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November 19, 2021

Via Certified Mail

The Honorable Michael Regan  
Administrator  
U.S. Environmental Protection Agency  
1200 Pennsylvania Avenue, N.W.  
Mail Code 1101A  
Washington, DC 20460

Re: Petition for Rulemaking: Regulating Photovoltaic Solar Panels as Universal Waste

Dear Administrator Regan:

The Edison Electric Institute, American Clean Power Association, National Association of Manufacturers, U.S. Chamber of Commerce, American Public Power Association, Large Public Power Council, National Rural Electric Cooperative Association, Utility Solid Waste Activities Group, and Cross-Cutting Issues Group, (collectively, the “Petitioners”) submit the enclosed rulemaking petition (“Petition”) in accordance with 40 C.F.R. § 260.20, 40 C.F.R. § 260.23, and 40 C.F.R. § 273.80, requesting that the U.S. Environmental Protection Agency (“EPA”) adopt a universal waste management standard for photovoltaic solar panels (“PV Panels”) to support the transition to clean energy. Such a standard is appropriate for used PV Panels, will improve management practices for such materials, and will encourage recycling by allowing for used PV Panels to be collected and mass recycled.

The electric sector is at the forefront of the clean energy transformation and has taken the lead on reducing greenhouse gas emissions over the past decade, while keeping reliability and affordability front and center for the customers and communities they serve. This transformation is being driven by a wide range of factors, including declining costs for natural gas and renewable

energy resources, energy efficiency and demand-side management, technological improvements, customer demand for clean energy, federal and state regulations and policies, and the increasing use of distributed energy resources. With the right policies and a balance of technologies, the electric sector can find cost-effective ways to provide reliable, affordable, and clean energy. With support by manufacturers and critical labor workers, the electric sector is poised to continue leading the clean energy transformation, reducing greenhouse gas emissions, and being a part of the solution to climate change.

PV Panels that produce solar-powered, carbon-free electricity are a critical renewable technology to the clean energy transformation. As the electric sector continues to increase the deployment of solar resources, the United States must have national policies in place to enable the responsible reuse and disposal of the materials in end-of-life PV Panels, given the tremendous number of PV Panels being deployed to meet the climate challenge.

Over the next several decades, millions of tons of PV Panels are expected to be taken out of service and potentially contribute millions of metric tons of waste in the United States as both the adoption rate and the subsequent retirement rate for PV Panels continues to increase. Without more recycling options, many of these PV Panels are expected to be disposed of without the reclamation of valuable materials, including metals, contained within. The cumulative technical potential of recoverable materials in end-of-life modules by 2050 has an estimated value of \$15 billion, and these materials could be used to produce two billion new solar modules.<sup>1</sup>

The enclosed Petition is an essential first step in addressing solar panel end-of-life concerns by facilitating the development of meaningful metal reclamation and reuse activities for certain older PV Panels in a sustainable and domestic manner while also ensuring the protection of human health and the environment.<sup>2</sup> Because it facilitates the diversion of PV Panels that would otherwise qualify as hazardous waste from landfills and encourages reclamation and reuse of valuable materials, adoption of the universal standards proposed by the Petitioners aligns with the Administration's goals of supporting a sustainable climate strategy, advancing environmental justice interests, and increasing U.S. supply chain independence. By granting the Petition, EPA will provide the regulatory consistency and clarity necessary to spur and sustain expansion of PV Panel recycling options.

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<sup>1</sup> Garvin A. Heath et al., *Research and development priorities for silicon photovoltaic module recycling to support a circular economy*, 5 *Nature Energy* 502-510, (July 2020), available at <https://www.nature.com/articles/s41560-020-0645-2.epdf>

<sup>2</sup> As an example, the aerosol can universal waste program has provided benefits to communities and the environment, and a PV Panel universal waste program would provide similar benefits.

The Petition for rulemaking to add certain spent PV Panels to the universal waste program under the Resource Conservation and Recovery Act, along with the proposed regulatory language, is enclosed. If you have any questions or comments about the information presented in the enclosed Petition for rulemaking, please do not hesitate to contact Alex Bond at [abond@eei.org](mailto:abond@eei.org).

Respectfully,

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

Enclosure

# PETITION TO DESIGNATE PHOTOVOLTAIC SOLAR PANELS AS UNIVERSAL WASTE UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT

## I. Introduction

The Petitioners listed in Section II submit the following rulemaking petition (the “Petition”) in accordance with 40 C.F.R. § 260.20, 40 C.F.R. § 260.23, and 40 C.F.R. § 273.80, requesting that the U.S. Environmental Protection Agency (“EPA”) adopt a universal waste management standard for those photovoltaic solar panels (“PV Panels”) that would otherwise qualify as hazardous waste under the Resource Conservation and Recovery Act (“RCRA”).<sup>1</sup> Such a standard is appropriate for used PV Panels, will improve management practices for such materials, and will encourage recycling by allowing for used PV Panels to be collected and mass recycled.

Over the next several decades, PV Panels are expected to generate approximately 10 million metric tons of waste in the United States, as both the adoption rate and the subsequent retirement rate for PV Panels continues to increase.<sup>2</sup> Since certain PV Panels contain metals that may be present at levels that would qualify as hazardous waste, responsible management and recycling are essential to ensure the protection of the environment and avoid unnecessary landfilling.<sup>3</sup> Without more recycling options, however, many of these PV Panels are expected to be disposed of without the reclamation of valuable materials, including metals, contained within.

Regulation of used hazardous waste PV Panels and their components as universal waste under streamlined universal waste regulations is appropriate and essential. Such a designation will improve management practices by providing a clear standard to follow, and will ultimately improve the hazardous waste program by ensuring proper handling of this material, encouraging recycling and metal reclamation, and diverting waste from landfills.<sup>4</sup> Accordingly, Petitioners hereby request that EPA designate those PV Panels that would otherwise qualify as hazardous waste as universal waste under RCRA. The information required under 40 C.F.R. § 260.20 and 40 C.F.R. § 260.23 for rulemaking petitions is provided in the following sections.

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<sup>1</sup> As discussed in this Petition and reflected in the attached proposed regulatory language included as Exhibit A, not all PV Panels qualify as “hazardous waste” in the first instance. This Petition only seeks to designate as universal waste those PV Panels that would otherwise qualify as hazardous waste. See Proposed Regulation 40 C.F.R. 273.7(b) (clarifying that the universal waste designation only applies to PV Panels that would otherwise be hazardous waste); see also 40 C.F.R. § 261.24 (current regulations identifying when solid waste should be treated as hazardous based on toxicity characteristic using the Toxicity Characteristic Leachate Procedure).

<sup>2</sup> Adriana Domínguez and Roland Geyer, *Photovoltaic waste assessment of major photovoltaic installations in the United States of America*, 133 *Renewable Energy* 1188-1200, (April 2019), available at <https://www.sciencedirect.com/science/article/abs/pii/S0960148118310139?via%3Dihub>.

<sup>3</sup> Taylor Curtis et al., *Best Practices at the End of the Photovoltaic System Performance Period*, National Renewable Energy Laboratory, NREL/TP-5C00-78678, (Feb. 2021), <https://www.nrel.gov/docs/fy21osti/78678.pdf>.

