

Solar Panel Recycling Research from the Counties of Butte and San Mateo and the City of Santa Monica in California

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Abstract— The California Product Stewardship Council (CPSC) is a 501(c)3 non-profit organization representing more than 200 California local governments, business partners, interested non-profits, and individuals working towards shifting California’s product waste management system from one focused on government-funded and ratepayer financed to one that relies on producer responsibility in order to reduce public costs and drive improvements in product design. CPSC collected firsthand data from California residents and solar panel installers across Butte and San Mateo counties, plus the City of Santa Monica. CPSC conducted an online resident survey using similar questions in each jurisdiction. Residents shared information on solar panel education and motivations for disposal, opportunities for solar panel collection and improvement, and support for a producer funded takeback program. CPSC also interviewed solar installers in the grant areas asking how solar panel recycling can be improved locally, installer responses were much more technical than the resident responses. Ninety-three percent of survey respondents felt proper management is important and the information should come from the City/County and the installer. Eighty-six percent of interviewed installers do not have a policy or process for advising their customers on end-of-life management of the solar panels and the majority have already removed panels for customers. Additionally, CPSC invited the public to a webinar sharing the results and a regulatory update on solar panel recycling in California. The research summarized above highlights the growing need to address solar panel recycling at all stages of the solar panel lifecycle and engage the producers in end-of-life management. Both residents and installers indicated solar panel recycling is not an immediate top concern, but many expressed fears, if not addressed quickly, could become a problem in due time.

I. INTRODUCTION

The California Product Stewardship Council (CPSC) is a 501(c)3 non-profit organization representing 200+ California local governments, business partners, interested non-profits, and individuals working towards a single mission: To shift California’s product waste management system from one focused on government-funded and ratepayer financed to one that relies on producer responsibility in order to reduce public costs and drive improvements in product design [1]. CPSC is piloting two CalRecycle funded projects on solar panel recycling that include comparable market research focused on

residents and solar installers. Additionally, under those grant projects, CPSC will host temporary collection events for unwanted panels with the primary goal of collecting data on types of panels brought to the event and reasons for disposal. San Mateo County also funded CPSC to conduct similar market research in the County and is available to expand the research to additional jurisdictions, given available funding.

II. METHODOLOGIES

CPSC collected firsthand data from residents and solar panel installers across Butte and San Mateo counties, plus the City of Santa Monica. Residents were surveyed online, and phone interviews were conducted with solar installers in each jurisdiction. Solar companies were identified and contacted to participate in the 5-minute interview, using a consistent set of questions. More information on engagement and common concerns was collected through a public educational webinar.

III. RESIDENT SURVEY RESULTS

CPSC conducted an online resident survey using similar questions in each jurisdiction. A total of 397 resident surveys were collected with 212 from San Mateo, 101 from Butte, and 84 from Santa Monica. Overall, 93% of residents think responsible disposal is important and think the City/County website is the best source of information on proper disposal. Thirty percent (30%) of respondents across all jurisdictions are considering purchasing solar panels in the next 5 years. A breakdown by individual jurisdiction is shown in Table 1. Additional survey data is provided in Tables 2 and 3. Reported installations occurred between 1971-2019; More installations took place in 2018 than any other year studied. 77% of survey respondents own their home. 24% of respondents currently have solar panels on their housing.

TABLE I. COMPARING RESIDENT SOLAR SURVEY RESULTS

	Jurisdiction			Average
	Butte County	San Mateo County	City of Santa Monica	
Respondants with solar	11%	12%	34%	24%

	Jurisdiction			Average
	Butte County	San Mateo County	City of Santa Monica	
Respondants considering solar (in the next 5 years)	21%	13%	40%	30%

TABLE II. WHAT YEAR WERE SOLAR PANELS INSTALLED?

Year Range	Total	Total Percentage
2015-2019	49	57%
2009-2014	21	24%
2003-2008	9	10%
1999 and older	5	6%
Not certain	2	2%

TABLE III. AVERAGE INSTALLATION YEAR BY JURISDICTION

Average Installation Year	Butte County	San Mateo County	City of Santa Monica
	2007	2017	2010

A. Solar Panel Education and Motivations for Disposal

Residents felt that the City/County website and the solar installer are the best sources of information on disposal of solar panels, other suggested sources included the manufacturer, the State of CA, Google/Internet, and the County’s franchised waste hauler. When asked what would provide the most encouragement to properly dispose of solar panels, residents prioritized knowledge on and access to proper disposal over monetary incentives and community pride. When asked to specify other sources of motivation, select responses include a “Personal sense of environmental responsibility” or “a fine for improper disposal.”

