Materials Management Roundtable

ASTSWMO Virtual Mid-Year Meeting
April 26, 2021

Roundtable starts at 2:15 PM Eastern

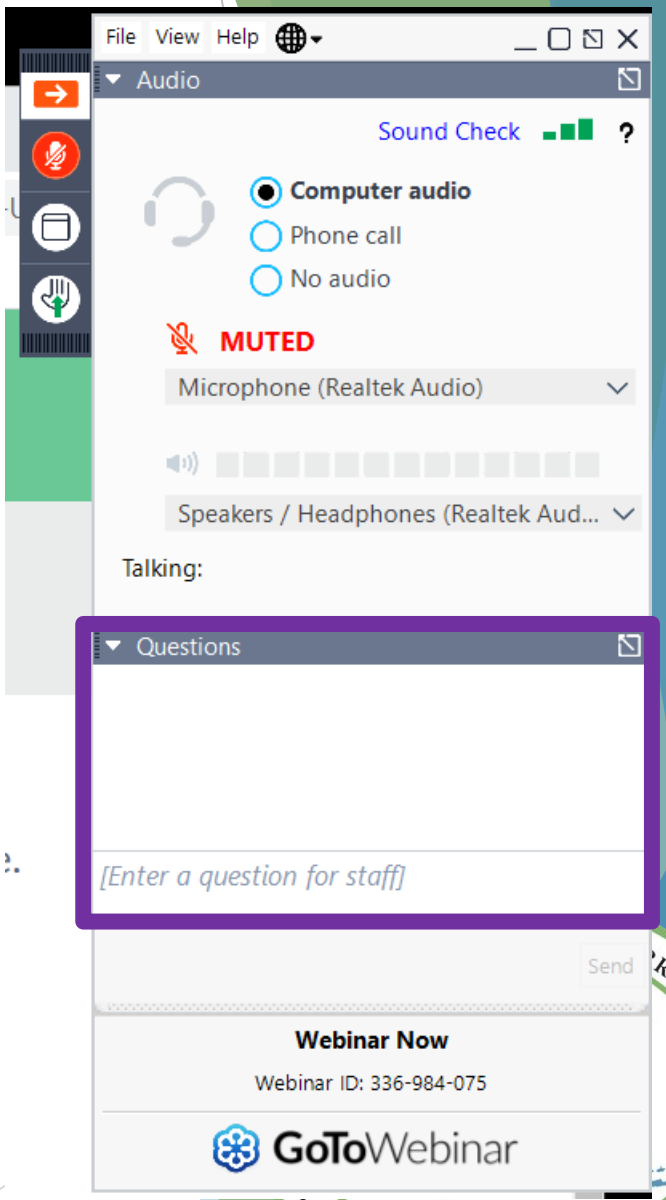
Agenda

- EPA Updates:
- Opening Remarks
- National Recycling Strategy and National Recycling Goal
- U.S. Government Accountability Office (GAO) Report on Recycling
- Sustainable Management of Food
- Electric Arc Furnace Slag
- Non-Hazardous Secondary Material (NHSM) Scrap Tire Fact Sheet

- Emerging Wastes (batteries, solar panels, wind turbines)
  Updates from EPA, and open discussion

Before we start

- All attendees will be muted throughout the webinar.
- **Questions:** Use the **Questions Panel** in the dashboard to send questions to the speakers during the webinar.
- **Note who the question is directed to in your submittal.**
- Questions will be answered at the end of the webinar.
- The webinar is being recorded and will be made available on the ASTSWMO website.