<sup>4</sup> As an example, the aerosol can universal waste program has provided numerous benefits to communities and the environment, and a PV universal waste program would provide similar benefits.

**II. Petitioner Names, Addresses, and Statements of Interest - 40 C.F.R. § 260.20(b)(1) & (b)(2)**

The Petitioners supporting this petition consist of the following:

**A. Utility Solid Waste Activities Group**

Name: Utility Solid Waste Activities Group (“USWAG”)

Address:

Jim Roewer ([jroewer@eei.org](mailto:jroewer@eei.org))  
Utility Solid Waste Activities Group  
701 Pennsylvania Avenue NW  
Third Floor  
Washington, D.C. 20004

Statement of Interest: USWAG is a voluntary, non-profit, unincorporated association of over one hundred and thirty electric utilities and cooperatives, independent power producers, and national trade associations. USWAG's core mission is to support the power industry's efforts to comply with federal environmental regulations, protect the environment, and serve its customers. USWAG supports public policies, based on sound science, that are protective of human health and the environment addressing waste, toxic substances, chemical management, and transportation issues under the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Toxic Substances Control Act, the Hazardous Materials Transportation Act, and other related statutes, and other issues of interest to its members.

**B. U.S. Chamber of Commerce**

Name: U.S. Chamber of Commerce

Address:

Heath Knakmuhs ([hknakmuhs@USChamber.com](mailto:hknakmuhs@USChamber.com))  
U.S. Chamber of Commerce  
1615 H Street, NW  
Washington, DC 20062

Statement of Interest: The U.S. Chamber of Commerce is the world's largest business federation. It represents the interests of more than 3 million businesses of all sizes, sectors, and regions. The Chamber's members range from the small businesses and local chambers of commerce that line the Main Streets of America to leading industry associations and large corporations. The Chamber's members count on the U.S. Chamber to be their voice in Washington, across the country, and around the world. For more than 100 years, the Chamber has advocated for pro-business policies that help businesses create jobs and grow our economy. The Chamber is dedicated to promoting, protecting, and defending America's free enterprise system.

### **C. National Rural Electric Cooperative Association**

Name: National Rural Electric Cooperative Association (“NRECA”)

Address:

Ted Cromwell ([ted.cromwell@nreca.coop](mailto:ted.cromwell@nreca.coop))  
National Rural Electric Cooperative Association  
4301 Wilson Boulevard  
Arlington, VA 22203

Statement of Interest: NRECA is the national trade association representing nearly 900 local electric cooperatives and other rural electric utilities. America’s electric cooperatives are owned by the people that they serve and comprise a unique sector of the electric industry. From suburbs to remote farming communities, electric cooperatives power 1 in 8 Americans and serve as engines of economic development for 42 million Americans across 56 percent of the nation’s landscape.

Electric cooperatives operate at cost and without a profit incentive. NRECA’s member cooperatives include 63 generation and transmission (“G&T”) cooperatives and 832 distribution cooperatives. The G&Ts generate and transmit power to distribution cooperatives that then provide it to the end of line co-op consumer-members. Collectively, cooperative G&Ts generate and transmit power to nearly 80 percent of the distribution cooperatives in the nation. The remaining distribution cooperatives receive power directly from other generation sources within the electric utility sector. Both distribution and G&T cooperatives share an obligation to serve their members by providing safe, reliable, and affordable electric service.

### **D. National Association of Manufacturers**

Name: National Association of Manufacturers (“NAM”)

Address:

Rachel Jones ([rjones@nam.org](mailto:rjones@nam.org))  
National Association of Manufacturers  
733 10<sup>th</sup> St NW, Suite 700  
Washington, DC 20001

Statement of Interest: NAM is the largest manufacturing association in the United States, representing small and large manufacturers in every industrial sector and in all 50 states. Manufacturing employs more than 12 million people, contributes roughly \$2.35 trillion to the U.S. economy annually, has the largest economic impact of any major sector, and accounts for nearly two-thirds of private-sector research and development in the Nation. NAM is the voice of the manufacturing community and the leading advocate for a policy agenda that helps manufacturers compete in the global economy and create jobs across the Nation. NAM member companies are committed to advancing renewable energy and sustainability efforts that positively impact manufacturing and industry’s contributions to environmental protection, economic performance and the social well-being of the employees, communities, customers, and consumers they serve. NAM advocates for the benefits of adopting sustainability best practices, including through

improving resource management through waste prevention and reduction efforts first and by increasing the amount of recycling throughout their operations.

**E. Large Public Power Council**

Name: Large Public Power Council (“LPPC”)

Address:

Stephen Fotis ([scf@vnf.com](mailto:scf@vnf.com))  
Large Public Power Council  
1050 Thomas Jefferson Street N.W.  
Seventh Floor  
Washington, DC 20007

Statement of Interest: LPPC is comprised of 27 of the nation’s largest public power systems in 21 states from Washington to Florida and California to New York as well as the Commonwealth of Puerto Rico that serve 30 million Americans, about 10 percent of the U.S. population. LPPC members are locally governed and directly accountable to consumers. We are not-for-profit and committed to reliability, affordability, and environmental stewardship for the consumers and communities we serve. LPPC advocates for policies that allow public power systems to build infrastructure, invest in communities, and provide reliable service at affordable rates. LPPC member utilities own and operate more than 80,000 MW of generation and over 35,000 circuit miles of high-voltage transmission lines. Together, LPPC members control 90 percent of the public agency owned, non-federal transmission investment in the nation.

**F. Edison Electric Institute**

Name: Edison Electric Institute (“EEI”)

Address:

Alex Bond ([abond@eei.org](mailto:abond@eei.org))  
Edison Electric Institute  
701 Pennsylvania Avenue, NW  
Washington, DC 20004

Statement of Interest: EEI is the association that represents all U.S. investor-owned electric companies. Our members provide electricity for about 220 million Americans, and operate in all 50 states and the District of Columbia. As a whole, the electric power industry supports more than 7 million jobs in communities across the United States. In addition to our U.S. members, EEI has more than 60 international electric companies, with operations in more than 90 countries, as International Members, and hundreds of industry suppliers and related organizations as Associate Members.

**G. Cross-Cutting Issues Group**

Name: Cross-Cutting Issues Group (“CCIG”)

Address:

Megan Berge ([mberge@bakerbotts.com](mailto:mberge@bakerbotts.com))  
Baker Botts  
700 K St., NW  
Washington, DC 20001 USA

Statement of Interest: CCIG is a group of electric-generating companies with a diverse portfolio of generating assets, including solar PV, serving electric customers across the U.S. CCIG members are subject to and comply with a wide range of regulatory requirements established by EPA, including regulations and policies related to waste management under the Resource Conservation and Recovery Act (“RCRA”). CCIG previously submitted comments supporting EPA’s proposal to add hazardous waste aerosol cans to the RCRA universal waste program.<sup>5</sup>

Many CCIG members have deployed PV Panels in response to customer, state, and investor interest in clean energy and to achieve corporate carbon reduction goals. As part of the further development of renewable projects to lower CO<sub>2</sub> emissions in the power generation sector, CCIG members continue to invest and develop new solar projects.<sup>6,7</sup> In addition, CCIG members are part of the communities they serve and have an interest in public policies that will reduce waste sent to landfills, promote recycling, and ensure uniform compliance with RCRA.

