

# Form 399 - ATTACHMENT TO ECONOMIC AND FISCAL IMPACT STATEMENT

## Photovoltaic Modules (PV Modules) – Universal Waste Management

This document details the background of the economic and fiscal impacts of Department of Toxic Substances Control's (DTSC's) regulation to allow waste PV modules to be managed in accordance with California Standards for Universal Waste Management, found in California Code of Regulations, title 22, division 4.5, chapter 23.

## Background

California's universal waste program, modeled after the federal Universal Waste Rule (40 Code of Federal Regulations part 273), was adopted into regulation in 2002. It provides a set of simplified hazardous waste management standards for a subset of hazardous wastes, which include batteries, electronic devices, lamps, mercury-containing equipment, cathode ray tubes, cathode ray tube glass, and aerosol cans. Universal wastes are generated by various entities, such as retail stores, office buildings, and households. Universal wastes are considered low-risk hazardous wastes due to their composition, management, and the quantity and the rate generated. The requirements of the universal waste program include:

Allowing generators to ship universal wastes without a hazardous waste manifest and without using registered hazardous waste transporters;

Removing requirements for generators to prepare biennial reports, contingency plans, and land disposal restriction notifications;

Allowing simpler training for employees; and

Increasing the accumulation time that generators can store universal wastes without obtaining a hazardous waste facility permit.

## Need for Regulation

Many waste PV modules are hazardous wastes due to the presence of metals (e.g., cadmium, copper, lead, and selenium),<sup>1</sup> which results in them exhibiting the hazardous waste characteristic of toxicity. Waste PV modules that fail the federal hazardous waste criteria for toxicity are regulated under the U.S. Resource Conservation and Recovery Act (RCRA) and are considered a RCRA hazardous waste.

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<sup>1</sup> "End-of-Life Management: Solar Photovoltaic Panels," International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems (IRENA and IEA-PVPS) (2016). Available at [http://www.irena.org/DocumentDownloads/Publications/IRENA\\_IEAPVPS\\_End-of-Life\\_Solar\\_PV\\_Panels\\_2016.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf), accessed on March 6, 2020.

Managing hazardous waste PV modules as fully regulated hazardous waste reduces environmental and human health risks associated with their management and disposal. However, generators of hazardous waste PV modules do not always manage them in compliance with the regulations, partly because they fail to recognize PV modules may be hazardous based on their appearance (i.e., they don't "look" hazardous). Another factor associated with mismanagement of waste PV modules is that generators must determine the presence and quantity of toxic substances, which requires time and cost associated with sampling and laboratory testing and may discourage generators of waste PV modules from making these determinations. Failure to properly handle and dispose of hazardous wastes increases the risk for adverse impacts on human health and the environment. In the absence of government intervention, generators may continue to improperly and illegally dispose of hazardous PV modules in nonhazardous municipal solid waste landfills.

As of 2018, the number of PV modules managed as waste in California and the number of hazardous waste PV modules are relatively low. These numbers are expected to rise as more PV modules are installed and those that expire are replaced, prompted by California's initiatives to promote the use of renewable energy throughout the state.<sup>2</sup>

Categorizing PV modules that are determined to be hazardous as a universal waste significantly simplifies the waste management process, reduces the regulatory burden and cost, and provides an incentive for generators to properly manage and dispose of waste PV modules. Imposing universal waste regulations on PV modules at this time is beneficial, as their popularity grows and market demand for energy alternatives accelerates, with a resulting increase in the generation of waste PV modules.

## **Regulation for Management of PV Modules that are Hazardous as Universal Waste**

Under the universal waste regulation, any person who generates, transports, treats, or stores hazardous waste PV modules has an option to manage these wastes as universal waste pursuant to California's Standards for Universal Waste Management, rather than California's full hazardous waste management requirements.

The regulation will extend universal waste responsibilities and authorities to handlers of PV modules. Key provisions include the following:

- PV modules managed under the regulation are not counted toward a business's hazardous waste generator status (i.e., large versus small quantity generator).
- All universal waste handlers must manage PV modules in a manner that prevents unauthorized releases to the environment.
- The containers that store PV modules must be labeled to easily identify their contents.
- Generators of PV modules may ship PV modules to handlers without using a hazardous waste manifest or a registered hazardous waste transporter.

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<sup>2</sup> California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases, S. 100, Sess. Of 2018 (CA. 2018).

- Other management standards include accumulation time limits, employee training, off-site shipment requirements, export requirements, notification, reporting and tracking requirements.
- Handlers may remove user-replaceable parts to facilitate their refurbishment, and/or dismantle PV modules into components for recycling prior to shipping, storing, or recycling them.
- Universal waste handlers of PV modules may conduct treatment specified in the regulation and be deemed authorized by DTSC to do so if they comply with specific requirements outlined in the regulation.