Cathy Jamieson, VT

Chair, ASTSWMO Materials Management Subcommittee

Welcome

Carolyn Hoskinson

Director, EPA Office of Resource Conservation and Recovery (ORCR)

Opening Remarks

Nena Shaw

Acting Director, ORCR Resource Conservation and Recovery Division

National Recycling Strategy
National Recycling Goal
GAO Report on Recycling

Lana Suarez

Associate Chief, Materials Management Branch
ORCR Resource Conservation and Sustainability Division

Sustainable Management of Food
Electric Arc Furnace Slag

Jessica Young

Chief of the Recycling and Generator Branch
ORCR Materials Recovery and Waste Management Division

Non-Hazardous Secondary Material (NHSM) Scrap Tire Fact Sheet

Jessica Young
Chief of the Recycling and Generator Branch
ORCR Materials Recovery and Waste Management Division

Emerging Waste Streams

Non-Hazardous Secondary Materials (NHSM) Program Updates

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Jessica Young – EPA ORCR

Examples of NHSMs

Construction & Demolition Wood

Poultry Litter

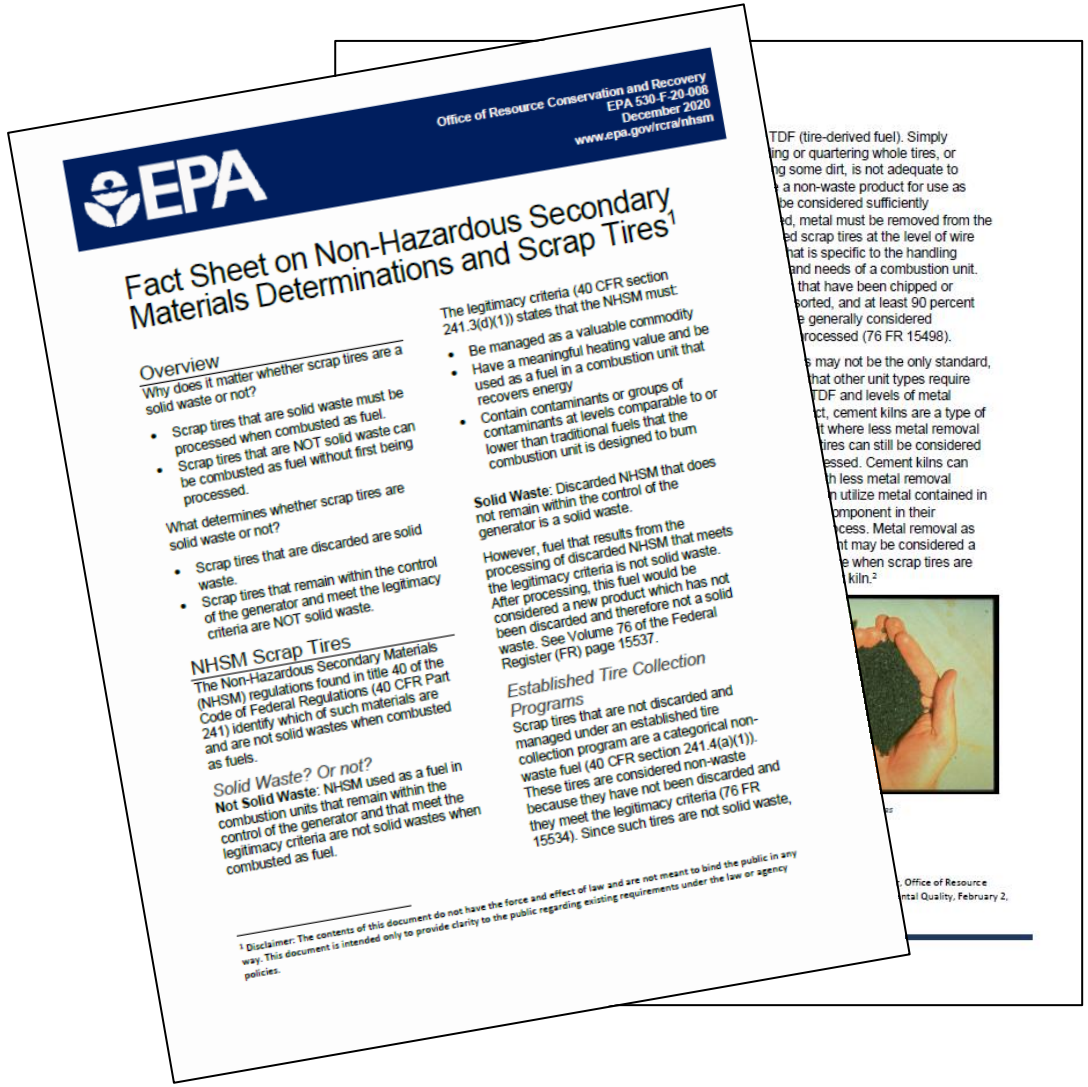
Biosolids

What is the Non-Hazardous Secondary Materials Program?

- The non-hazardous secondary material (NHSM) regulations under RCRA identify which NHSM are, or are not, solid wastes when burned in combustion units as ingredients or fuels
- These regulations help combustion facilities in determining applicable emission standards for combustion units under the Clean Air Act (CAA) for the purposes of determining which Clean Air Act requirements apply:
  - Units that burn NHSM that are not solid waste under RCRA are subject to the section 112 CAA requirements for boilers.
  - Units that burn NHSM that are solid waste under RCRA are subject to the section 129 CAA requirements for waste incinerators.

NHSM Scrap Tire Fact Sheet

- Published in December 2020
- User-friendly reference on how the non-hazardous secondary materials (NHSM) regulations apply to scrap tires.
  - Fact sheet posted here: https://www.epa.gov/rcra/fact-sheet-non-hazardous-secondary-materials-determinations-and-scrap-tires
- Fact sheet compiles references from Federal Register rules, the Code of Federal Regulations (CFR) regulatory language, and RCRAOnline memos.



NHSM Scrap Tire Fact Sheet

- Fact sheet explains when scrap tires are considered a solid waste when burned as a fuel.
- Scrap tires that have been discarded are solid waste.
