

Solar Panel and Lithium Battery Universal Waste Proposed Rule



Office of Resource Conservation and
Recovery

Tribal Waste Management Program
Webinar Series

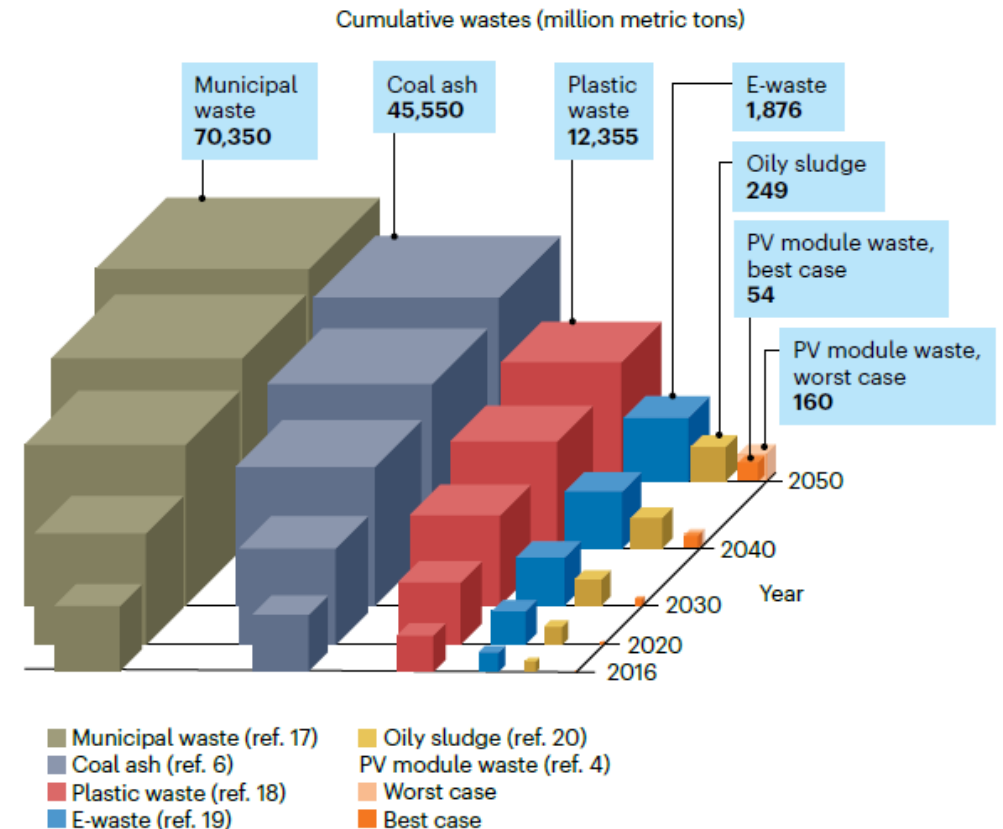
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Overview

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Overview

- Clean energy technologies like solar panels and lithium-ion batteries will be instrumental to fight climate change.
- These technologies will continue to see increases in the market over the coming years.
- As with all energy-producing technologies, wastes will be generated and need to be managed safely according to applicable regulations.
- Resource Conservation and Recovery Act (RCRA) rules exist to facilitate the recycling and reuse of these technologies as well as ensure safe end-of-life (EOL) management.



Source: Mirlletz, H., Hieslmair, H., Ovaitt, S. *et al.* Unfounded concerns about photovoltaic module toxicity and waste are slowing decarbonization. *Nat. Phys.* **19**, 1376–1378 (2023). <https://doi.org/10.1038/s41567-023-02230-0>

Background on Universal Waste

- EPA's universal waste regulations streamline the hazardous waste management standards for certain categories of hazardous waste that are commonly generated by a wide variety of establishments.
- The five existing types of federal universal wastes:
 1. Batteries
 2. Pesticides
 3. Mercury-containing equipment
 4. Lamps
 5. Aerosol cans
- States can also add state-specific universal wastes to their state program.