## Economic Impact Statement

### A. ESTIMATED PRIVATE SECTOR COST IMPACTS

The following parameters were used to estimate cost impacts:

Baseline Parameters	With Regulation Parameters
<p>All generators of waste PV modules who have determined that the PV modules are hazardous are subject to full hazardous waste management requirements. Half the total volume of waste PV modules that are generated in California are assumed to be hazardous.<sup>3</sup></p>	<p>All generators of waste PV modules may elect to manage their PV modules as universal waste. They do not need to make a hazardous waste determination if the modules are managed as universal waste. Half the total volume of waste PV modules that are generated are California are assumed to be hazardous.<sup>3</sup></p>
<p>Requirements for hazardous waste generators:</p> <ul style="list-style-type: none"> <li>A. Acquire Identification Number</li> <li>B. Comply with accumulation time limit requirements</li> <li>C. Comply with hazardous waste label requirements</li> <li>D. Have emergency procedures/contingency plans</li> <li>E. Train employees</li> <li>F. Ship using a manifest and registered transporter</li> </ul>	<p>Requirements for universal waste generators:</p> <ul style="list-style-type: none"> <li>A. Do not require an Identification Number before accumulating 5,000 kg of universal waste</li> <li>B. Comply with longer accumulation time limit requirements</li> <li>C. Comply with universal waste label requirements</li> <li>D. Have emergency procedures, but not required to have contingency plans</li> <li>E. Train employees</li> </ul>

<sup>3</sup> DTSC is aware that not all PV module waste generated are hazardous. The regulation only applies to waste PV modules that are determined to be hazardous and does not apply to the modules that are not hazardous. DTSC does not have enough data to accurately predict the percent of PV module waste generated in California that would be considered hazardous. Therefore, DTSC conservatively assumed that half of the total volume of PV module waste generated in California would be hazardous.

Baseline Parameters	With Regulation Parameters
<ul style="list-style-type: none"> <li>G. Submit a biennial report if RCRA large quantity generator</li> <li>H. Maintain records for at least 3 years</li> </ul>	<ul style="list-style-type: none"> <li>F. Transport universal waste using a shipping document in one's own vehicle or by a common carrier as allowed by U.S. Department of Transportation (DOT) and California law; Send universal waste to a universal waste handling facility that collects or recycles universal waste PV modules</li> <li>G. Submit an annual report and/or a biennial report if RCRA large quantity generator</li> <li>H. Do not require record maintenance</li> </ul>
<p>All generators send their waste PV modules to 8 storage facilities and 2 hazardous waste evenly distributed geographically throughout the state that are authorized to accept PV modules because there are no recycling options available in California as of 2019. Storage facilities dispose of the waste PV modules at the 2 hazardous waste disposal facilities.</p>	<p>All generators send their waste PV modules to 8 universal waste handlers in California that comply with the self-implementing authorization requirements under chapter 23. There are 8 universal waste handlers authorized in California, evenly distributed geographically throughout the state. Handlers perform varying levels of authorized treatment activities. Two-thirds, five (5), of the handlers perform removal and disassembling activities that do not result in hazardous waste disposal. Waste PV modules are next transported to the remaining one-third, three (3), of the handlers that conduct processing treatment activities, 85 percent of which results as hazardous waste residuals which are disposed of at 2 hazardous waste disposal facilities.</p>
<p>Storage facility requirements:</p> <ul style="list-style-type: none"> <li>A. Obtain Identification Number for each site that generates hazardous waste</li> <li>B. Comply with requirements for use and management of hazardous waste containers</li> <li>C. Have emergency procedures and contingency plans in place</li> </ul>	<p>Universal waste handler requirements:</p> <ul style="list-style-type: none"> <li>A. Obtain Identification Number for each site that handles universal waste</li> <li>B. Store PV modules for no more than one year from the accumulation start date; Document accumulation time; Label universal waste PV modules</li> <li>C. Conduct authorized treatment</li> <li>D. Train employees in proper universal waste management including</li> </ul>

Baseline Parameters	With Regulation Parameters
<p>D. Train all employees to ensure they are thoroughly familiar with proper waste handling and emergency procedures</p> <p>E. Ship using only transporters that are registered or permitted by DTSC and comply with U.S. DOT requirements; Use a uniform hazardous waste manifest to accompany hazardous waste from the point of generation to the point of ultimate disposal</p> <p>F. Maintain records for at least 3 years</p> <p>G. Submit an annual/biennial report</p>	<p>handling, packaging, storing and labeling the waste, and in how to respond to releases</p> <p>E. Only ship universal waste to a destination facility Comply with applicable U.S. DOT rules; Prepare shipping documents; When sending universal waste outside of the country, comply with regulations addressing universal waste export</p> <p>F. Keep records of all shipments and receipts of universal waste for 3 years</p> <p>G. Submit an annual/ biennial report</p> <p>H. If a universal waste handler of PV modules decides to dispose of the PV modules or any components resulting from the authorized treatment of PV modules, they must manage them as hazardous waste, outlined in the baseline parameters.</p>

**3. Enter the total number of businesses impacted: Approximately 3,000**

**Describe the types of businesses (Include nonprofits):**

The regulation impacts those who generate, transport, treat, and store PV modules. Most PV modules are generated during four life cycle phases:

- 1) Manufacturing;
- 2) Transportation;
- 3) Installation, maintenance, and servicing during use; and
- 4) End-of-life, when the PV modules are taken out of service.

The types of businesses that are expected to be impacted include PV module manufacturers, installers or developers,<sup>4</sup> service companies, utilities, and organizations that install PV modules for their businesses or customers.

As of 2017, the Solar Energy Industries Association,<sup>5</sup> a PV module industry association, indicates that there are approximately 28,906 businesses in California that may

<sup>4</sup> A developer arranges for the design, permitting, financing and installation of a solar energy system on a customer's property through an agreement: <https://www.seia.org/research-resources/solar-power-purchase-agreements>, last accessed March 6, 2020.

