

Abstracts

【Special Issues: Recent Trend in Reuse, Recycling and Disposal of Waste Photovoltaic Modules】

1. Reuse/Recycling of PV Modules and Guidelines from the MOE

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Abstract

Solar panels have been rapidly introduced as a means of mitigating climate change and enhancing energy security through certain policies such as the feed-in tariff of 2012. So far, many of the used solar panels could be reused, and because these contain aluminum, silver, and other valuable metals those that are not reusable are recycled. However, there are reasons that make recycling problematic: difficulties in separating out glass and some of the other parts, antifoaming chemicals used in the cover glass, and special plastics contained in the back sheet all make it harder to fully recycle the panels. It is forecast that there will be a sharp increase in discarded waste solar panels by the 2030s, and in fact some have recently been disposed of in large amounts due to such things as improper installations and damage from natural disasters. In line with the 3R Principle, we must immediately enforce the promotion of reuse, recycling, and proper waste management for solar energy systems.

Keywords: photovoltaic (PV) module, reuse, recycling, proper waste management

2. Generation and Potential Flow of Waste PV Panels

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Abstract

Since the Paris Agreement in 2015, the promotion of renewable energy use has increased in

importance, however proper attention is yet to be given to developing adequate preparations for the recycling and waste treatment of these newly favored facilities at the End-of-life (EoL) phase. One of the reasons for this is the difficulty of forecasting amounts for EoL generation and a timeline. In order to clarify the cause of this difficulty, our paper analyzes factors influencing decision making by the user regarding PV panel disposal, as well as the impact of societal changes on eventual material flows (i.e. destination and timing for EoL PV panels). Potential flow scenarios for these destinations are summarized to identify the associated issues. In short, since predicting one scenario for EoL generation is not possible, we must prepare for multiple scenarios by organizing all of the available information and analyzing it carefully. It is also crucial that every stakeholder in industry, government, and academia works together collaboratively to address and respond to all the issues that may come their way.

Keywords: End-of-life (EoL) photovoltaic (PV) panels, EoL generation forecasts, reuse, reverse logistics

3. Toward Sustainable End-of-life Management of Photovoltaics Modules in Japan

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Abstract

To the best of our knowledge, there are no end-of-life (EoL) management systems for photovoltaics modules (PV modules) in Japan. Although there are concerns regarding the massive amounts of waste that will be generated in the future, private companies are unable to provide EoL services as part of their business because waste generation is currently still in such limited amounts. In addition, a regulatory system for EoL management has not been clearly developed in Japan. In order to address these issues, we have analyzed the causes and were able to assess that different types of EoL systems will be needed for each type of waste being generated. Accordingly, in order to install sustainable EoL management systems in Japan we have been developing and trying to execute our plan with respect to collection systems that are accessible both from solar firms with high (more than or equal to 50kW) and low voltages (less than 50kW), as well as accessible at the time of and following natural disasters. As for reuse and recycling, we have been trying to establish the Economically Viable Application of Best Available Technology (EVABAT). This paper includes a discussion of what we are

currently experimenting with and where we predict things will go from here.

Keywords: photovoltaics module (PV module), disaster waste, collection point, reuse, material cycle

4. Endeavoring to Create a PV Recycling Scheme Encompassing a Waste Panel Take-back System

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Abstract

PV system installations have rapidly been on the increase since the Japanese Feed in Tariff Act was enforced in 2012. This means that a large amount of PV panels will be become waste in 2030s as they reach their end-of-life (EoL) stage. However, maintenance vendors will exchange some of the panels with new ones before they reach their EoL stage. This scenario is estimated to generate two hundred tons of waste per year corresponding to 2MW in 2020 in Kyushu and considered to be no small amount. In order to promote a recycling scheme for the wasted panels, the Fukuoka PV Maintenance and Recycling Promoting Committee was established last year to initiate a take-back and recycling system. We are now developing the smart take-back support system that shares information among members in the Japan Waste Network through the Cloud and aims to manage collection efficiently using IoT. We also intend to perform social experiments on this take-back and recycling system for discarded panels in order to create optimal efficiency. Because sustainability is the most crucial aspect of the take-back system and relies upon a self-sustaining committee, we have also started to develop unique technology to uphold this self-sustaining committee.

