2016 <http://www.ecfr.gov/cgi-bin/text-idx?SID=ce0006d66da40146b490084ca2816143&mc=true&node=pt40.26.261&rgn=div5#sp40.28.261.b>
- 6 40 C.F.R. §261.24 *Toxicity Characteristic*. November 2016. Accessed November 2016. http://www.ecfr.gov/cgi-bin/text-idx?SID=ce0006d66da40146b490084ca2816143&mc=true&node=pt40.26.261&rgn=div5#se40.28.261_124
- 7 International Renewable Energy Agency. Stephanie Weckend, Andreas Wade, Garvin Heath. *End of Life Management: Solar Photovoltaic Panels*. June 2016. Accessed November 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf
- 8 First Solar. Parikhith Sinha, Andreas Wade. *Assessment of Leaching Tests for Evaluating Potential Environmental Impacts of PV Module Field Breakage*. October 2015. Accessed August 2016. <http://www.firstsolar.com/->
- 9 TLCP test results from third-party laboratories for REC, Jinko, and Canadian Solar silicon-based panels. Provided by PV panel manufacturers directly or indirectly to NC Clean Energy Technology Center
- 10 Sinovoltaics, *Introduction to Solar Panel Recycling*, March 2014. Accessed October 2016. <http://sinovoltaics.com/solar-basics/introduction-to-solar-panel-recycling/>
- 11 RBI Solar, Decommissioning Plan submitted to Catawba County associated with permitting of a 5MW solar project in June 2016. Accessed April 2017. www.catawbacountync.gov/Planning/Projects/Rezoning/RZ2015-05_DecommissioningPlan.pdf
- 12 Birdseye Renewables, Decommissioning Plan submitted to Catawba County associated with permitting of a 5MW solar project in May 2015. Accessed April 2017. www.catawbacountync.gov/Planning/Projects/Rezoning/RZ2015-04_DecommissioningPlan.pdf
- 13 Cypress Creek Renewables, Decommissioning Plan submitted to Catawba County associated with permitting of a 5MW solar project in September 2016. Accessed April 2017. www.catawbacountync.gov/Planning/Projects/Rezoning/RZ2016-06decommission.pdf

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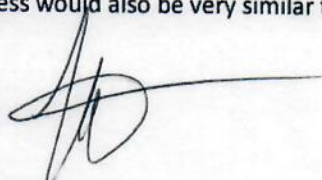
February 13, 2019

Spotsylvania County
Board of Supervisors
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To Whom it May Concern,

My company, Herling Construction regularly services and decommissions wind facilities around the country. Herling Construction completed a decommissioning of 651 obsolete wind turbines for Sustainable Power Group, LLC ("sPower") in Altamont, California during the summers of 2017 and 2018. Due to the recycle value of the wind turbines, the project was completed at no cost to sPower. The value of the steel more than offset all labor, machinery, disposal and trucking costs associated with decommissioning the Altamont facility. In each bid for decommissioning, the recycle value of any metal and other materials is used by owners and decommissioning contractors to offset the overall labor, equipment, disposal, permitting and other costs. This process would also be very similar to decommissioning a solar facility.

Sincerely



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