#### **H. American Public Power Association**

Name: American Public Power Association

Address:

Carolyn Slaughter ([cslaughter@publicpower.org](mailto:cslaughter@publicpower.org))  
American Public Power Association  
2451 Crystal Drive, Suite 1000  
Arlington, VA 22202

Statement of Interest: The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. We represent public power before the federal government to protect the interests of the more than 49 million people that public power utilities serve, and the 96,000 people they employ. Our association advocates and advises on electricity policy, technology, trends, training, and

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<sup>5</sup> CCIG Comments, Docket No. EPA-HQ-OLEM-2017-0463-0082.

<sup>6</sup> For example, Florida Power and Light announced on January 16, 2019, its ‘30-by-30’ plan to install 30 million solar panels by 2030 in the state of Florida. Florida Power and Light, *FPL announces groundbreaking ‘30-by-30’ plan to install more than 30 million solar panels by 2030, make Florida a world leader in solar energy*, (Jan. 16, 2019), <http://newsroom.fpl.com/2019-01-16-FPL-announces-groundbreaking-30-by-30-plan-to-install-more-than-30-million-solar-panels-by-2030-make-Florida-a-world-leader-in-solar-energy>.

<sup>7</sup> As another example, Salt River Project (“SRP”) plans to more than double its solar generation commitment by adding a total of 2,025 megawatts to its power system by 2025. Salt River Project, *SRP to more than Double its Utility Scale Solar to 2,025 Megawatts by 2025*, (May 3, 2021), <https://media.srpnet.com/srp-to-more-than-double-its-utility-scale-solar-to-2025-megawatts-by-2025/>. SRP currently has approximately 280 megawatts (alternating current) of customer-generated solar, with over 700 industrial and commercial customers (banks, school districts, retail stores, etc.) and 28,000 residential customers.



operations. Our members strengthen their communities by providing superior service, engaging citizens, and instilling pride in community-owned power.

## **I. American Clean Power Association**

Name: American Clean Power Association (“ACP”)

Address:

Gene Grace ([ggrace@cleanpower.org](mailto:ggrace@cleanpower.org)) and Tom Vinson ([tvinson@cleanpower.org](mailto:tvinson@cleanpower.org))  
American Clean Power Association  
1501 M St. NW, Suite 900  
Washington, DC 20005

Statement of Interest: ACP is the national trade association representing the renewable energy industry in the United States, bringing together hundreds of member companies and a national workforce located across all 50 states with a common interest in encouraging the deployment and expansion of renewable energy resources in the United States. By uniting the power of wind (both land-based and offshore), solar, storage, and transmission companies and their allied industries, we are enabling the transformation of the U.S. power grid to a low-cost, reliable, and renewable power system. Additional information is available at <http://www.cleanpower.org>.

## **III. Description of Proposed Action – 40 C.F.R. § 260.20(b)(3)**

Petitioners request that EPA promptly initiate a rulemaking to add spent PV Panels that would otherwise qualify as hazardous waste to the universal waste program under the RCRA regulations. Under this rule, used PV Panels, like other hazardous wastes designated as universal waste, would be managed in a streamlined manner that would encourage the environmentally sound collection and proper management of the material within the waste management and recycling system. Petitioners have provided a draft of the proposed language for a PV Panels Universal Waste Category and Management Standards as Exhibit A.

## **IV. Statement of Need and Justification – 40 C.F.R. § 260.20(b)(4)**

EPA’s RCRA regulations streamline hazardous waste management standards for categories of hazardous waste considered “universal wastes” that are commonly generated and that pose a lower risk to people and the environment than other hazardous wastes.<sup>8</sup> This streamlining of the RCRA regulations, which alleviates certain recordkeeping burdens and allows for longer waste accumulation times, was established by EPA to ensure that “certain post-user items that are hazardous wastes” are “managed safely, without unnecessary regulation.”<sup>9</sup> Currently, EPA classifies five types of waste as universal waste: (1) batteries, (2) pesticides, (3) mercury-containing equipment, (4) mercury lamps, and (5) aerosol cans.<sup>10</sup> When deciding whether to add

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<sup>8</sup> See 40 C.F.R. § 273.

<sup>9</sup> 58 Fed. Reg. 8,102, 8,102 (Feb. 11, 1993).

<sup>10</sup> See 40 C.F.R. § 273.2-273.6. On December 9, 2019, EPA released a final rule adding aerosol cans to the universal waste program. Increasing Recycling: Adding Aerosol Cans to the Universal Waste Regulations, 84 Fed. Reg. 67,202 (Dec. 9, 2019).

a new type of waste as universal waste, EPA considers whether: (1) it is appropriate for the waste or category of waste; (2) it would improve management practices for the waste or category of waste; and (3) it would improve the implementation of the hazardous waste program.<sup>11</sup>

In evaluating these elements, EPA considers as many of the following factors as are appropriate for the particular waste or waste category:

- a) The waste is hazardous.
- b) The waste is commonly generated (not specific to an industry).
- c) The waste is generated by a large number of generators (over 1,000 nationally).
- d) Systems used for collecting the waste (e.g., packaging, marking, labeling) would ensure close stewardship.
- e) The risk posed during accumulation and transport is relatively low compared to other hazardous wastes, and the proposed management standards would protect human health and the environment during accumulation and transport.
- f) Regulation as universal waste will increase the likelihood that the waste will be diverted from non-hazardous waste management systems.
- g) Regulation as universal waste will improve implementation of and compliance with hazardous waste regulations.
- h) Such other factors as may be appropriate.<sup>12</sup>

In 2020, the California Department of Toxic Substances Control (“DTSC”) analyzed PV Panels under these same criteria<sup>13</sup> and finalized a rule regulating discarded hazardous PV Panels as universal waste.<sup>14</sup> Additionally, the Hawaii Department of Health recently released a proposed rule that would classify discarded PV Panels as universal waste, and the North Carolina Department of Environmental Quality expects to do the same this year.<sup>15</sup> Below is an explanation

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<sup>11</sup> 40 C.F.R. §§ 260.23(b), 273.80(b).

<sup>12</sup> *Id.* § 273.81(a)-(h).

<sup>13</sup> Compare Cal. Code Regs., tit. 22, § 66260.23 with 40 C.F.R. § 273.81.

<sup>14</sup> Department of Toxic Substances Control, Photovoltaic modules (PV modules) – Universal Waste Management, Final Regulation Text (Apr., 2020), available at [https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/10/C.-RegTextFinal-PVM-09252020\\_no-watermark-PV-Regulations.pdf](https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/10/C.-RegTextFinal-PVM-09252020_no-watermark-PV-Regulations.pdf).

<sup>15</sup> Department of Health, Solid & Hazardous Waste Branch, *HW Proposed Rule Changes*, <https://health.hawaii.gov/shwb/hw-rules-update/> (last visited Mar. 24, 2021); Department of Environmental Quality and Environmental Management Commission, Final Report on the Activities Conducted to Establish a Regulatory Program for the Management and Decommissioning of Renewable Energy Equipment, ES-1 (Jan. 1, 2021), available at <https://files.nc.gov/ncdeq/Environmental%20Management%20Commission/EMC%20Meetings/2021/jan2021/attachments/AttachA-21-05-H329---FINAL-REPORT-Ellen--1-.pdf>.

of why regulating discarded PV Panels as universal waste meets each of the specified regulatory factors above, and additional factors important to EPA's consideration.