  - Exception for scrap tires managed under an established tire collection program.
- If a scrap tire is solid waste, it must be processed before it can be burned as a non-waste fuel.
  - It must also meet the NHSM legitimacy criteria.
- Scrap tires that are not solid waste, that remain within the control of the generator, and that meet the NHSM legitimacy criteria can be burned as a non-waste fuel without processing.

Upcoming: NHSM Guide

- The NHSM guide will explain the self-determination process for the regulated community.
- Flowchart and Q&As will go through each step of making a non-waste determination using the NHSM legitimacy criteria for fuels.
- The guide also explains the 2 NHSM petition processes and CAA recordkeeping requirements.
- Guide is currently in review, anticipating a May/June 2021 publish date.
- https://www.epa.gov/rcra/identification-non-hazardous-secondary-materials-are-solid-waste

EPA's NHSM Team

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Emerging Wastes: Lithium-ion Batteries, Solar PV, Wind Turbine Blades

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Jessica Young – EPA ORCR

Background on Lithium-ion Batteries (LIBs)

- LIBs are in a large, and growing, number of products:
  - Consumer electronics (headphones, cell phones, tablets, etc.)
  - Electric vehicles
  - Energy storage
- LIBs are also a growing component of the waste stream
- LIBs have been causing fires at MRFs and other waste management facilities
  - This is partially due to consumers disposing of LIBs in household trash and recycling.
  - Consumers should instead drop off LIBs at household hazardous waste collection sites or dedicated battery or electronics recyclers.

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

Recycling LIBs

- Recycling market is growing in the US
- Two main methods for recycling: pyrometallurgy (smelting) and hydrometallurgy (chemical leaching)
- LIB Recyclers:
  - Retriev (Kinsbursky Bros). Lancaster, OH and Trail, British Columbia
  - Li-Cycle, Rochester, NY, and Kingston, Ontario
  - Redwood Materials, Carson City, NV
- Collection and Transportation Companies:
  - Call2Recycle
  - Big Green Box
- Some recyclers have Part B permits
  - However, one recycler planned to operate with no prior storage, and site their recycling facility down the road from their LQHUW handler which stored the batteries.