Background on Universal Waste (continued)

- In general, universal waste is hazardous waste that:
 - Is generated by a wide variety of industries and establishments and large number of generators;
 - Is subject to collection systems (including packaging, marking, and labeling practices) that help ensure close stewardship of the waste;
 - Presents a relatively low risk during accumulation and transport as compared to other hazardous wastes, with specific management standards that would be protective of human health and the environment during accumulation and transport;
 - Has an increased likelihood of diversion from non-hazardous waste management systems when regulated as universal waste; and
 - Has improved implementation and compliance when regulated as universal waste.

Background on Universal Waste (continued)

- Universal Waste participants are:
 - Handlers
 - Subject to streamlined requirements (e.g., not required to use a manifest, may accumulate UW for up to one year and ship UW to and receive UW from other handlers, and other requirements)
 - Small quantity handlers accumulate < 5,000 kg of UW at one time
 - Large quantity handlers accumulate \geq 5,000 kg of UW at one time
 - Transporters
 - Common carriers that do not have to ship waste under a hazardous waste manifest
 - Must comply with DOT requirements for hazardous materials
 - Destination facilities
 - Permitted TSDFs or recyclers who do not store prior to recycling

Solar Panels: New and Growing Waste Stream

- 179 gigawatts of solar capacity has been installed nationwide in the U.S. (Source: SEIA).
 - Enough to power almost 33 million homes
- Solar panels last 25-30 years.
 - Solar panels may be removed from service much earlier due to storm damage, system upgrades (“repowering”) or other reasons.
- The US will generate an estimated 170,000 tons of solar panel waste by 2030, increasing 44x to 7.5 million tons by 2050 (Source: IRENA).
- If disposed, solar panels will take up a lot of landfill space.
 - They are a bulky waste (about 3’ x 5’ each).



Source: NIST

Are Solar Panels Hazardous Waste?

- Some solar panels are considered hazardous waste under the RCRA toxicity characteristic.
 - This can differ even within the same model and manufacturer.
- Depends on the relative amount of toxic materials in the specific panel in question
 - Lead solder
 - Silver front metal grid
 - Cadmium in some solar panels