<sup>5</sup> SEIA/GTM Research U.S. Solar Market Insight.

generate, manage, or handle waste PV modules. The number includes the following businesses:

- 493 PV module manufacturers, including companies that manufacture photovoltaic cells encapsulated in glass. Manufacturers also include distributors and companies that assemble PV modules.
- 1,449 PV module installers/developers that install PV modules.
- 901 businesses that provide services, such as maintenance, for PV module installations.
- 26,057 buildings (nonresidential) with rooftop installations, which include commercial, industrial, business-owned, school, and hospital facilities.
- 6 utility companies that own and operate 455 utility-scale PV module installations that generate electricity to augment other sources of electricity to meet customer demands.

As of 2018, there are no businesses in California with a hazardous waste facility permit to store or treat PV modules. However, during a stakeholder workshop held by DTSC on August 22, 2017, businesses that currently manage and recycle universal waste electronic devices (e-waste) expressed interest in potentially expanding their operations to manage waste PV modules. (As of 2018, 25 e-waste recyclers operate in California.)<sup>6</sup> It is unclear whether these businesses will modify their operations to manage hazardous waste PV modules or develop new and separate businesses to perform a similar role. Although DTSC estimates that 28,906 businesses in California may generate, manage, or handle waste PV modules in the future, businesses with rooftop installations (a total of 26,057) are not anticipated to generate waste PV modules for their expected service life of 30 years.<sup>7</sup> DTSC assumes that businesses and residences with rooftop PV installations have warranties that cover the service life of their PV modules, and that removal of any waste PV modules is covered under warranty. Under the warranty, service providers are responsible for PV modules that are discarded from rooftop installations and act as generators. Thus, the total number of businesses used to estimate the economic impact is 2,947, calculated factoring in an average annual increase for 5 years at 1.7% annual increase.<sup>8</sup>

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<sup>6</sup> Approved Recyclers in Covered Electronic Waste Payment System of the Department of Resources Recycling and Recovery (CalRecycle). See page 2 in the following link: <https://www.calrecycle.ca.gov/Electronics/Recovery/Approved/>, accessed on March 6, 2020.

<sup>7</sup> End-of-Life Management: Solar Photovoltaic Panels, International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems (IRENA and IEA-PVPS) (2016). Available at [http://www.irena.org/DocumentDownloads/Publications/IRENA\\_IEAPVPS\\_End-of-Life\\_Solar\\_PV\\_Panels\\_2016.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf), accessed on March 6, 2020.

<sup>8</sup> <https://www.census.gov/data/tables/2015/econ/susb/2015-susb-employment.html>, accessed on March 6, 2020.

**Enter the number or percentage of total businesses impacted that are small businesses: Approximately 98.3%**

Government Code section 11346.3 defines a small business as any business that employs fewer than 100 employees. According to 2018 labor market information from the California Employment Development Department (the most current full year of data available),<sup>9</sup> 98.3 percent of all businesses in California employ less than 100 employees. DTSC does not have any other information indicating to what degree small businesses are impacted. Therefore, DTSC estimates that 98.3 percent of the businesses impacted by the regulation are small businesses.

**4. The number of businesses created or eliminated within the State of California  
Created: 8; Eliminated: None**

The use of PV modules continues to grow as demand for alternative energy in California increases. The increase in the number of PV modules installed will ultimately lead to an increase in the number of waste PV modules generated when they are taken out of service. PV modules that are determined to be hazardous waste must be handled as any other hazardous waste and are subject to the requirements for fully regulated hazardous waste.

DTSC anticipates that the number of hazardous waste PV modules generated in the future will be the same whether or not DTSC adopts the regulation. These hazardous waste PV modules must be managed as hazardous wastes and are required to be sent to businesses that possess hazardous waste facility permits from DTSC, or appropriate permits issued by the state where the destination facility is located, to accept and manage them. As of 2018, very few waste management businesses carry out PV module management because only a limited amount of these wastes is being generated from a limited number of generators.<sup>10</sup>

The universal waste management requirements reduce the burden for businesses that receive, handle, and treat waste PV modules (e.g., remove user-replaceable components, dismantle or manually segregate components from PV modules). As of 2018, there are no businesses in California with a hazardous waste facility permit to store or treat PV modules. However, during a stakeholder workshop held by DTSC on August 22, 2017, the 25 businesses that currently manage and recycle universal waste electronic devices (e-waste) in California expressed interest in potentially expanding their operations to manage waste PV modules. As more PV modules become wastes, DTSC anticipates more businesses will be created or expanded in California to accept and manage these wastes. For this economic impact analysis, DTSC assumes that one-third, 8, of the businesses that express interest in managing PV modules as

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<sup>9</sup> California Employment Development Department's Labor Market Information for 2018. [https://www.labormarketinfo.edd.ca.gov/LMID/Size\\_of\\_Business\\_Data\\_for\\_CA.html](https://www.labormarketinfo.edd.ca.gov/LMID/Size_of_Business_Data_for_CA.html), accessed on March 6, 2020.

<sup>10</sup> <https://www.solarpowerworldonline.com/2018/04/its-time-to-plan-for-solar-panel-recycling-in-the-united-states/>, accessed on March 6, 2020.

universal waste would create business to also manage PV modules.

DTSC does not anticipate the regulation will result in elimination of businesses in California.