Conflicting symbols on an LIB

Recycling LIBs (continued)

- Economically, cobalt is the driver of LIB recycling*
  - Pyrometallurgy recycling yields cobalt and sometimes nickel
  - Lithium often ends up in the slag or used for non-battery applications
  - Most cobalt comes from Democratic Republic of Congo, where there can be significant unrest
  - Manufacturers are seeking effective cobalt substitutes, which could negatively affect recycling market
  - New recyclers are developing hydrometallurgical recycling and other methods to extract lithium and other metals
- Reuse in stationary applications is another option for LIBs at the end of life
- February 24, 2021, President Biden issued Executive Order 14017, ''America's Supply Chains" part of which looks at advanced batteries and critical minerals which will likely increase focus on the need for recycling of batteries
- LIBs have a few critical minerals in them such as lithium, cobalt, graphite, and manganese

* Source: Harvey, Jan. "Metal recyclers prepare for electric car revolution." Nov. 17, 2017. Reuters

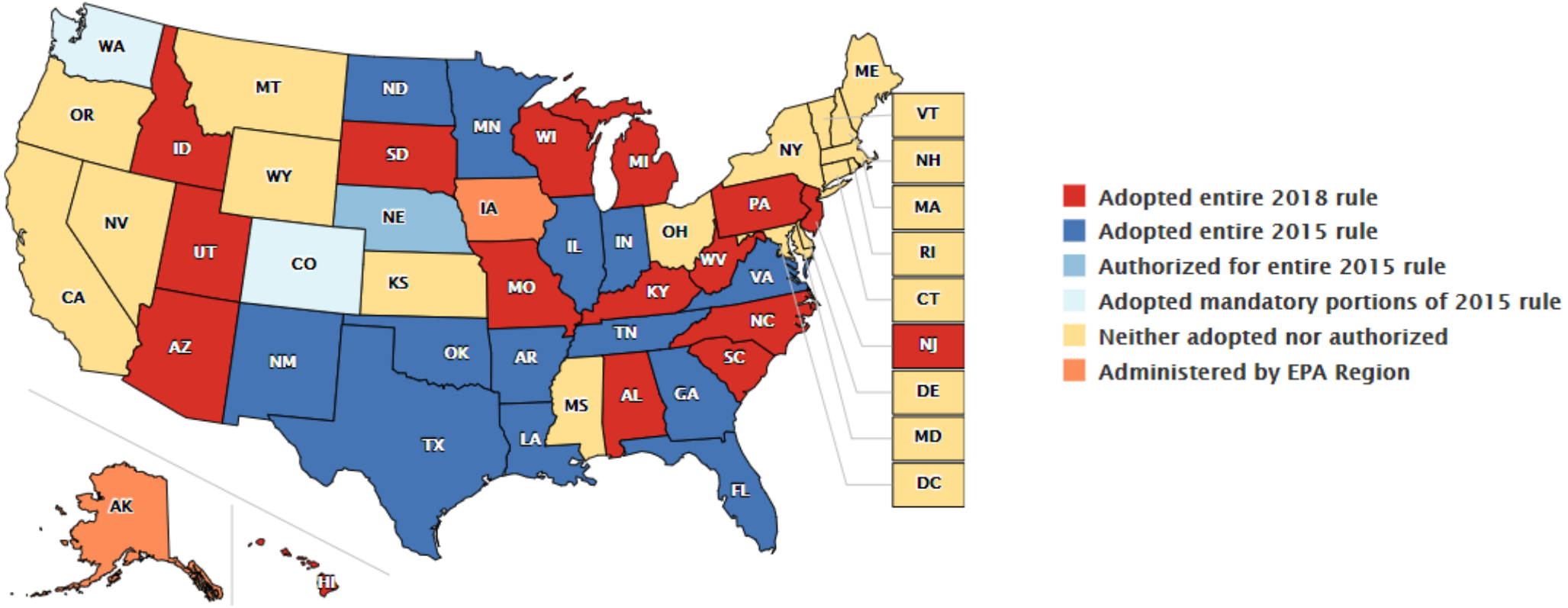
Are LIBs Hazardous Waste? What Regulations Apply?