First, **PV Panels can be hazardous**. For a waste to be hazardous, it must either be listed in subpart D of 40 C.F.R. part 261, or a portion of the waste stream must exhibit one or more characteristics of hazardous waste identified in subpart C of 40 C.F.R. part 261.<sup>16</sup> The composition of PV Panels involves the use of metals, sometimes including cadmium, lead, and/or silver, as active elements of the unit.<sup>17</sup> Composition and content vary by manufacturer and technology, but there is the potential for used PV Panels to exceed the criteria for one or more of these constituents and be classified as a Toxicity Characteristic waste, due to metallic content with cadmium (D006), lead (D008), or silver (D011). It should be noted that due to design and construction, not all PV Panels manufactured with one or more of these constituents will exceed the applicable toxic characteristic leaching procedure ("TCLP") limit when tested for waste characterization. However, since certain currently installed PV Panels may be deemed hazardous, this factor is satisfied.

Second, **PV Panels are commonly used**. For this factor, EPA considers whether the waste is commonly generated by a wide variety of types of establishments.<sup>18</sup> PV Panels are in general use in the residential, commercial, governmental, industrial, manufacturing, and utility sectors. Applications include the use of PV Panels as rooftop solar, municipal charging stations, small commercial installations for offices and businesses, private industry installations, and utility generation installations. All generator classes are represented because of their widespread use: Very Small Quantity Generators, Small Quantity Generators, and Large Quantity Generators. Overall, PV Panels are widely and commonly used by a variety of sectors, and use is not limited to a specific industry.

Third, **PV Panel waste is generated by a large number of generators**. For this factor, EPA considers whether the waste is "generated by a large number of generators (e.g., more than 1,000 nationally) and is frequently generated in relatively small quantities by each generator."<sup>19</sup> In May 2019, Wood Mackenzie Power & Renewables and the Solar Energy Industries Association ("SEIA") announced the United States has surpassed 2 million solar installations.<sup>20</sup> The forecast predicts that the country will surpass 3 million total installations in 2021 and 4 million in 2023, based on the current growth curve.<sup>21</sup> Furthermore, the Biden administration's goal of 100 percent

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<sup>16</sup> 40 C.F.R. § 273.81(a). However, note that PV Panels are not, and nor should they be, a listed hazardous waste. PV Panels generally do not exhibit any hazardous waste characteristic other than a toxicity characteristic.

<sup>17</sup> In its proposed rule, DTSC noted that PV Panels "are likely to exhibit the characteristic of toxicity due to the presence of toxic heavy metals (e.g., lead, cadmium, copper, and selenium) and thus are classified as hazardous waste when discarded." Department of Toxic Substances Control, Initial Statement of Reasons: Photovoltaic (PV) Modules – Universal Waste Management R-2017-04, 6 (Jan. 8, 2019), available at <https://dtsc.ca.gov/wp-content/uploads/sites/31/2019/11/Accessible-ISOR-Final-PVM-1.pdf>.

<sup>18</sup> 40 C.F.R. § 273.81(b).

<sup>19</sup> *Id.* at § 273.81(c).

<sup>20</sup> Solar Energy Industries Association, *United States Surpasses 2 Million Solar Installations*, (May 9, 2019), <https://www.seia.org/news/united-states-surpasses-2-million-solar-installations>.

<sup>21</sup> *Id.*

clean energy electricity by 2035 would require annual PV Panel installations to grow from 20 gigawatts in 2020 to more than 80 gigawatts by 2030.<sup>22</sup> Additionally, based on U.S. Census Bureau statistics published in 2018 in the “2014-2015 SUSB Employment Change Data Tables,” DTSC estimated in its rulemaking that the number of PV Panel waste generators will only continue to grow, increasing at a rate of 1.7 percent per year.<sup>23</sup>

PV Panels use ranges from small one- or two-panel portable units, such as those used during highway construction, to large utility-scale projects that may contain more than a million panels. Within this range are small- to moderate-sized systems installed for residential rooftop solar, solar parking canopies, commercial rooftop solar, solar for school and government buildings, community solar, and solar for industrial facilities.

Due to the inherent durability by the design of construction and relatively long service life, few panels are generated at any location under regular use and conditions. The typical generation rates are fewer than 5 per month, and only a certain percentage of the overall amount of PV Panels disposed of nationwide would be hazardous waste. A site or geographical area may generate a larger number of damaged or failed panels as the result of a catastrophic event such as a tornado or fire, but these events are rare.

As the number of installations increases across all generator types, the total volume of waste panels removed will continue to increase. PV Panels have an average lifetime of 30 years.<sup>24</sup> When existing acres of PV Panel fields begin to reach the end of their useful lifetime, this will result in a significant increase in the volume of waste generated, as shown in Figure 1 below. As this quantity increases over time, the need for an effective management plan will become more critical. By 2030, cumulative discarded PV Panel waste is predicted to result in up to 8 million metric tons of waste, and by 2050, this number is expected to reach up to 78 million metric tons.<sup>25</sup> For context, the PV Panel waste added annually by 2050 could exceed 10 percent of the record global e-waste added in 2014.<sup>26</sup> Overall, PV Panel waste is being generated in increasingly large amounts by a large number of entities.

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<sup>22</sup> Solar Energy Industries Association, *Solar Industry Research Data*, <https://www.seia.org/solar-industry-research-data> (last visited May 10, 2021).

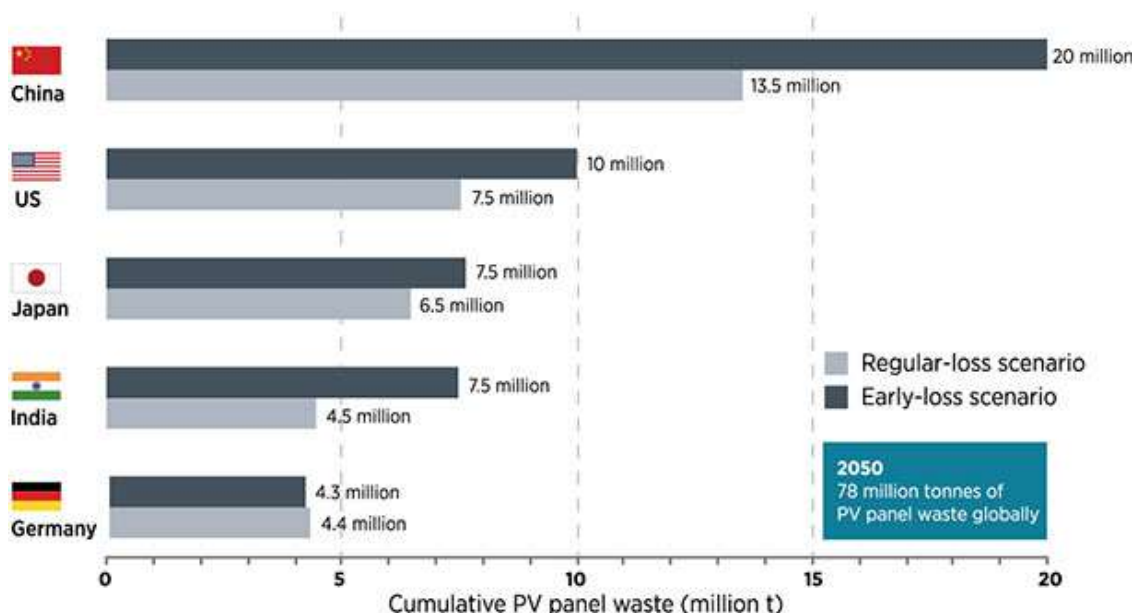
<sup>23</sup> Department of Toxic Substances Control, Final Statement of Reasons: Photovoltaic Modules (PV Modules) – Universal Waste Management, 4 (Apr. 2020), available at <https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/10/L-FSOR-Final-03.09.2020-PV-Regulations.pdf>.

