



Hawai'i Natural Energy Institute Research Highlights

Energy Policy & Analysis

Disposal and Recycling of Clean Energy Products in Hawai'i

OBJECTIVE AND SIGNIFICANCE: Hawai'i's pursuit to become fully renewable by 2045 will produce substantial streams of clean energy product waste over the next 30 years and beyond. In recent years, Hawai'i has seen a large uptake in the use of solar photovoltaic (PV) panels. This is expected to continue with new systems, both rooftop and utility scale, combined with battery energy storage systems. Due to this, it is crucial for the state to develop a process to manage these waste streams in a manner that is both safe and environmentally sound. The objective of this work is twofold: 1) to quantify this waste stream and enumerate best practices for cost-effective recycling and 2) to recommend best practices for disposal, recycling, or secondary use of clean energy products produced in the State.

BACKGROUND: The 2021 Hawai'i State Legislature passed House Bill 1333 which required HNEI, in consultation with the Hawai'i State Department of Health, to conduct a thorough study on best practices for disposal and recycling of discarded clean energy products in Hawai'i. Specific deliverables addressed were: 1) the amount of PV and solar water heater panels in the State that will need to be disposed of or recycled; 2) other types of clean energy materials expected to be discarded in the State including glass, frames, wiring, inverters, and batteries; 3) the type and chemical composition of those clean energy materials; 4) best practices for collection, disposal, and recycling of those clean energy materials; 5) whether a fee should be charged for disposal or recycling of those clean energy materials; and 6) any other issues the Hawai'i State Energy Office and Department of Health consider appropriate.

PROJECT STATUS/RESULTS: This project, commenced in September 2021, remains ongoing. Findings to date include: 1) material composition of PV panels, inverters, cabling, mounting equipment and Li-ion battery storage as a function of installed power (kg/kW); 2) cumulative PV and battery storage installed by island for residential, commercial, and utility scale since 2005; 3) projected disposal loading rate of aging PV materials to 2045; 4) assessment of waste treatment options, costs, and risks; and 5) assessment of fee options with recommendations. Specifics:

1. As of 2021, it is estimated that 3.86 million modules have been installed on O'ahu, 720,000

in Maui County, 580,000 in Hawai'i County, and 480,000 on Kaua'i; representing up to 225,000 tons of PV related clean energy materials. For comparison, 2,570,478 tons of municipal solid and commercial/demolition waste generated in the State during the 2021 calendar years. The total amount of these PV related clean energy materials installed to date is equivalent to approximately 8.8% of the total municipal solid and commercial and demolition waste generated in a single year (2021).

2. Covering the cost of off-island disposal for PV panels and Li-ion batteries is likely to require one or more revenue-generating schemes, potentially including waste generator or producer responsibility, state encouraged/assisted recycle, and/or visible fees.
3. The possibility of enhanced restrictions or outright banning of ocean shipping of end-of-life Li-ion batteries is identified as an existential threat to Hawai'i's disposal of Li-ion batteries.
4. The need to deactivate and/or pre-process Li-ion batteries on island was identified as needed to ensure long term access to ocean transport.

These and other results have been detailed in HNEI's report "[Recommendations on Waste Management of Clean Energy Products in Hawai'i](#)," which was previously submitted to the legislature. Although not mandated, this work was continued in 2022 and 2023 to add depth to policy recommendations for the disposal and recycling of clean energy materials in Hawai'i and a [supplemental report\(s\)](#) was produced and is available on HNEI's website.

FUTURE WORK: To support state decision making in regard to the potential needs for development of a Li-ion battery deactivation and/or preprocessing facilities in Hawai'i, HNEI is now conducting a comprehensive study to identify the requirements and general costs of: 1) a full pre-processing facility, 2) a full de-activation facility, and 3) a ship-only facility. Outcomes will assist the State in policy decision making as well as soliciting bids as necessary.

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