- Most LIBs are likely hazardous due to ignitability and/or reactivity, given the damage case incidents.
  - EPA has not made a blanket statement on this issue.
  - There is no current test method for reactivity.
- EPA recommends managing LIBs as universal waste (UW) and applying the standards found at 40 CFR Part 273.
  - BMPs for packaging batteries for accumulation include individually bagging and taping terminals.
- For household sources of LIBs, there is the household hazardous waste exclusion (261.4(b)(1)) that would likely exclude batteries from hazardous waste regulation, though not all states have this exclusion.

Regulatory Exclusions for Recycling LIBs

- If LIBs are characteristically hazardous, an exclusion that can be used is called the transfer-based recycling exclusion for hazardous secondary material (261.4(a)(24)).
- This exclusion allows the transfer of hazardous secondary materials to third parties for recycling:
  - Materials covered under this exemption are excluded from the definition of solid waste (and hazardous waste).
  - Certain requirements must be met, including:
    - Material must go to a facility with a RCRA permit, or a facility that will pass the reasonable efforts environmental desk audit
    - Material cannot be speculatively accumulated
    - Material must be legitimately recycled
    - Material must be contained to prevent releases to the environment
    - Recordkeeping and emergency preparedness requirements for the generator
    - Reclaimer and intermediate sites must have financial assurance
    - Notification requirements
  - https://www.epa.gov/hw/final-rule-2018-definition-solid-waste-dsw-response-court-vacatur

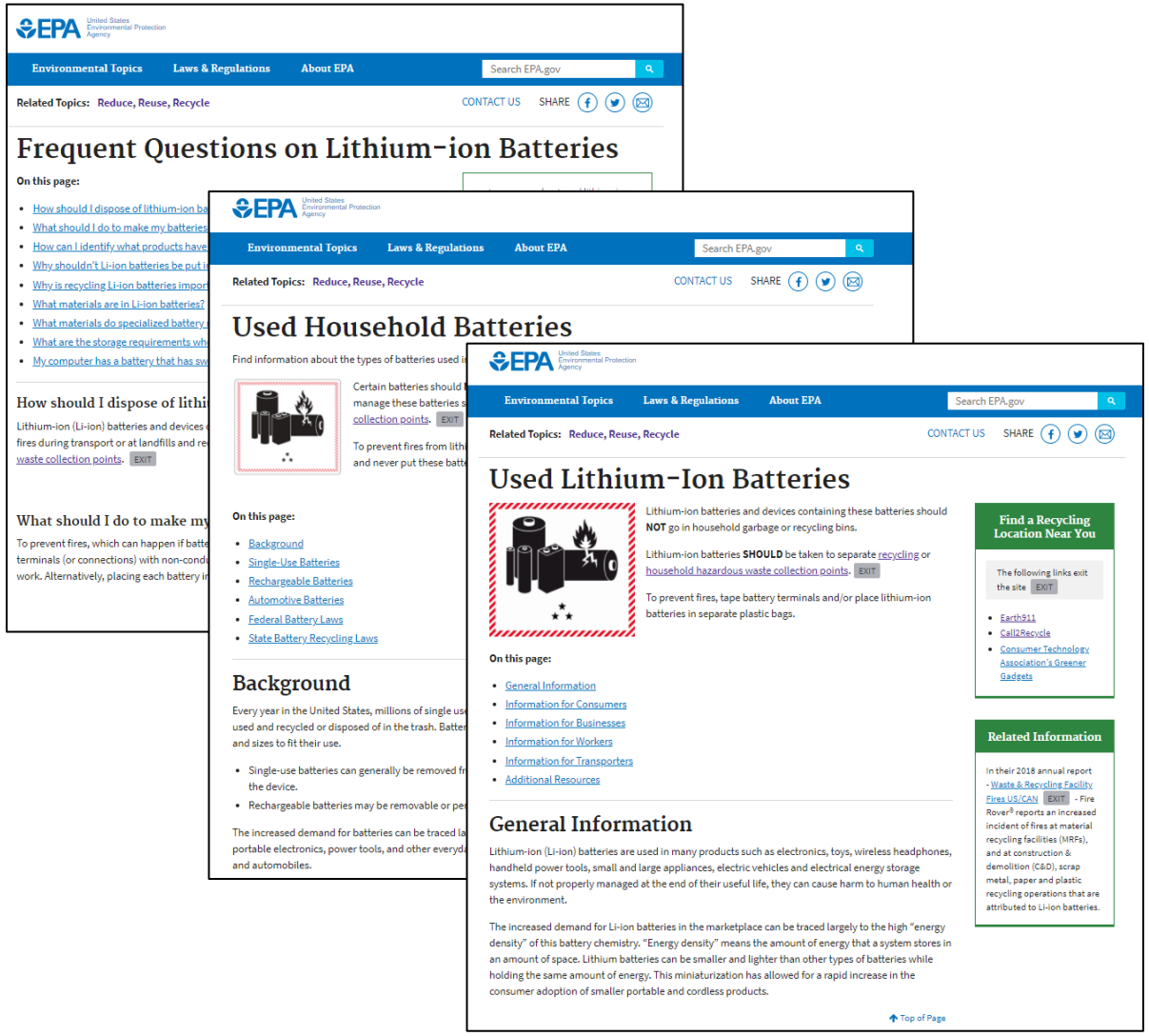
Where the DSW rule (including the transfer-based exclusion) is in effect