Keywords: photovoltaic (PV) cells, photovoltaic (PV) recycling, wasted panels, smart take-back, supporting system

5. The Business Side of Reuse and Recycling for Used Solar Systems

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Abstract

The amount of power generated by solar technologies, which stands as the core of Japan's renewable energy program, is 7% of the total energy policy forged by METI. The social need for such solar facilities has become quite common in recent years. However, treatment and handling of used solar

cell modules has not yet become common in terms of the institutional and technical aspects involved. Responses to disaster waste due to heavy rain disasters, earthquakes, typhoons, etc. have already started. Toshiba Environmental Solutions Corporation is developing technology for assessing the performance of used solar cell modules, currently reusing solar cell modules that have undergone evaluation at power generation facilities and in power generation equipment. Following this example, we plan to develop technologies for quantifying the resources and hazardous substances of used solar cell modules and recycling technologies such as crushing/scratching. After proper treatment, we will sell collected materials that use these alongside our business selling both systems and recycling equipment. The effects of such efforts has been a marked reduction in CO2 emissions, as well as more effective utilization of resources and an overall reduction in environmental loading.

Keywords: renewable energy, solar cell modules, reuse, recycling, resource

6. Management of Collection, Recycling, and Appropriate Disposal of Waste Photovoltaic Modules under the WEEE Directive in EU

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Abstract

In tandem with the continuous global expansion of the renewable energy field, renewable energy in Japan has been introduced with the formation of a low-carbon society and promulgation of energy resources produced domestically as its goal. Currently, some of the photovoltaic modules have already become waste and are being discharged. In the future, the amount of this type of waste is expected to increase exponentially, up to approximately 500 to 800 thousand tons of waste photovoltaic modules will be discharged annually in the latter half of the 2030s. To prepare for accommodating the collection, recycling, and appropriate disposal system of waste photovoltaic modules in Japan, it is important to benchmark the cases in EU where photovoltaic modules were earlier introduced. In preparation for such large amounts of waste, it is necessary to establish a system for the proper disposal of waste photovoltaic modules and introduce reduction of wastes through reuse and recycling. This article argues the outline of the WEEE Directive, which has had enormous influence on the waste disposal system. Moreover, this article gathers and organizes information primarily on the management system of collection, recycling, and appropriate disposal of waste photovoltaic modules by PV CYCLE in Germany and France as its present situation of waste disposal.

Keywords: photovoltaic module, recycling, appropriate disposal, WEEE Directive, PV CYCLE

7. Incidents of Accident Damages Caused by Natural Disasters at Solar Power Plants

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Abstract

Typically, any photovoltaic power generation system is operated up until the time its service life ends and then dismantled for reuse or recycling. However, when natural disasters occur and cause accidents, resulting in damages to photovoltaic power generation systems, the systems or parts often land up in mistaken waste or recycling streams instead. This report investigates damages caused by natural disasters based on accident reports filed under the Electricity Business Act.

Last year, a total of 48 incidents of damage were reported as a result of natural disasters, i.e. the Japan Floods of 2018, the Hokkaido Iburi Eastern Earthquake, and Typhoons Jebi and Trami. During the severe flooding of 2018, photovoltaic panels and power conditioners were mainly destroyed or damaged by flooding and landslides. In the same year, it was observed that the Hokkaido Iburi Eastern Earthquake caused damage to the base and panels of the systems, PSC shorts, and ground faults, mainly due to upheaval, fissures, and ground liquefaction.

Keywords: photovoltaic power, accident, typhoon, earthquake, floods