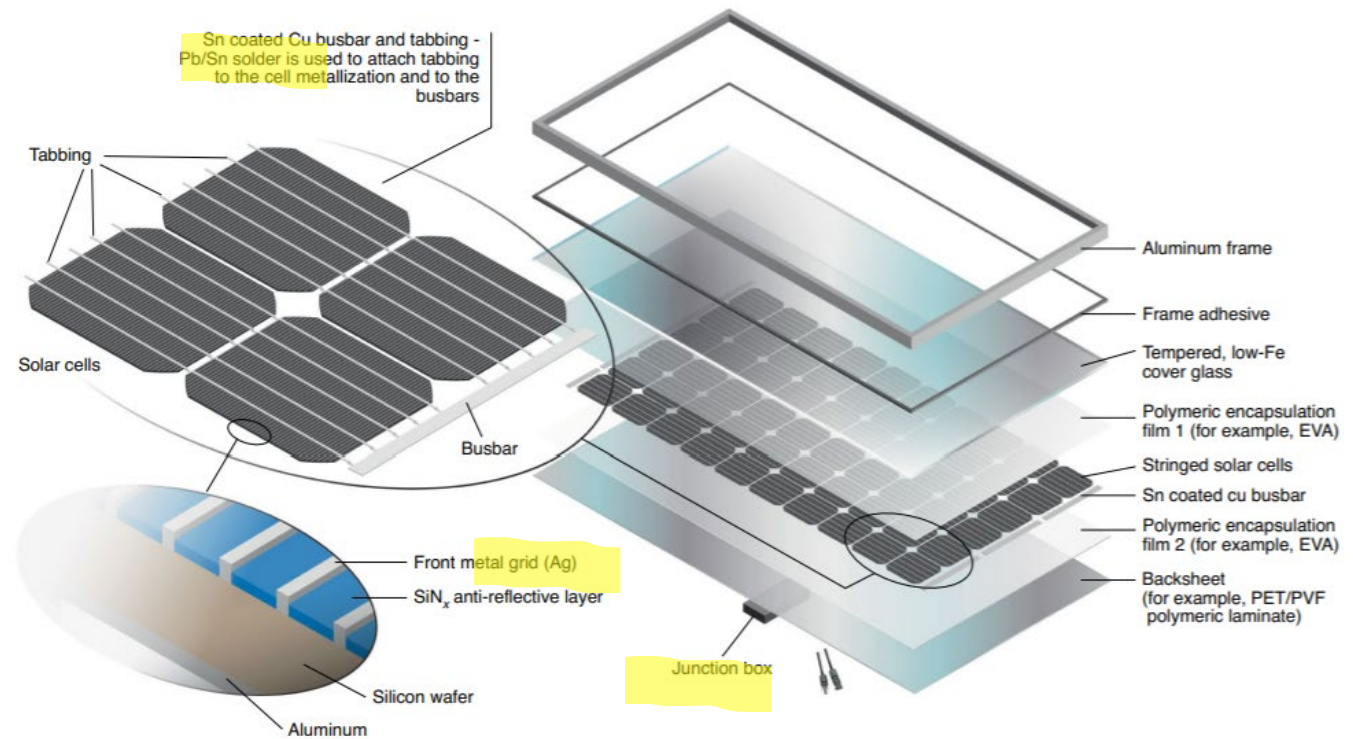


Diagram of a crystalline-silicon panel.

Source: [Research and development priorities for silicon photovoltaic module recycling to support a circular economy, Heath et. al, 2020.](#)

Testing for Toxicity

- EPA required test is the TCLP (toxicity characteristic leaching procedure)
 - Must obtain a representative sample
 - Representative sampling of solar panels can be difficult
 - Toxic components (e.g., lead) are not evenly distributed throughout a solar panel
- A new procedure for obtaining a representative sample for TCLP has been released by ASTM (ASTM E3325-21, Standard Practice for Sampling of Solar Photovoltaic Modules for Toxicity Testing)
 - Designates where to take samples from on a solar panel
 - Sampling performed using waterjet cutting, said to reduce variability compared to mechanical cutting
 - Not evaluated by EPA

Current Solar Panel Management Practices

- End-of-life management options
 - About 90% of decommissioned solar panels are landfilled
 - Some solar panels are being recycled—there are a small but growing number of recyclers
 - Some solar panels are reused, mainly outside of the US
- Management of non-HW solar panels under RCRA
 - Non-HW solar panels may be managed under RCRA subtitle D and disposed in MSW landfills or recycled
- Management of HW solar panels under RCRA
 - EPA recommends using the transfer-based exclusion (40 CFR 261.4(a)(24)) to recycle HW solar panels
 - This exclusion is part of the federal RCRA program and has been adopted by 33 states.
 - Tribal members looking to use this exclusion for recycling solar panels should confirm that the recycler accepting solar panels is also operating under the exclusion.
 - Two states have added solar panels as a state-only universal waste, and three more are considering it
 - Many facilities don't know how to manage end-of-life solar panels yet
 - Anecdotal reports of used solar panels stored in warehouses for long periods of time (speculative accumulation)
 - Industry concern that LQG accumulation time limit means they have less than 90 days to find a recycler—real possibility that no solar panel recyclers will be available, especially after extreme storm events
 - Concern that some HW solar panels are not being tested for toxicity and illegally disposed in MSW landfills
 - Some solar panels likely also being recycled without a HW determination under an assumption that they're non-HW

Petition to Add Solar Panels as a Federal Universal Waste



- In 2021, EPA received a petition requesting a rulemaking to add solar panels as a federal universal waste
- Petition was submitted by a group of industry associations affiliated with the electric utility industry:
 - The Edison Electric Institute
 - The American Clean Power Association
 - The U.S. Chamber of Commerce
 - The National Association of Manufacturers
 - The American Public Power Association
 - The Large Public Power Council
 - The National Rural Electric Cooperative Association
 - The Utility Solid Waste Activities Group
 - The Cross-Cutting Issues Group

Petition to Add Solar Panels as a Federal Universal Waste (cont'd)