Last updated on March 8, 2021
Source: https://www.epa.gov/hw/where-2018-definition-solid-waste-rule-effect

EPA LIB Updates

- New battery webpages under www.epa.gov/recycle:
  - Used LIBs
    - https://www.epa.gov/recycle/used-lithium-ion-batteries
  - Used household batteries
    - https://www.epa.gov/recycle/used-household-batteries
  - Frequent questions on LIBs
    - https://www.epa.gov/recycle/frequent-questions-lithium-ion-batteries



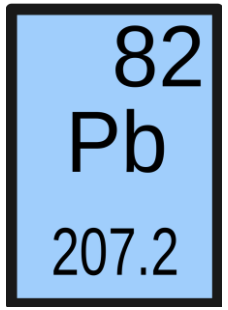
Upcoming EPA LIB Actions

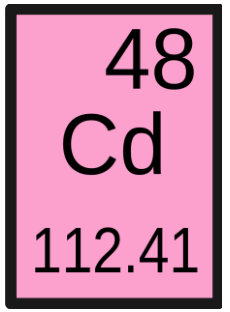
- Damage Case Report
  - Compilation of incidents where LIBs have started fires in the waste management process.
  - To be published ~June 2021
- Stakeholder Workshop
  - Bringing together recycling industry, waste management industry, LIB manufacturers, NGOs, and regulators to discuss the problem and potential solutions.
- Potential Future Actions
  - EPA's role and actions will be informed by results of stakeholder workshop.

- Let us know if there are additional resources that would be useful

Are Solar Panels Hazardous Waste?

- Generally, if solar panels are considered hazardous waste, they would be hazardous under the toxicity characteristic.
- Depends on the concentration of the toxic constituents in the specific panel in question.
  - Some panels are considered hazardous waste and some are not, even within the same model and manufacturer.
  - Solar panels that are hazardous waste commonly exhibit the toxicity characteristic from lead in the solder and/or cadmium in the panels.
- Aluminum from the frame is not hazardous waste and can be removed and recycled separately.