<sup>24</sup> International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems, *End-of-Life Management: Solar Photovoltaic Panels*, 11 (2016), available for download at <https://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels>.

<sup>25</sup> *Id.* at 13.

<sup>26</sup> *Id.* at 11.

**Figure 1. Cumulative Waste Volumes of PV Panels by 2050<sup>27</sup>**



Fourth, **the systems used for collecting PV Panel waste would ensure close stewardship.** For this factor, EPA considers whether systems used for collecting the waste, including packaging, marking, and labeling practices, would “ensure close stewardship of the waste.”<sup>28</sup> Notably, PV Panels removed are usually sufficiently intact and can be stacked on pallets or placed in boxes in a manner that preserves the integrity of the panel. The panels are robust enough to avoid breakage under these circumstances. Panels that have been broken can be placed in drums, roll-off containers, Gaylord boxes, or similar containers rated to manage broken glass for transport. As offered in the sample standard, attached as Exhibit A, each PV Panel, or each container holding PV Panels, could be labeled or marked clearly with any of the following phrases: “Universal Waste Photovoltaic Module(s),” “Waste Photovoltaic Module(s),” or “Used Photovoltaic Module(s).” The phrasing would clearly identify the material during storage prior to disposal. Thus, the systems used for collecting PV Panel waste would ensure close stewardship.

Fifth, **the risk posed during accumulation and transport of PV Panels is relatively low.** For this factor, EPA considers whether the risk posed during accumulation and transport of the waste is relatively low compared with analogous risks posed by other hazardous wastes and whether the proposed management standards would protect human health and the environment during accumulation and transport.<sup>29</sup> Regarding the risk posed during accumulation and transport, DTSC previously concluded that hazardous waste PV Panels are “low-risk hazardous waste due

<sup>27</sup> International Renewable Energy Agency, End-of-Life Management: Solar Photovoltaic Panels, <https://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels>.

<sup>28</sup> 40 C.F.R. § 273.81(d).

<sup>29</sup> 40 C.F.R. § 273.81(e).

to their manufacturing design.”<sup>30</sup> They are designed to withstand environmental conditions to last up to thirty years, so they have built-in attributes of durability and structural integrity. Specifically, they are designed to have any toxic materials encased in the glass or laminate. So, even when broken, there is limited risk of exposure to the materials contained inside of the module. Furthermore, there is no liquid, gas, vapor, or powder in the panel construction. The panel is similar to other e-waste and may actually present less risk due to the encapsulation of the components in the design. Overall, there is relatively low risk posed during the accumulation and transport of PV Panels.

**Sixth, regulating PV Panels as universal waste will likely divert them from being disposed of incorrectly and will encourage reclamation.** For this factor, EPA considers whether regulation of the given waste as universal waste will increase the likelihood that the waste will be diverted from non-hazardous waste management systems (e.g., the municipal waste stream, non-hazardous industrial or commercial waste stream, or municipal sewer or stormwater systems).<sup>31</sup>

As with aerosol cans, a universal waste classification for used PV Panels would increase both the ability to recycle and the economic incentive to do so—thereby reducing the need to dispose of PV panels. EPA estimates that 75 percent of a crystalline-silicon PV Panel by weight is generally recyclable.<sup>32</sup> Nevertheless, recycling and reclamation options are currently very limited, and those that do exist may only be available out-of-state. A universal waste designation will allow for longer term accumulation of used PV Panels (up to a year) so that these panels can be recycled in bulk, providing economic incentives for more users to recycle panels and for more recyclers to enter the market. A *federal* universal waste designation that states can adopt is especially important in this regard because, while recycling options remain limited, users may be forced to recycle out-of-state.<sup>33</sup> Uniformity of regulations across states is therefore important to continue to encourage recycling and diversion from landfills.

EPA and states already have recognized the benefits of a universal waste designation with respect to recycling. For instance, DTSC anticipates an increase in PV Panel recycling under California’s universal waste regulations, thereby reducing the amount of waste PV Panels disposed of as hazardous waste.<sup>34</sup> Similarly, other universal waste designations, like those for aerosol cans, have likewise promoted recycling.<sup>35</sup>

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<sup>30</sup> Department of Toxic Substances Control, Initial Statement of Reasons: Photovoltaic (PV) Modules – Universal Waste Management, at 8.

<sup>31</sup> 40 C.F.R. § 273.81(f).

<sup>32</sup> <https://www.epa.gov/hw/solar-panel-recycling>

<sup>33</sup> The website SolarRecycle.org has only identified 15 states that have recycling available for solar panels currently, further underscoring the need to promote recycling on a uniform basis. See <https://www.solarrecycle.org/> (last visited Nov. 2, 2021).

<sup>34</sup> Department of Toxic Substances Control, Form 399 – Attachment to Economic and Fiscal Impact Statement: Photovoltaic Modules (PV Modules) – Universal Waste Management, at 14.

<sup>35</sup> See, e.g., 84 Fed. Reg. 67,202, at 67,208 (“One of the streamlined provisions of the Universal Waste Rule allows consolidation of aerosol cans at central locations, which makes it easier for smaller generators to arrange for hazardous waste recycling or disposal of these materials when they are generated. Because the streamlined structure of the universal waste standards makes aerosol can collection programs more economical, hazardous waste aerosol cans that

A universal waste designation for discarded PV Panels will also encourage recycling by allowing more recycling facilities to enter the market. First, the longer accumulation time allowed for universal wastes will encourage the bulk recycling of PV Panels, making them more cost-effective to transport, which will likely lead to an increased demand for recycling facilities. Second, universal wastes pose less of a regulatory burden for recycling facilities to manage than hazardous wastes. These two factors will encourage more recycling facilities to begin recycling PV Panels, thereby increasing the recycling options for this important product category.