- Petitioners' case for Universal Waste:
 - Potential to increase recycling and decrease landfilling
 - Would improve regulatory clarity for solar panel waste management
 - Would avoid the need for expensive Hazardous Waste sampling and testing
 - Would provide additional storage time for end-of-life management
- EPA believes solar panels meet the UW petition criteria
- California and Hawaii have also added solar panels as state-only universal wastes

Lithium Batteries

- As lithium batteries become more common in consumer electronics, stationary storage, and electric vehicles, more are entering the waste stream.
- EPA has been evaluating incidents of fires caused by lithium-ion batteries in the waste stream and wrote a summary report and held a workshop to gain stakeholder feedback on this issue.
 - <https://www.epa.gov/recycle/analysis-lithium-ion-battery-fires-waste-management-and-recycling>
- Most lithium-ion batteries are likely hazardous waste at end of life due to ignitability and/or reactivity, given the fire and damage case incidents.
 - No RCRA test methods for reactivity or ignitability for solids



Fire at a recycling facility in Larimer County, CO, likely caused by a cell phone battery (August 2018)

Lithium Batteries and Universal Waste

- EPA currently recommends managing lithium-ion batteries as universal waste batteries (UW) and applying the standards found at 40 CFR Part 273.
- However, the current UW battery category is not optimal for lithium battery-specific challenges.
 - The existing UW battery category was created before lithium batteries were common and does not address the fire risk.
- While we think that the universal waste regulations work to support battery recycling, we think it could be more protective to decrease the number of fires.

Universal Waste Proposed Rule

- In October 2023, EPA announced a new proposed rulemaking effort.
- EPA is planning to propose adding solar panels to the universal waste regulations and adding a new category for universal waste lithium batteries.



The screenshot shows the EPA website's 'Hazardous Waste' section. The main heading is 'Improving Recycling and Management of Renewable Energy Wastes: Universal Waste Regulations for Solar Panels and Lithium Batteries'. The page content states: 'EPA is planning to propose new rules to improve the management and recycling of end-of-life solar panels and lithium batteries. EPA is working on a proposal to add hazardous waste solar panels to the universal waste regulations found at [Title 40 of the Code of Federal Regulations Part 273](#) and to establish a new, distinct category of universal waste specifically tailored to lithium batteries. To view the schedule for this rulemaking, please visit the [Unified Regulatory Agenda entry for this action](#).' Below this, there is an 'On this page:' section with links to 'Solar Panel Waste', 'Lithium Battery Waste', and 'Additional Resources'. A left-hand navigation menu lists various hazardous waste topics such as 'Hazardous Waste Home', 'Learn the Basics of Hazardous Waste', 'Hazardous Waste Management', 'Generation', 'Identification', 'Definition of Solid Waste', 'Exclusions', 'Characterization', 'Delistings', 'Transportation', 'Permitting', 'Land Disposal Restrictions', 'Requirements for Importers', 'Requirements for Exporters', 'Recycling', 'Cleanups', and 'Regulations for Certain Wastes'.

Rule Webpage: <https://www.epa.gov/hw/improving-recycling-and-management-renewable-energy-wastes-universal-waste-regulations-solar>

Goals for Rulemaking

- Ensure safe management of solar panels and lithium batteries
- Increase compliance with RCRA and improve regulatory clarity
- Promote recycling of solar panels with the levers we have available
- Decrease number of solar panels that are sent to MSW landfills
- Maintain benefits of recycling lithium batteries under universal waste
- Decrease number of fires caused by lithium batteries

Key Issue: Solar Panel Handler Treatment

- Generally, UW handlers are not allowed to perform treatment (including recycling activities), with limited exceptions.
- However, current state-only solar panel UW programs in Hawaii and California allow handlers to remove ancillary equipment like the junction box, inverters, and cables, and to dismantle the frame.
 - California also allows handlers intentionally break the solar panel glass.
- EPA will consider what, if any, solar panel handler treatment should be allowed under the rule.