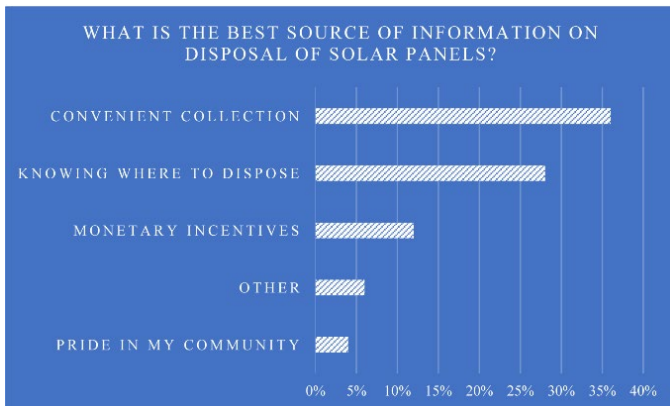


Fig. 1. An analysis of what residents think is the best source of recycling information.

B. Solar Panel Collection and Improvement

Residents were given an opportunity to describe how solar panels can be better managed locally. The responses varied from unsure to specific suggestions, but the majority of responses alluded to a need for more education.

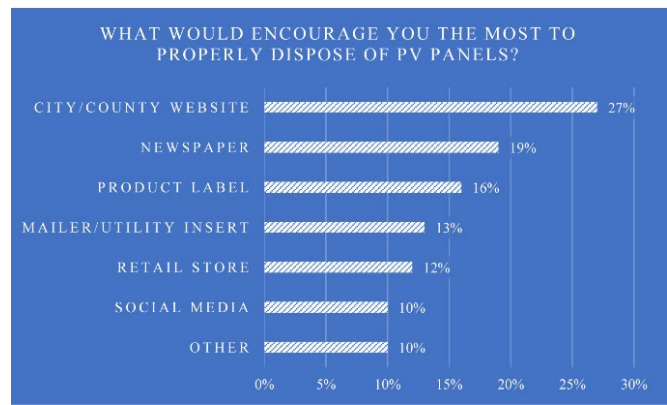


Fig. 2. An analysis of what incentivizes proper disposal.

Select responses include –

- “Establish a registry.”
- “We need to know expected lifetime of panels and what to do.”
- “Like with hazardous light bulbs and batteries have convenient collection places.”
- “Better education around full life cycle - installation and disposal.”
- “Offer a service that will collect them from your house when you have them down.”
- “Require installers to give user information.”
- “Rebates and other cost incentives to install. County sponsored installation.”
- “Work with manufacturer to provide disposal options.”
- “Work with Habitat for Humanity to promote reuse” or “Donation is a good option.”
- “Increase awareness of free and convenient drop off locations.”

C. Additional Questions from San Mateo

The San Mateo survey had some additional questions the other two surveys did not. For example, when survey respondents answered yes to having solar panels, the San Mateo survey followed up with asking if they received instructions for end-of-life management at the time of installation. Ninety-seven percent (97%) of respondents did not receive information on responsible recycling from the installer at the time of installation and only 2 respondents did receive information on responsible recycling. Selected responses to what the end-of-life instructions include –

- “There were no recycling instructions. My panels are leased until 2025, but at the end of the lease Solar City has the option to relinquish the panels, then it becomes my problem.”
- “None -- I assume that an installer would recycle if new replacements were installed”
- “Nothing the company is out of business”
- “None, but since they should last 20 plus years, I think the recycling technology/methods by then aren't necessarily known yet.”

D. Supporting a Producer Funded Takeback Program

The survey for San Mateo County asked residents if they would support a collection program for solar panels that was included in the initial cost of the solar panel purchase and to explain why. Responses can determine an effective funding system for a solar panel recycling program. When asked if they support a recycling program funded at purchase, 64% of respondents answered, “Yes,” while 36% said “No.”

Select responses in support include:

- “Less burden on new homeowner who purchased house with panels already installed.”
- “If there is no program then disposal is a big headache and bad for the environment.”
- “Paid for upfront, then there’s no hassle or decisions that have to be made at the end.”
- “While I would want them to be conscientiously disposed of / recycled, I wouldn’t be interested in doing the necessary research to determine how best to do it.”
- “Why not? Why would I leave the issue to future citizens to deal with, if I can knowledgeably support the now?”

Select responses in opposition include:

- “If I decide to sell then it should be the responsibility of the new homeowner.”
- “The cost of solar needs to stay low in order to compete other dirtier sources of energy.”
- “Will the program and funds still be sufficient in 10-30 years?”
- “I would rather see a fine for improper disposal. Serial numbers could be registered to owners, and companies that do construction could be paid to dispose of them properly.”
- “Because it should be already covered by taxes.”
- “Ownership should stay with the manufacturer. Also, residents currently DO NOT KNOW when they purchase that these become hazardous waste and it’s a buyer beware situation.”