Further, a universal waste designation will likely divert PV Panels from being disposed of incorrectly by reducing compliance costs. For example, in its final economic analysis, DTSC estimated annual cost savings of \$6,991,151 for PV Panel waste generators in California, because the generators would not need to use a manifest or fulfill certain transportation requirements when shipping the waste to a universal waste handler.<sup>36</sup> Similarly, DTSC estimated annual cost savings of \$10,740,164 for universal waste handlers, resulting in total annual net savings of \$17,973,273 for universal waste generators, handlers, and disposal facilities.<sup>37</sup>

**Seventh, management of PV Panels under the universal waste program will improve implementation and compliance.** For this factor, EPA considers whether regulation of the waste as universal waste “will improve implementation of and compliance with the hazardous waste regulatory program.”<sup>38</sup> Management of used PV Panels as universal waste could improve the regulatory program and the intent of the standards. Currently, as few as three to four PV Panels generated in a month could exceed the 220-pound threshold to be qualified as a Small Quantity Generator, requiring disposal within 180 days. In the case of a catastrophic event, this timing is reduced further to a 90-day storage limitation. Large Quantity Generators are already subject to a 90-day limitation. Since the availability of recycling options is limited due to the small volumes generated in a geographical area, most generators (Small Quantity and Large Quantity) have little choice but to dispose of the panels in properly permitted landfills.

In contrast, if EPA classified used PV Panels as universal waste, then such waste generators would have additional time to dispose of or recycle PV Panels. As a result, they could safely accumulate sufficient quantities to support additional options for establishing a viable recycling market. Affording universal waste generators the one-year storage limit provides the needed time to identify, select, negotiate, and arrange for management with available recycling facilities for the larger quantities of PV Panels.

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might otherwise be sent to a municipal landfill under a VSQG or household hazardous waste exemption would be more easily collected and consolidated for hazardous waste disposal by those who are interested in managing it this way.”).

<sup>36</sup> Department of Toxic Substances Control, Form 399 – Attachment to Economic and Fiscal Impact Statement: Photovoltaic Modules (PV Modules) – Universal Waste Management, 11-14 (2020), *available at* [https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/11/remediated\\_PV-Mods-399-K2.-Attachment-Form-6.26.2020\\_v04-002.pdf](https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/11/remediated_PV-Mods-399-K2.-Attachment-Form-6.26.2020_v04-002.pdf).

<sup>37</sup> *Id.*

<sup>38</sup> 40 C.F.R. § 273.81(g).

Finally, several additional factors warrant designation of used PV panels as universal waste:

- **Adoption by states:** In its rule classifying aerosol cans as a universal waste, EPA considered state designations of aerosol cans as universal waste as an additional factor justifying the Agency's decision.<sup>39</sup> Likewise, EPA should consider here that multiple states either have already adopted or are moving in the direction of adopting universal waste designations for PV Panels. In 2020, the California DTSC finalized a rule regulating discarded hazardous PV Panels as universal waste, becoming the first state to do so.<sup>40</sup> Additionally, the Hawaii Department of Health has released a proposed rule that would classify discarded PV Panels as universal waste, and the North Carolina Department of Environmental Quality expects to do the same this year.<sup>41</sup>
- **Recovery of metals and other materials to increase domestic supply chain resiliency:** Designating discarded PV Panels as universal waste would increase their recycling, making it more feasible to recover precious metals, such as silver, silicon, tellurium, and indium, among other valuable materials.<sup>42</sup> By 2030, the value of raw materials recoverable from PV Panels could yield a cumulative value of \$450 million (in 2016 dollars), and by 2050, the cumulative recoverable value of such materials could exceed \$15 billion.<sup>43</sup> Such recycling would allow the United States to increase its domestic supply of these metals crucial for future renewable energy expansion. In 2018, the United States relied on foreign

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<sup>39</sup> Increasing Recycling: Adding Aerosol Cans to the Universal Waste Regulations, 84 Fed. Reg. 67,202 (Dec. 9, 2019).

<sup>40</sup> Department of Toxic Substances Control, Photovoltaic modules (PV modules) – Universal Waste Management, Final Regulation Text (Apr., 2020), available at [https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/10/C-RegTextFinal-PVM-09252020\\_no-watermark-PV-Regulations.pdf](https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/10/C-RegTextFinal-PVM-09252020_no-watermark-PV-Regulations.pdf).

<sup>41</sup> Department of Health, Solid & Hazardous Waste Branch, HW Proposed Rule Changes, <https://health.hawaii.gov/shwb/hw-rules-update/> (last visited Mar. 24, 2021); Department of Environmental Quality and Environmental Management Commission, Final Report on the Activities Conducted to Establish a Regulatory Program for the Management and Decommissioning of Renewable Energy Equipment, ES-1 (Jan. 1, 2021), available at <https://files.nc.gov/ncdeq/Environmental%20Management%20Commission/EMC%20Meetings/2021/jan2021/attachments/AttachA-21-05-H329---FINAL-REPORT-Ellen--1-.pdf>.

<sup>42</sup> See, e.g., Fulvio Ardenete et al., *Resource efficient recovery of critical and precious metals from waste silicon PV panel recycling*, 91 WASTE MGMT., 156-167 (2019), <https://reader.elsevier.com/reader/sd/pii/S0956053X19302909?token=6447F94041BD0273C109605D03273A3773D24C79280A4D321A4BC254AB768ACDA27FD1C27D29309C8EA556ECA3CC7FD5&originRegion=us-east-1&originCreation=20210417022355>; Garvin A. Heath et al., *Research and development priorities for silicon photovoltaic module recycling to support a circular economy*, 5 Nature Energy, 502-510 (2020), [https://www.nature.com/articles/s41560-020-0645-2.epdf?sharing\\_token=gTbOszbDSFo3DPHaqB2oKtRgN0jAjWel9jnR3ZoTv0OtL9QEzcgFMYa45OUzo4NruhWqFy6wgWcztdDwim4XS3hCVOCBhp4d3QDIeKJkRd1qE3jMWfn99b100TnsqoqOjZXZdVAs0r5jaR6vhHiEI\\_Yr8DM9BCYUFb15u73ruAc%3D](https://www.nature.com/articles/s41560-020-0645-2.epdf?sharing_token=gTbOszbDSFo3DPHaqB2oKtRgN0jAjWel9jnR3ZoTv0OtL9QEzcgFMYa45OUzo4NruhWqFy6wgWcztdDwim4XS3hCVOCBhp4d3QDIeKJkRd1qE3jMWfn99b100TnsqoqOjZXZdVAs0r5jaR6vhHiEI_Yr8DM9BCYUFb15u73ruAc%3D).

<sup>43</sup> International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems, End-of-Life Management: Solar Photovoltaic Panels, at 13.



sources for 100 percent of its indium and for more than 75 percent of its tellurium.<sup>44</sup> The U.S. Department of the Interior has deemed such metals “vital to the Nation’s security and economic prosperity” while noting that U.S. dependency on foreign sources for these metals “creates a strategic vulnerability for both its economy and military to adverse foreign government action, natural disaster, and other events that can disrupt supply of these key minerals.”<sup>45</sup> Additionally, President Biden stated in his Executive Order on America’s Supply Chains, “it is the policy of my Administration to strengthen the resilience of America’s supply chains.”<sup>46</sup> Thus, designating PV Panels as universal waste stands out as a significant step that EPA can take in making American supply chains more resilient in the future.