## **6. The number of jobs created or eliminated within the State of California**

**Created: Up to 334; Eliminated: None**

As discussed in A.4. above, DTSC predicts an increase in PV module installation across all sectors as the demand for alternative energy increases, which will ultimately lead to an increase in the number of waste PV modules as they are taken out of service. As more PV modules become wastes, DTSC anticipates more businesses will be created or expanded in California to accept and manage these wastes. These businesses will likely add employees to manage the added work. Therefore, DTSC does not anticipate the regulation will result in elimination of jobs in California. Also, new businesses created as a result of the regulation will likely hire employees to manage PV modules. DTSC assumed that each business of the 27 businesses that may manage waste PV modules could employ from 20 up to 2300 employees, estimated based on the information available on the CalRecycle Directory of Approved Collectors and Recyclers of Covered Electronic Waste.<sup>11</sup> As these businesses expand to manage waste PV modules, DTSC assumed additional ten percent jobs will be added. Based on this estimation and factoring in the 1.7 percent annual growth for the lifetime of this regulation, DTSC calculated the numbers of jobs that might be created to be up to 334.

### **Describe the types of jobs or occupations impacted**

Regulating PV modules as universal waste will incentivize proper collection, transportation, and disposal or recycling of waste PV modules, like other universal wastes such as batteries and electronic devices, which consumers and businesses are more familiar with. An entity managing PV modules according to universal waste standards will have confidence its operations are lawful and with the benefit of the reduced cost and time universal waste standards afford. Businesses that manage waste PV modules will be similar to those that manage e-waste, another type of universal waste. Types of occupation employed by these businesses are handlers, transporters, materials coordinators, and recycling specialists, as well as business support positions, such as administration.

## **B. ESTIMATED COSTS**

### **1. What are the total statewide dollar costs that businesses and individuals may incur to comply with this regulation over its lifetime?**

First, the regulation does not impact the requirements for disposal of hazardous PV modules. The costs associated with transporting hazardous waste PV modules to a permitted hazardous waste disposal facility via a registered hazardous waste

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<sup>11</sup> <https://www2.calrecycle.ca.gov/Electronics/cew/participantsDirectory>, accessed on June 10, 2020.

transporter remain the same for both the baseline and with regulation.

Second, a unit cost, defined as the total estimated expenditure incurred by a single business to comply with a regulation, is estimated for both the baseline and with regulation. The unit cost is categorized into one-time costs, fixed annual costs, and variable costs, which are further divided into specific line items. Total costs, calculated by multiplying the estimated unit costs by the total number of businesses, vary between generators and disposal facilities. Please see the Appendix, which details the methodology DTSC used to calculate these costs.

**Table 1** is the comparison for the breakdown of itemized costs and total costs in the baseline and with regulation. DTSC estimates the total benefits of \$18,374,823 and itemized additional costs of \$401,621, resulting in a net benefit of \$17,973,203 for all business under the regulation. Based on the added costs of \$401,621, DTSC estimated the total statewide costs that business and individuals may incur to comply with this regulation over 5 years lifetime to be \$2,008,105.

**Table 1. Costs Comparison for Generators, Storage Facilities/Universal Waste Handlers, and Disposal Facilities – Baseline and With Regulation**

	BASELINE	WITH REGULATION		
	Total Costs (\$)	Total Costs (\$)	Total Benefits (\$)	Itemized Additional Costs (\$)
	<b>One-time Costs (\$)</b>			
Notification of hazardous waste activity	\$ 62.00	\$ 62.00	\$ -	\$ -
Rule familiarization	\$ 424.00	\$ 535.00	\$ (236.00)	\$ 347.00
Closure plan	\$ 13,424.00	\$ 7,081.15	\$ (6,342.85)	\$ -
Contingency plan	\$ 1,462.00	\$ 1,005.13	\$ (456.88)	\$ -
<b>Total One-time costs per business</b>	\$ 15,372.00	\$ 8,683.28	\$ (7,035.73)	\$ 347.00
<b>Total One-time costs for all impacted business</b>	\$ 98,730.00	\$ 35,308.20	\$ (66,197.80)	\$ 2,776.00
	<b>Fixed Annual Costs (\$)</b>			
Annual review	\$ 186.00	\$ 186.00	\$ -	\$ -
Waste recordkeeping	\$ 123.00	\$ 123.00	\$ -	\$ -
Annual reporting	\$ 2,093.00	\$ 1,674.00	\$ (419.00)	\$ -
Annual employee training	\$ 9,725.00	\$ 7,346.88	\$ (2,378.13)	\$ -