Toxic Constituents in Solar Panels

- Different varieties of solar panels have different amounts of the toxic metals
- Crystalline-silicon solar PV
  - Lead solder in junction box and in cell connections
- Cadmium-telluride solar PV
  - Cadmium in semiconductor
- Emerging Technology: Perovskite solar cells
  - Lead in semiconductor
- Solar panels exhibit the characteristic of toxicity if concentrations of toxic constituents are above the RCRA thresholds found in [40 CFR Part 261.24]

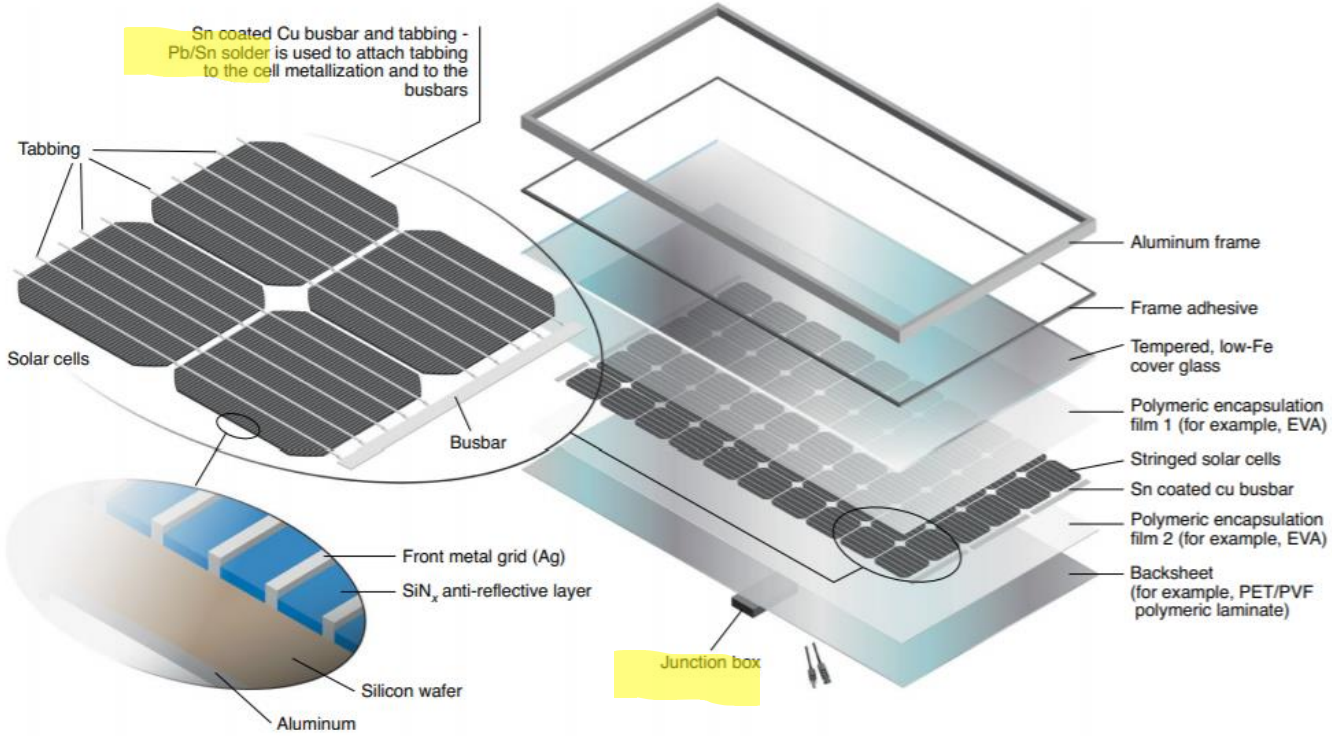


Diagram of a crystalline-silicon panel.
Source: https://www.nature.com/articles/s41560-020-0645-2.pdf

Recycling Solar Panels

- Current recycling practices can only recover the glass, aluminum, and copper.
  - About $3 of revenue per panel, but costs about $30 per panel to recycle (Dr. Meng Tao, 2021).
  - Low demand for recycled glass.
- With new technology, revenue could increase to $10 per panel
  - Chemical leaching methods can recover silver, which has the highest material value in a solar panel, and other metals.
  - However, the technology is not yet commercially available.
  - Manufacturers are also decreasing the silver content in new panels, which hurts recycling economics.