- **Reducing landfill disposal:** Landfills and hazardous waste facilities can frequently be sited in disadvantaged communities in the United States.<sup>47</sup> Designating discarded PV Panels as universal waste therefore has the potential to reduce greatly the disposal of hazardous materials in overburdened and underserved communities. A universal waste designation promotes recycling by allowing the electric sector to store PV Panels that have been taken out-of-service for up to one year, rather than just 90 days,<sup>48</sup> which makes bulk collection of the panels for recycling more feasible, thereby decreasing the number of PV Panels disposed and reducing costs to customers from landfilling. Consideration of such benefits aligns with President Biden’s Executive Order on Tackling the Climate Crisis at Home and Abroad,<sup>49</sup> as well as EPA’s recent directive to staff to “infuse equity and environmental justice principles and priorities into all EPA practices, policies, and programs.”<sup>50</sup>

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<sup>44</sup> U.S. Geological Survey, *Critical Mineral Commodities in Renewable Energy*, <https://www.usgs.gov/media/images/critical-mineral-commodities-renewable-energy> (last visited Apr. 16, 2021).

<sup>45</sup> Final List of Critical Minerals 2018, 83 Fed. Reg. 23,295 (May 18, 2018).

<sup>46</sup> America’s Supply Chains, Exec. Order 14017 (Feb. 24, 2021).

<sup>47</sup> See generally NAACP Environmental and Climate Justice Program, *Our Communities, Our Power*, 409 (2019), <https://www.urbanwaterslearningnetwork.org/wp-content/uploads/2019/06/Our-Communities-Our-Power-TOOLKIT.pdf>; Robert D. Bullard et al, *Toxic Wastes and Race at Twenty 1987-2007: A Report Prepared for the United Church of Christ Justice & Witness Ministries*, x-xii, (Mar. 2007), <https://www.ucc.org/wp-content/uploads/2021/03/toxic-wastes-and-race-at-twenty-1987-2007.pdf>; EPA, *Environmental Equity: Reducing Risk for All Communities*, 7-9, (June 1992), [https://www.epa.gov/sites/production/files/2015-02/documents/reducing\\_risk\\_com\\_vol1.pdf](https://www.epa.gov/sites/production/files/2015-02/documents/reducing_risk_com_vol1.pdf) (referencing multiple studies finding that waste sites disproportionately affect minority communities).

<sup>48</sup> Compare 40 C.F.R. §§ 273.15(a), 273.35(a) with 40 C.F.R. § 262.17(a).

<sup>49</sup> Tackling the Climate Crisis at Home and Abroad, Exec. Order No. 14008 (Jan. 27, 2021) (“Agencies shall make achieving environmental justice part of their missions by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.”).

<sup>50</sup> Email from EPA Administrator Michael S. Regan to EPA Staff, (Apr. 7, 2021), [https://www.eenews.net/assets/2021/04/07/document\\_gw\\_05.pdf](https://www.eenews.net/assets/2021/04/07/document_gw_05.pdf).

## **V. Conclusion**

We appreciate EPA's consideration of this petition and ask that EPA act on it swiftly so that the promise of solar technology is not limited by counter-productive regulatory requirements. Petitioners have provided a draft of the proposed language for a PV Panels universal waste category and management standards as Exhibit A.

Respectfully submitted,

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

## EXHIBIT A

### **Part 260 – HAZARDOUS WASTE MANAGEMENT SYSTEM: GENERAL**

#### **Subpart B – Definitions**

##### **§260.10 Definitions**

Photovoltaic cell means a specialized semiconductor diode designed to convert solar radiation into electrical energy. Photovoltaic cells are individual cells that are not electrically connected or an integral part of photovoltaic modules that are electrically connected. Photovoltaic cells are also commonly referred to as solar cells. Photovoltaic cells are managed as photovoltaic modules.

Photovoltaic module means a device consisting of or containing one or more electrically connected photovoltaic cells that are designed to convert solar radiation into electrical energy. Photovoltaic module includes integrated components that cannot be separated without breaking the photovoltaic module glass. Examples of integrated components include, but not limited to, protective glass, conductive metal contact, metal framing the photovoltaic cells, housing or pocket holding the photovoltaic cells/modules, and top and back layer. Photovoltaic modules are composed of, but are not limited to, monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, copper indium gallium selenide, and gallium indium phosphide/gallium arsenide/gallium, and perovskite. Photovoltaic cells that are not electrically connected are managed as photovoltaic modules.

Photovoltaic panel see photovoltaic module

Universal waste means any of the following hazardous wastes that are managed under the universal waste requirements of part 273 of this chapter:

\* \* \* \*

(6) Photovoltaic cells or modules as described in § 273.7 of this chapter.

### **PART 261 – IDENTIFICATION AND LISTING OF HAZARDOUS WASTE**

#### **Subpart A – General**

##### **§261.9 Requirements for universal waste**

\* \* \* \*

(f) Photovoltaic cells or modules as described in § 273.7 of this chapter.

### **PART 264 – STANDARDS FOR OWNERS OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITIES**

#### **Subpart A - General**

##### **§ 264.1 Purpose, scope and applicability.**

\* \* \* \*

**(g) \* \* \***

**(11) \* \* \***

(vi) Photovoltaic cells or modules as described in § 273.7 of this chapter.

### **PART 265 – INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES**

**Subpart A – General**

**§ 265.1 Purpose, scope and applicability.**

\* \* \* \*

(c) \* \* \*

(14) \* \* \*

(vi) Photovoltaic cells or modules as described in § 273.7 of this chapter.

**PART 268- LAND DISPOSAL RESTRCITIONS**

**Subpart A – General**

**§ 268.1 Purpose, scope and applicability.**

\* \* \* \*

(f) \* \* \*

(6) Photovoltaic cells or modules as described in § 273.7 of this chapter.

**PART 270 – EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM**

**Subpart A – General**

**§ 270.1 Purpose and scope of these regulations.**

\* \* \* \*

(c) \* \* \*

(2) \* \* \*

(viii) \* \* \*

(F) Photovoltaic cells or modules as described in § 273.7 of this chapter.

**PART 273 – STANDARDS FOR UNIVERSAL WASTE MANAGEMENT**

**Subpart A – General**

**§ 273.1 Scope**

(a) This part establishes requirements for managing the following:

\*\*\*

(6) Photovoltaic cells or modules as described in 273.7 of this chapter.

**§ 273.7 Applicability – Photovoltaic Modules**

(a) Photovoltaic modules covered under this part 273. The requirements of this part apply to persons managing photovoltaic modules, as described in § 273.9, except those listed in paragraph (b) of this section.

(b) Photovoltaic modules not covered under this part 273. The requirements of this part do not apply to persons managing the following photovoltaic modules:

(1) Photovoltaic modules that are not yet a waste under part 261 of this chapter. Paragraph (c) of this section describes when a photovoltaic module becomes a waste; and

(2) Photovoltaic modules that are not hazardous waste. A photovoltaic module is a hazardous waste if the photovoltaic module exhibits one or more of the characteristics identified in part 261, subpart C of this chapter.

(c) Generation of waste photovoltaic modules.

(1) A used photovoltaic module becomes a waste on the date it is discarded.

(2) An unused photovoltaic module becomes a waste on the date the handler decides to discard it.