Manifest training	\$ 723.00	\$ 331.38	\$ (391.63)	\$ -
Labeling	\$ 222.00	\$ 101.75	\$ (120.25)	\$ -
Facility Permit application preparation (annualized)	\$ 50,000.00	\$ 25,000.00	\$ (25,000.00)	\$ -
Facility Permit application review (annualized)	\$ 50,000.00	\$ 25,000.00	\$ (25,000.00)	\$ -
Financial Assurance for closure (annualized)	\$ 20,000.00	\$ 10,750.00	\$ (9,250.00)	\$ -
Annual Facility Fee	\$ 342,700.00	\$ 330,970.00	\$ (11,730.00)	\$ -
<b>Total Fixed Annual costs per business</b>	<b>\$ 475,772.00</b>	<b>\$ 401,483.00</b>	<b>\$ (74,289.00)</b>	<b>\$ -</b>
<b>Total Fixed Annual costs for all impacted business</b>	<b>\$ 7,646,412.00</b>	<b>\$ 4,850,789.00</b>	<b>\$(2,795,623.00)</b>	<b>\$ -</b>
	<b>Variable Costs (\$)</b>			
Hazardous waste analysis and characterization	\$ 1,200.00	\$ 1,800.00	\$ (1,200.00)	\$ 1,800.00
Waste shipping recordkeeping	\$ 18,154.00	\$ 15,973.68	\$ (2,180.32)	\$ -
Manifest and land disposal notification	\$ 20,499.00	\$ 17,341.13	\$ (3,157.88)	\$ -
Waste transportation	\$ 67,295.00	\$ 80,748.63	\$ (72.00)	\$ 13,525.63
The cost of HW handling/treatment	\$ 8,737,750.00	\$ 7,430,587.50	\$ (1,307,162.50)	\$ -
Haz Waste Generator Fees	\$ 230.00	\$ 34,530.00	\$ (230.00)	\$ 34,530.00
Fee (Disposal)	\$ 806,479.82	\$ 685,536.19	\$ (120,943.63)	\$ -
<b>Total Variable costs per business</b>	<b>\$ 9,651,607.82</b>	<b>\$ 8,266,517.12</b>	<b>\$ (1,434,946.33)</b>	<b>\$ 49,855.63</b>
<b>Total Variable costs for all impacted business</b>	<b>\$ 146,998,132.64</b>	<b>\$ 131,883,975.50</b>	<b>\$ (15,513,002.14)</b>	<b>\$ 398,845.00</b>
<b>TOTAL INITIAL COSTS PER BUSINESS</b>	<b>\$ 15,372.00</b>	<b>\$ 8,683.28</b>	<b>\$ (7,035.73)</b>	<b>\$ 347.00</b>
<b>TOTAL ANNUAL ONGOING UNIT COSTS PER BUSINESS</b>	<b>\$ 10,127,379.82</b>	<b>\$ 8,668,000.12</b>	<b>\$ (1,509,235.33)</b>	<b>\$ 49,855.63</b>
<b>TOTAL COSTS FOR PER BUSINESS</b>	<b>\$ 10,142,751.82</b>	<b>\$ 8,676,683.39</b>	<b>\$ (1,516,271.05)</b>	<b>\$ 50,202.63</b>
<b>TOTAL INITIAL COSTS FOR ALL BUSINESSES</b>	<b>\$ 98,730.00</b>	<b>\$ 35,308.20</b>	<b>\$ (66,197.80)</b>	<b>\$ 2,776.00</b>
<b>TOTAL ANNUAL ONGOING COSTS FOR ALL BUSINESSES</b>	<b>\$154,644,544.64</b>	<b>\$ 136,734,764.50</b>	<b>\$ (18,308,625.14)</b>	<b>\$ 398,845.00</b>
<b>TOTAL COSTS FOR ALL BUSINESSES</b>	<b>\$ 154,743,274.64</b>	<b>\$ 136,770,072.70</b>	<b>\$ (18,374,822.94)</b>	<b>\$ 401,621.00</b>

**Table 2** is a summary of one-time costs, fixed costs, and variable costs estimated for generators and disposal facilities, for the baseline and with regulation. The total costs estimated for generators with regulation is lower than that of the baseline. Also, the total costs estimated for universal waste handlers with regulation is lower than hazardous waste storage facilities. The estimated costs for disposal facilities with regulation is lower because at least 15 percent of the PV module waste is recycled, and only 85 percent of the waste is disposed of as hazardous waste.

**Table 2. Costs for Generators, Storage Facilities/Universal Waste Handlers, and Disposal Facilities – Baseline and With Regulation**

COST CATEGORY	BASELINE			WITH REGULATION			COSTS SAVINGS (Benefits)		
	Generators	Storage Facilities	Disposal Facilities	Generators	Handlers	Disposal Facilities	Generators	Storage Facilities / Handlers	Disposal Facilities
One-time Costs (\$)	\$ 24,300	\$ 59,544	\$ 14,886	\$ 12,500	\$ 7,922	\$ 14,886	\$ (11,800)	\$ (51,622)	\$ -
Fixed Annual Costs (\$)	\$6,235,852	\$ 617,664	\$ 792,896	\$ 4,028,549	\$ 29,344	\$ 792,896	\$(2,207,303)	\$ (588,320)	\$ -
Variable Costs (\$)	\$74,827,277	\$70,557,896	\$1,612,960	\$70,055,229	\$60,457,674	\$1,371,072	\$(4,772,048)	\$ (10,100,222)	\$ (241,888)
Total Costs (\$)	\$81,087,429	\$71,235,104	\$2,420,742	\$74,096,278	\$60,494,940	\$2,178,854	\$(6,991,151)	\$ (10,740,164)	\$ (241,888)
Total Costs (Generators, Storage Facilities /Handlers, and Disposal Facilities)	\$ 154,743,275			\$ 136,770,072			\$ 17,973,203		

The difference in costs associated with the baseline and with regulation are presented in **Table 3** to compare and predict the economic impact of the regulation in California. DTSC estimates cost savings of \$6,991,151 for generators and \$10,740,164 for universal waste handlers annually, assuming they would otherwise comply with existing hazardous waste statutes and regulations. The majority of cost savings if the regulations are enacted will result from a reduction in the fixed annual costs for generators, largely because they will no longer need to manage PV modules as a fully regulated hazardous waste and ship PV modules on a manifest using a registered hazardous waste transporter or prepare biennial reports. Most notably, because there are currently no recycling markets for PV module glass in California, the variable costs under both the baseline and with regulation are similar. Generator fee liability will shift from generators to universal waste handlers under the regulation. DTSC anticipates that rates that universal waste handlers will charge to handle PV modules, once new businesses are created to manage waste PV modules, will be adjusted to account for all variable costs and will be passed back to generators for universal waste disposal.