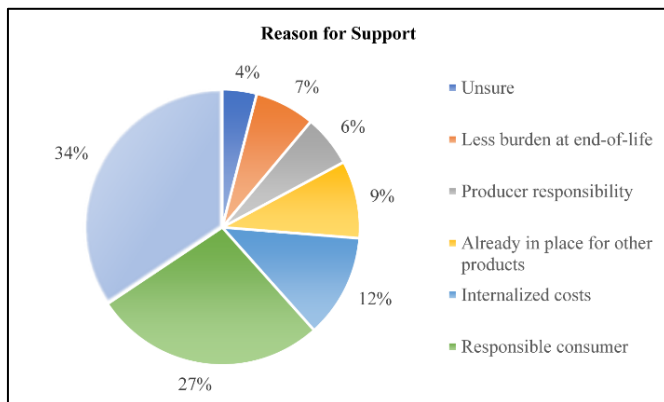


Fig. 3. A pie chart showing the reasons for supporting a collection program for solar panels that was included in the initial cost of the solar panel purchase.

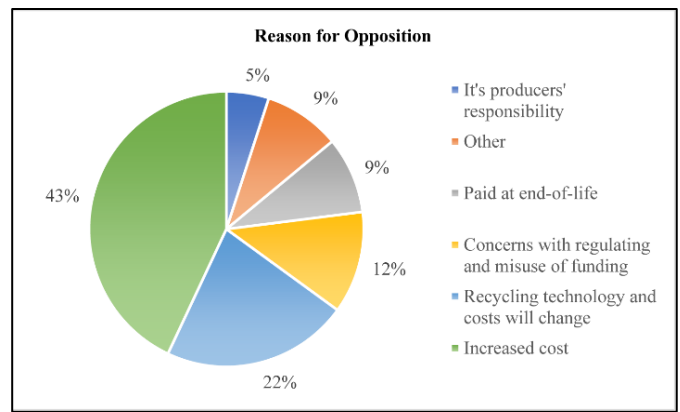


Fig. 4. A pie chart showing the reasons for opposing a collection program for solar panels that was included in the initial cost of the solar panel purchase.

IV. INSTALLER INTERVIEW RESULTS

CPSC conducted phone interviews with solar installers in each jurisdiction, using similar questions for open-ended responses. When asked how solar panel recycling can be improved locally, installer responses were much more technical than the resident responses. Select responses include:

- “More reusable components, more manufacturer take-back, replacing broken parts.”
- “Partner with big distributors like LG and Sun Power to deal with recycling.”
- “A standard operating procedure would be ideal for local solar companies to reference.”

A. Advising on End-of-Life Management

Very few interviewed installers give advice on end-of-life management to their customers, and most do not know what to recommend. In fact, 86% of interviewed installers do not have a policy or process for advising on end-of-life management for panels, but at least 5 installers expressed willingness to remove panels, if requested. Fifty-two percent (52%) said they have disposed of panels in the past, including taking them to an HHW facility, sending to a recycler, or back to the manufacturer. When asked if they have panels awaiting disposal, 29% of installers said yes, but hope to find opportunities for reuse, such as putting them on their own warehouse or donating for use on recreational vehicles.

B. Reported Causes of Unwanted Panels

The installers shared information on reasons for unwanted panels. Unwanted panels are not necessarily broken or not working. In one interview, the customer wanted a different brand of panel, so they had the unwanted panels removed. In another interview, the customer bought a set of 24 panels and only needed 18. In other cases, it would be when the panels have issues related to damage or inefficiency.

V. EDUCATIONAL WEBINAR

CPSC invited the public, including targeted outreach to installers and residents in the three jurisdictions, to a webinar sharing the results and a regulatory update on solar panel recycling in California. It was attended by 130 people from

across the nation. The webinar recording is available for ongoing use on the CPSC website (calpsc.org/webinars).

The webinar attendees varied with representation with the majority (67%) from all levels of government, including local and state agencies from California and other states, and federal.

The webinar attendees engaged with the panelists, asking questions throughout the duration of the webinar. The types of questions asked determine gaps in knowledge and topics to target with educational outreach. The most questions were regarding the current state of regulations for solar panel recycling in California and CPSC's research/collection projects.

VI. PROJECT SUMMARY

The research summarized above highlights the growing need to address solar panel recycling at all stages of the solar panel lifecycle and engage the producers in end-of-life management [2, 3]. Both residents and installers indicated solar panel recycling is not an immediate top concern, but many expressed fears, if not addressed quickly, could become a problem in due time. Ninety-three percent (93%) of survey respondents felt proper management is important and the information should come from the City/County and the installer. Eighty-six percent (86%) of interviewed installers do not have a policy or process for advising their customers on end-of-life management of the solar panels and the majority have already removed panels for customers. The volume of panels facing end-of-life will likely increase as 30% of residents are interested in solar for their existing homes and all newly constructed houses must have solar pursuant to the CEC requirement that began on January 1, 2020 [4]. Installers are in contact with residents most frequently and should be equipped

to advise on and/or collect unwanted panels. Most questions during the webinar requested information on the state regulations, which should be a top priority for educational outreach. Both supporters and opponents to the costs of a collection program for solar panels being included in the initial cost of the solar panel purchase believe producers must play a role in creating a sustainable end-of-life program. A subsequent report will be shared with details from the community collection events, including event logistics, available recyclers, and collection data.

ACKNOWLEDGMENT

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