Key Issue: Whether Residential Solar Panels Qualify as Household Hazardous Waste

- EPA will examine the issue of whether solar panels are household hazardous waste under RCRA hazardous waste rules.
- States have differing approaches and have asked for EPA's position on this question.
- Allowing solar panels to be managed as HHW could result in more solar panels being landfilled in MSW landfills but may simplify solar panel adoption by households.

Key Issue: Increasing Safety with Updated Lithium Battery Management Standards

- To address the risk of fires during collection and accumulation, EPA will consider what increased safety standards for tailored management of lithium batteries are appropriate for this new UW lithium battery category.
- Currently, UW battery handlers are allowed to:
 - Sort batteries by type
 - Mix battery types in one container
 - Discharge batteries to remove the electric charge
 - Regenerate used batteries
 - Disassemble batteries or packs into individual modules or cells
 - Remove batteries from consumer products
 - Remove electrolyte from batteries

Key Issue: Increasing Safety with Updated Lithium Battery Management Standards (cont'd)

- Some of these allowed handler management activities are not relevant or may not be appropriate for lithium batteries (e.g., regenerating used batteries and removing electrolyte).
- Some handler activities may need to be tailored to lithium batteries for safety reasons (e.g., emergency planning, notification for all/or more of lithium battery UW handlers, isolating battery terminals in accumulation, special standards for recalled batteries).

Preliminary Regulatory Impact Information: Cost

- The solar panel portion of this rule is expected to be a cost-savings measure, as regulatory burden would be reduced on generators of solar panel hazardous waste.
- While household waste is exempt from RCRA hazardous waste regulations, EPA would recommend that household hazardous waste collection sites follow the proposed lithium battery UW standards as a best management practice.
 - New proposed safety standards could increase costs.
- Costs from following new standards could be offset by expected reductions in fires that cause costly repairs and losses of recyclable materials.
- EPA will analyze the cost impacts and develop a Regulatory Impact Assessment (or Economic Assessment) to support this rule.

Tribal Implications

- This rule will potentially impact Tribal members that manage solar panel and lithium battery waste streams in:
 - end-of-life renewable energy installations
 - household hazardous waste collection sites
 - materials recovery facilities (MRFs)
 - landfills
- The rules will streamline the management of end-of-life solar panels and increase safety standards for managing end-of-life lithium batteries.
- At the 2021 Tribal Lands and Environment Forum, ORCR presented on emerging waste streams, including end-of-life solar panels and lithium batteries, and received feedback that the topic was of high interest to Tribes.

Tribal Consultation

- The consultation process for the Rulemaking is being conducted in accordance with the EPA Policy on Consultation with Indian Tribes.
 - (<https://www.epa.gov/tribal/epa-policy-consultation-indian-tribes>)
- EPA does not expect that the proposed rule would have Tribal implications as specified in Executive Order 13175. However, to the extent that Tribes manage end-of-life solar panels and lithium-ion batteries, this proposed rule, if and when finalized, would apply in Indian country.
- EPA invites interested Tribal governments to consult with us prior to issuance of the Proposed Rulemaking.
 - To initiate government-to-government consultation with EPA or if you have questions related to the Solar Panel and Lithium Battery Universal Waste Proposed Rule, please contact Phoebe O'Connor by phone at (202) 566-1451 or email at Oconnor.phoebe@epa.gov by May 31, 2024.

Public Comment

- EPA will accept public comments on the Solar Panel and Lithium Battery Proposed Rulemaking for 60 days after publication of the Federal Register notice announcing the Proposed Rulemaking.
- Tribes are encouraged to submit comments to the docket on the proposal, as well as any other information that you believe may be relevant to the development of the rule during the public comment period.
- All comments must be received no later than the end of the public comment period. The specific dates for the submittal of public comments will be available on EPA's Solar Panel and Lithium Battery Proposed Rulemaking website at: <https://www.epa.gov/hw/improving-recycling-and-management-renewable-energy-wastes-universal-waste-regulations-solar>.

Next Steps and Tentative Schedule for Proposed Rule

- Consultation period: April 9, 2024 to June 30, 2024
 - Deadline to request consultation: May 31, 2024
- Signature of proposed rule expected June 2025

Thank you! Questions?

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