**Table 3. Costs Comparison for PV Modules Generators and Storage Facilities/Universal Waste Handlers Before and After the Regulation**

COST CATEGORY	GENERATORS		STORAGE FACILITIES / HANDLERS	
	Cost Savings	Percent Change from Baseline (%)	Cost Savings	Percent Change from Baseline (%)
One-Time Cost Savings	\$ (11,800.00)	\$ 48.56	\$ (51,622.00)	\$ 86.70
Fixed Annual Cost Savings	\$ (2,207,303.00)	\$ 35.40	\$ (588,320.00)	\$ 95.25
Variable Cost Savings	\$ (4,772,048.00)	\$ 6.38	\$ (10,100,222.00)	\$ 14.31
Total Cost Savings	\$ (6,991,151.00)	\$ 8.62	\$ (10,740,164.00)	\$ 15.08

**3. If the regulation imposes reporting requirements, enter the annual costs a typical business may incur to comply with these requirements. Include the dollar costs to do programming, recordkeeping, reporting, and other paperwork, whether or not the paperwork must be submitted.**

DTSC assumes that generators of PV modules waste both in the baseline and with regulation are a small business and are not included as a typical business.

Storage facilities, universal waste handlers, and disposal facilities associated with handling PV modules waste both in the baseline and with regulation are required to keep record of waste management. DTSC estimates the cost of waste recordkeeping is \$41 per business.

Under existing regulations, a storage facility that accepts hazardous wastes from a generator must be authorized to do so via a standardized permit and is required to submit an annual report to DTSC. DTSC estimated that the cost of permit compliance with the existing regulations is \$837 per storage facility per year.

The regulation requires businesses that intend to accept PV modules from generators to submit a notification to DTSC prior to accepting waste PV modules, and to submit an annual report to DTSC on universal waste handling activities from the prior year. DTSC estimated that the costs for businesses to prepare and submit the initial notification and the annual report are approximately the same as the costs under the existing regulations (\$837 per handler per year).

Disposal facilities that accept hazardous wastes are also required to submit an annual report to DTSC both in the baseline and with regulation. DTSC estimated that the costs for disposal facilities to prepare and submit the annual report to be \$837 per disposal facility per year.

Under the baseline, a storage facility that ships hazardous wastes to a disposal facility is required to keep record of waste shipping. The cost of waste shipping recordkeeping is estimated to be \$18,096 per storage facility per year based on the number of shipments.

Universal waste handlers are also required to keep record of waste shipment with regulation. The cost of waste shipping recordkeeping is estimated to be \$15,970 per universal waste handler per year, calculated based on the number of shipments.

Disposal facilities do not incur waste shipping recordkeeping.

The annual costs a typical business may incur in terms of record keeping, reporting, and other paperwork to comply with universal waste regulation is estimated to be \$17,726.

## **5. Are there comparable federal regulations? No**

### **Explain the need for state regulation given the existence or absence of federal regulations.**

PV modules are not listed under the federal universal waste management regulations or under any exemptions or exclusions. PV modules that are determined by the generator to be federally regulated hazardous waste are required to be managed as RCRA hazardous waste. When DTSC inspected e-waste handling facilities and their records in 2012, it found that hazardous waste PV modules were being illegally accepted and improperly handled. This indicates that PV modules that are determined to be hazardous waste are being improperly and illegally disposed of.

DTSC determined that PV modules have low hazardous risks due to their manufacturing design; silicon wafers that contain heavy metals are immobilized and protected between panes of glass to prevent damage and untimely release. DTSC also determined that universal waste requirements, designed to be protective of public health and the environment, are adequate for such risks posed by PV modules. Managing PV modules under universal waste standards will divert hazardous waste PV modules out of solid waste streams and into proper management and disposal. It will also incentivize and encourage proper collection, transportation, and disposal or recycling of the modules, similar to other universal wastes.

DTSC is authorized by U.S. Environmental Protection Agency (U.S. EPA) for its universal waste management program and can designate additional waste streams as universal waste. Therefore, waste PV modules that are determined by the generator to be federally regulated hazardous waste can be managed as universal waste in California under the proposed rule. Once waste PV modules leave the state boundary, California's universal waste requirements will no longer apply and the waste must be managed according to federal, state, and local requirements.

## **C. ESTIMATED BENEFITS**

### **1. Briefly summarize the benefits of the regulation, which may include (among others) the health and welfare of California residents, worker safety and the state's environment.**

DTSC estimated a net savings of \$17,973,273 for universal waste generators, handlers and disposal facilities with regulation, resulting from the total benefits of \$18,374,823 and added costs of \$401,621. Additionally, DTSC has determined that the regulation will increase protection of public health and the environment by reducing the mismanagement and the number of PV modules illegally disposed of as solid waste in landfills. Such wrongful practices are expected to cause a release of hazardous constituents from waste PV modules to soil and water, thereby posing a threat to public health and the environment. DTSC witnessed similar improved waste management practices with the management of e-waste and other universal wastes after they were included in DTSC's universal waste program. In addition, DTSC estimates that the regulation will save PV module generators a significant amount in costs for waste management of PV modules as fully regulated hazardous waste.

### **2. Are the benefits the result of specific statutory requirements?**

Health and Safety Code section 25259 was added by Senate Bill 489 (Monning, Ch. 419, Stats. 2015), effective January 1, 2016, authorizing DTSC to adopt regulations to designate hazardous waste PV modules as a universal waste to be managed according to universal waste requirements. Although inclusion of PV modules in California's universal waste program requires DTSC to adopt the regulation, the Legislature and Governor, in enacting this statute, anticipated benefits that would result from the regulation.