Material	Weight	Price ($/kg)	Value
Glass	13.5 kg	0.05	$0.68
Al	1.83 kg	0.84	$1.53
Cu	0.11 kg	6.79	$0.75
Total			$2.96

Material	% Recovery	Weight	Price ($/kg)	Value	% Total
Glass	100	13.5 kg	0.10	$1.35	14.1
Al	100	1.83 kg	0.84	$1.53	15.9
Polymers	0	1.18 kg		0	0
Si	90	0.56 kg	1.50	$0.93	9.7
Ag	100	6 g	818.61	$4.91	51.1
Cu	100	0.11 kg	6.79	$0.75	7.8
Pb	100	18.3 g	1.28	$0.02	0.2
Sn	100	21.9 g	4.96	$0.11	1.1
Total				$9.60	100

Source: Dr. Meng Tao, Arizona State University, Major Challenges and Opportunities in Solar Module Recycling Webinar, March 2021

Solar Panel Waste Regulation

- For hazardous waste solar panels, the hazardous waste generator regulations found at 40 CFR Part 262 apply.
- Requirements depend on the quantity of HW generated per month, and can include:
  - Obtaining an EPA ID number
  - Personnel training
  - On-site management requirements
  - Manifesting the waste
  - Sending the hazardous waste to a RCRA permitted treatment, storage, or disposal facility
- Additional information is available on the EPA Hazardous Waste Generator Regulatory Summary webpage.
- Solar panels that are recycled can also use the transfer-based exclusion (261.4(a)(24)) mentioned earlier in the presentation.

Actions on Solar Panel Waste

Source: National Renewable Energy Laboratory

- EPA Actions
  - Answering questions as they come in
    - Pointing to transfer-based exclusion
  - Upcoming: solar panel webpages
- State actions
  - California added solar panels as a state UW in January 2021.
    - Hawaii is considering adding solar panels as a state UW and held a public hearing in February 2021.
  - Washington enacted a product stewardship and takeback program for solar panels purchased after July 1, 2017.

DOE's National Renewable Energy Laboratory

- Two recent NREL papers written by Taylor L. Curtis, Heather Buchanan, Ligia Smith, and Garvin Heath are useful resources:
  - "A Circular Economy for Lithium-Ion Batteries Used in Mobile and Stationary Energy Storage: Drivers, Barriers, Enablers, and U.S. Policy Considerations." https://www.nrel.gov/docs/fy21osti/77035.pdf
  - "A Circular Economy for Solar Photovoltaic System Materials: Drivers, Barriers, Enablers, and U.S. Policy Considerations." https://www.nrel.gov/docs/fy21osti/74550.pdf

Emerging Wastes: Wind Turbines

- No current EPA action in our office in this area.
- Wind turbine blades are likely not hazardous waste, and likely to be regulated under Subtitle D of RCRA as non-hazardous solid waste. Would be subject to regulations under Subtitle D including:
  - Ban of open dumping of waste.
  - Minimum federal criteria for landfill operation, including design criteria, location restrictions, financial assurance, corrective action, and closure requirement.
- States play a lead role in implementing these regulations and may set more stringent requirements as well as having specific solid waste and recycling requirements or bans.

Source: US Department of Energy

EPA's End-of-Life Battery Team

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*Contacts for solar panel questions

The End.

Thank You!
Please respond to the Feedback Survey.