**§ 273.9 Definitions.**

*Large Quantity Handler of Universal Waste* means a universal waste handler (as defined in this section) who accumulates 5,000 kilograms or more total of universal waste (batteries, pesticides, mercury-containing equipment, lamps, ~~or~~ aerosol cans, or photovoltaic modules, calculated collectively) at any time. This designation as a large quantity handler of universal waste is retained through the end of the calendar year in which the 5,000-kilogram limit is met or exceeded.

\* \* \* \* \*

*Photovoltaic cell* means a specialized semiconductor diode designed to convert solar radiation into electrical energy. Photovoltaic cells are individual cells that are not electrically connected or an integral part of photovoltaic modules that are electrically connected. Photovoltaic cells are also commonly referred to as solar cells. Photovoltaic cells are managed as photovoltaic modules.

*Photovoltaic module* means a device consisting of or containing one or more electrically connected photovoltaic cells that are designed to convert solar radiation into electrical energy. Photovoltaic module includes integrated components that cannot be separated without breaking the photovoltaic module glass. Examples of integrated components include, but not limited to, protective glass, conductive metal contact, metal framing the photovoltaic cells, housing or pocket holding the photovoltaic cells/modules, and top and back layer. Photovoltaic modules are composed of, but are not limited to, monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, copper indium gallium selenide, and gallium indium phosphide/gallium arsenide/gallium, and perovskite. Photovoltaic cells that are not electrically connected are managed as photovoltaic modules.

*Small Quantity Handler of Universal Waste* means a universal waste handler (as defined in this section) who does not accumulate 5,000 kilograms or more of universal waste (batteries, pesticides, mercury-containing equipment, lamps, ~~or~~ aerosol cans, or photovoltaic modules, calculated collectively) at any time.

\* \* \* \* \*

*Universal Waste* means any of the following hazardous wastes that are subject to the universal waste requirements of this part 273:

\* \* \* \* \*

(6) Photovoltaic cells or modules as described in § 273.7

*Universal Waste Handler:*

\* \* \* \* \*

(2) Does not mean:

(i) A person who treats (except under the provisions of 40 CFR 273.13(a) or (c), or 40 CFR 273.33(a) or (c)), disposes of, or recycles (except under the provisions of 40 CFR 273.13(e) or 40 CFR 273.33(e)) universal waste; or 40 CFR 273.13(f) or 40 CFR 273.33(f).

\* \* \* \* \*

**Subpart B – Standards for Small Quantity Handlers of Universal Waste**  
**§ 273.13 Waste Management.**

(f) Photovoltaic Modules. A small quantity handler of universal waste must manage universal waste photovoltaic modules or cells in a way that prevents releases of any universal waste or component of universal waste to the environment as follows:

(1) Universal waste PV module stored in a manner that prevents breakage and release of any constituent of a PV module to the environment. If a container or package is used, such a container or package shall prevent breakage, leakage, spillage, or damage that could cause leakage to the environment under reasonably foreseeable conditions.

(i) Intact PV modules that are managed in a manner (such as palletizing or banding) that prevents breakage of the PV modules and release of constituents of the PV modules to the environment under reasonably foreseeable conditions shall be deemed to comply with subsection (f)(1) of this section.

(ii) A universal waste handler shall clean up and place in a container any PV module or constituent of the PV module if that PV module is broken. The container shall be structurally sound, compatible with the PV modules and their constituents, and shall prevent releases of constituents of the PV modules to the environment under reasonably foreseeable conditions.

(2) A small quantity handler of universal waste may dismantle photovoltaic panels removing external assemblies such as cables, junction boxes, and framing.

(3) A small quantity handler may, in order to facilitate shipment or separation of external components, break, cut, saw, shred or crush the glass panel, provided:

(i) The small quantity handler has established written procedures detailing how to safely break, cut, saw, shred or crush (including proper assembly, operation and maintenance of equipment used; segregation of incompatible waste; and proper waste management to contain waste and prevent any releases), and maintains a copy of manufacturer’s specification and instruction for any equipment used onsite;

(ii) Ensure employees are properly trained for the dismantling process including the operation of equipment, appropriate employee safety procedures, and proper waste management practices;

(iii) Immediately contain the broken panel glass and other segregated components.

(4) The procedures in 40 C.F.R. § 273.13(f)(1) do not apply for the duration of a severe weather event, but must be followed as soon as practicable following such event.

**§ 273.14 Labeling/markings**

(g) Each Photovoltaic module, or each container holding Photovoltaic modules, must be labeled or marked clearly with any of the following phrase: “Universal Waste Photovoltaic Module(s), “Waste Photovoltaic Module(s)” or “Used Photovoltaic Module(s)”. “PV” or “Solar” may be used in place of photovoltaic.

**Subpart C – Standards for Large Quantity Handlers of Universal Waste**  
**§ 273.32 Notification.**

\* \* \* \* \*

(b) \* \* \*

(4) A list of all the types of universal waste managed by the handler (e.g., batteries, pesticides, mercury-containing equipment, lamps, ~~and aerosol cans,~~ and photovoltaic modules); and

**§ 273.33 Waste management.**

\* \* \* \* \*

(f) Photovoltaic Modules. A large quantity handler of universal waste must manage universal waste photovoltaic modules or cells in a way that prevents releases of any universal waste or component of universal waste to the environment as follows:

(1) Universal waste PV module stored in a manner that prevents breakage and release of any constituent of a PV module to the environment. If a container or package is used, such a container or package shall prevent breakage, leakage, spillage, or damage that could cause leakage under reasonably foreseeable conditions.

(i) Intact PV modules that are managed in a manner (such as palletizing or banding) that prevents breakage of the PV modules and release of constituents of the PV modules to the environment under reasonably foreseeable conditions shall be deemed to comply with subsection (f)(1) of this section.

(ii) A universal waste handler shall clean up and place in a container any PV module or constituent of the PV module if that PV module is broken. The container shall be structurally sound, compatible with the PV modules and their constituents, and shall prevent releases of constituents of the PV modules to the environment under reasonably foreseeable conditions.

(2) A large quantity handler of universal waste may dismantle photovoltaic panels removing external assemblies such as cables, junction boxes, and framing.

(3) A large quantity handler may, in order to facilitate shipment or separation of external components, break, cut, saw, shred or crush the glass panel, provided:

(i) The large quantity handler has established written procedures detailing how to safely break, cut, saw, shred or crush (including proper assembly, operation and maintenance of equipment used; segregation of incompatible waste; and proper waste management to contain waste and prevent any releases), and maintains a copy of manufacturer's specification and instruction for any equipment used onsite;

(ii) Ensure employees are properly trained for the dismantling process including the operation of equipment, appropriate employee safety procedures, and proper waste management practices;

(iii) As soon as practicable, contain the broken panel glass and other segregated components.

(4) The procedures in 40 C.F.R. § 273.33(f)(1) do not apply for the duration of a severe weather event, but must be followed as soon as practicable following such event.

**§ 273.34 Labeling/marketing.**

\* \* \* \* \*

(g) Each Photovoltaic module, or each container holding Photovoltaic modules, shall be labeled or marked clearly with any of the following phrase: "Universal Waste Photovoltaic Modules,

“Waste Photovoltaic Modules” or “Used Photovoltaic Modules”. “PV” or “Solar” may be used in place of photovoltaic.