### **3. What are the total statewide benefits from this regulation over its lifetime?**

DTSC estimates the total statewide benefits of this regulation over its lifetime to be \$91,874,115, calculated based on annual benefits of businesses that are required to comply with regulation over 5-year lifetime for the regulation. Other benefits due to avoided environmental contamination or avoided health impacts from exposure to the hazardous constituents in waste PV modules by proper management and disposal of PV modules waste are also expected. Furthermore, the regulation for the universal waste management of PV modules is structured to encourage recycling of PV modules. DTSC estimates that at least 15 percent of the PV modules will be recycled under the regulation, thereby reducing the amount of waste PV modules disposed of as hazardous waste. DTSC anticipates that, as more PV modules become wastes in the future, recycling options will be developed and become available, reducing the number of PV modules disposed of further. However, DTSC cannot forecast when this might occur.

#### **4. Briefly describe any expansion of businesses currently doing business within the state of California that would result from this regulation.**

The rate of generation of hazardous waste PV modules is expected to increase in the future, and that is likely to increase in the number of businesses needed to handle hazardous waste PV modules. DTSC observed this in the creation of approximately 25 e-waste treatment facilities after e-waste was added to California's universal waste program. Participants in workshops that DTSC held with stakeholders regarding the PV module regulation expressed interest in expanding their businesses to manage PV modules if they are regulated as a universal waste. Businesses that currently manufacture, install or provide maintenance services for PV modules may also expand their operations to include some type of waste PV module treatment.

For this economic impact analysis, DTSC assumes that one-third, 8, of the businesses that express interest in managing PV modules as universal waste would create business to also manage PV modules..

## **D. ALTERNATIVES TO THE REGULATION**

### **1. List alternatives considered and describe them below. If no alternatives were considered, explain why not.**

The following alternatives were not selected in the regulation. The recommended alternative is not listed here as it has already been addressed in previous sections of this analysis.

#### ***Alternative 1. No Action***

Under existing hazardous waste control laws, all PV modules that are characterized as hazardous are regulated as hazardous wastes when discarded. Generators of these wastes are subject to the hazardous waste generator standards, transporters to the manifesting and registration requirements, and receiving facilities to the hazardous waste facility permit standards. This alternative ensures the greatest protection of human health and the environment, but the regulatory requirements it places on generators and transporters of PV modules could be construed as a disincentive to proper collection, safe management practices, and proper recycling or disposal. This alternative also fails to establish waste management standards for PV modules that are commensurate with the risks posed by them. DTSC has concluded that because PV modules have lower hazardous risks and are generated by a wide segment of society, the application of universal waste management standards for these wastes provides an appropriate protection for human health and the environment. Note that the universal waste approach is not an alternative to the "do nothing" full hazardous waste regulation approach – nor are the two mutually exclusive. Instead, it is an alternative set of management standards that generators may, but are not mandated to, apply to manage these wastes. This is the main reason that DTSC has rejected the "do nothing" alternative.

This alternative has been evaluated as the baseline for cost calculations in which PV

modules are regulated as a fully hazardous waste.

### ***Alternative 2. Waste Exclusion***

DTSC evaluated a waste exclusion for PV modules as another alternative. With this alternative, DTSC would create, by regulation, an exemption requiring PV modules to be sent for recycling, similar to the exemption for scrap metal, and for reclamation. Reclamation is a form of recycling that recovers usable materials and hazardous constituents. This alternative could reduce or remove the regulatory requirements placed on handlers and transporters if they intend to recycle the PV modules. The waste exclusion alternative for PV modules is not a viable option because California cannot adopt regulations that are less stringent than the standards as specified under RCRA (nor can any other state). Analytical tests using the federal Toxicity Characteristic Leaching Procedure (TCLP) demonstrated that some PV modules may exceed the federal threshold levels for toxicity of regulated metals.<sup>12</sup> DTSC concludes that any PV modules that fail the federal hazardous waste criteria for toxicity must be managed as hazardous waste because these wastes are not excluded from federal hazardous waste regulations. Selecting the waste exclusion alternative for the management of PV modules that are RCRA hazardous waste would mean allowing them to be managed under less stringent standards than those of federal requirements, which is not allowed. Therefore, DTSC rejected the waste exclusion alternative.

## **E. MAJOR REGULATIONS**

### **5. Briefly describe the following:**

#### ***The increase or decrease of investment in the state:***

DTSC is not aware of any increase or decrease of investment in the state that will result from the implementation of the regulation. However, the alternative universal waste management standards could reduce or remove the regulatory requirements placed on the businesses handling or transporting PV modules. This could incentivize businesses to develop recycling options, as similar regulations have done for other universal wastes, thereby increasing potential investment in the state.

#### ***The incentive for innovation in products, materials, or processes:***

As of 2018, DTSC cannot quantify any incentive for innovation in PV module products, materials or processes that would result from the regulation in California. The regulation of universal waste management standards for PV modules could reduce or remove the regulatory requirements placed on the person managing and transporting PV modules and incentivize businesses to create new processes to recycle them, similar to processes in Asia or Europe. In addition, as manufacturers become aware that PV modules are identified as hazardous wastes and must be managed according to hazardous waste or the universal waste regulation, they may explore material changes that do not contain hazardous constituents that make PV modules hazardous.

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<sup>12</sup> (i) *Regulations on Photovoltaic Module Disposal and Recycling*, Vasilis Fthenakis, Brookhaven National Laboratory, 2001. (ii) Fthenakis V. and Gonsiorawski R., Lead-free solder technology from ASE Americas, Workshop Report BNL-67536, 1999.

*The benefits of the regulations, including but not limited to benefits to the health, safety, and welfare of California residents, worker safety, and the state's environment and quality of life, among any other benefits identified by the agency.*

The regulation will increase protection of public health and the environment by reducing the mismanagement of waste PV modules that are hazardous and the number of those PV modules disposed of as solid waste. DTSC has witnessed similar improved waste management practices and public health and environmental protection with the management of e-waste and other universal wastes, when they were included in the DTSC's universal waste program.

In addition, DTSC estimates that the regulation saves PV module generators and handlers a significant amount of costs compared to managing the modules as a fully regulated hazardous waste.

## **Fiscal Impact Statement**

### **B. Fiscal Effect on State Government.**

#### **4. Other. Explain.**

Identification of PV modules as universal waste would decrease the amount of fees associated with having to manage the waste as hazardous waste, assuming regulated parties would otherwise treat waste PV modules as hazardous waste and comply with all applicable statutes and regulations. Relevant hazardous waste management fees (which fund DTSC's hazardous waste management program), which would otherwise be collected for PV modules managed as hazardous waste, would not be collected with the regulation. DTSC estimates the decrease in annual fee revenues to be \$947,717, and thus \$2,843,152 for three years, as calculated based on fees associated with hazardous waste manifest, generator, and disposal, as shown in **Table 3**.

**Table 3. Estimated Loss of Fees with Regulation**

<b>DTSC Fee impact</b>	<b>Baseline</b>	<b>With Regs</b>	<b>Difference</b>
<b>Annual Facility Fee</b>	\$ 93,840	\$ -	\$ 93,840
<b>Manifest Fee</b>	\$ 349,149	\$ 138,729	\$ 210,420
<b>Generator Fee</b>	\$ 677,810	\$ 276,240	\$ 401,570
<b>Disposal Fee</b>	\$ 1,612,960	\$ 1,371,072	\$ 241,887
<b>Total Fees</b>	\$ 2,733,759	\$ 1,786,041	<b>\$ 947,717</b>

In addition, as the regulation becomes effective, DTSC will require permanent resources for the regulation roll-out and associated implementation work for inspections and recordkeeping. DTSC will require permanent scientific staff positions. Following the regulation roll-out, DTSC scientists will plan and organize workshops, meetings, and training within the department, to make sure DTSC inspectors are consistent in applying the newly adopted regulatory requirements towards the industry, and externally, to provide industry with guidance on adopting and complying with newly enacted regulatory requirements.

Once the regulation roll-out is completed, DTSC expects senior scientists and scientists to continue carry out inspection and enforcement related activities on impacted businesses for complying with the regulation. DTSC expects that reporting, reviewing, recordkeeping and tracking activities related to the regulation will be processed by scientists and analysts.

DTSC projects that its costs with the regulation will be an estimated \$187,583 in the year following its adoption, and \$134,985 annually in the subsequent years; therefore, resulting \$457,553 for three years. These costs are tabulated based on the estimated work hours DTSC scientists are expected to incur with and after the adoption of the regulation and current salaries and benefits of DTSC scientists shown in **Table 4 and 5**.

**Table 4. Calculations for Fiscal Effect on State Government with the Adoption of the Regulation Fiscal Year 2020-21<sup>13</sup>**

<b>Task (Yearly)</b>	<b>Staff Classification</b>	<b>Total Salary &amp; Benefits per PY<sup>1</sup></b>	<b>Estimated Time (hours)</b>	<b>Conversion to PY<sup>1</sup> (/1800)</b>	<b>Cost of PY<sup>1</sup></b>
Review and provide program information	Senior Environmental Scientist (Sup)	\$175,821	80	0.04	\$7,814
Provide program information and guidance	Senior Environmental Scientist (Spec)	\$133,874	1800	1	\$133,874
Present information/train 55 inspectors (CUPA and DTSC) 16 hrs. x 55 (inspectors)	Environmental Scientist	\$91,789	900	0.5	\$45,895
<b>Total cost</b>					<b>\$187,583</b>
<sup>1</sup> Personnel Year.					

**Table 5. Calculations for Fiscal Effect on State Government with the Adoption of the Regulation Fiscal Year 2021-22 and After**

<b>Task</b>	<b>Staff Classification</b>	<b>Total salary &amp; benefits per PY<sup>1</sup></b>	<b>Estimated Time (Hours)</b>	<b>Conversion to PY<sup>1</sup> (/1,800)</b>	<b>Cost of PY<sup>1</sup></b>
Review notifications/ Annual reports	Associate Governmental Program Analyst	\$104,684	407	0.226	\$23,659
Provide program	Senior Environmental	\$133,874	1250	0.69	\$92,968

<sup>13</sup> Assumes that this regulation becomes effective on October 1, 2020.

<b>Task</b>	<b>Staff Classification</b>	<b>Total salary &amp; benefits per PY<sup>1</sup></b>	<b>Estimated Time (Hours)</b>	<b>Conversion to PY<sup>1</sup> (/1,800)</b>	<b>Cost of PY<sup>1</sup></b>
information and guidance	Scientist (Spec)				
Cost of Inspections by EERD	Environmental Scientist	\$91,789	360	0.2	18,358
<b>Total cost</b>					<b>\$134,985</b>
<sup>1</sup> Personnel Year.					