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In response to comments from David Murray of MDV-SEIA at the last meeting of the RPS workgroup about PV recycling, Kent Conservation and Preservation Alliance submits the following information. The comment made noted that (recycling is) manufacturer-specific and that "the salvage value of solar power plant is quite high".

A quick review of the literature on recycling points to both problems and solutions, but recycling should not be left to be dealt with later when a tsunami of panels needs to be processed.

Although there are the beginnings of an industry for recycling of the panels, a paper, The Economic Feasibility for Recycling of Waste Crystalline Silicon Photovoltaic Modules, *Idiano et all, International Journal of Photoenergy Volume 2017,* concluded that recycling was not currently profitable for Crystalline Silicone solar panels, which represents the bulk of solar panels deployed (85-90% of market share).

Electric Power Research Institute (EPRI) has concluded that recycling of panels is feasible and improving with technology and process advancements, but not economical. They have concluded **in Program on Technology Innovation: Feasibility Study on Photovoltaic Module Recycling in the United States, Technical Update**, S. Shaw and C. Libby, April 2018:

"For PV recycling to be adopted in the U.S., regulations will likely be needed, along with a robust collection system." ....
"Based on experiences in Europe and Japan, a regulated recycling program will likely entail a robust collection system that gathers PV modules from sites of waste generation and transports them to a cost-effective recycling plant."

I. Why does this need to be considered?

- House Bill 1242 requiring a fund to be established for Solar PV recycling, failed in the 2018 session. This shows, however, that there is interest in constructing a bill to tackle this issue that would be supported and moved forward.
- The US has no national recycling program mandates. The classification of hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA) and determined by the

Toxicity Characteristic Leaching Procedure (TCLP). Panels not be determined to exceed standards of TCLP are considered universal waste and can be disposed in landfills.

- Since the early 1990's the number of solar panels installed has increased exponentially with approximately 35.3 million new solar panels installed so far in 2018. Panels having a useful life span of 20-30 years before needing replacement are already being removed from service and producing waste. The number of panels in Maryland is ramping up rapidly. In addition, solar panels that are not functioning due to damage, either from weather, or other events or malfunctions are entering the waste stream.
- Although SEIA is leading the industry and is committed to responsible end-of-life management, there is nothing mandatory in participation. Neither, domestic or foreign manufactures nor installers have any requirements to participate in recycling programs.
- There are no specific regulations regarding PV disposal in landfill in Maryland.
- Although end of life owners of utility scale projects are responsible under the conditions of a CPCN for removal and disposal of panels, the only language governing disposal is that the panels be disposed of legally and that "where practicable" recycled or reused. Therefore, if the panels, under RCRA are determined to be universal waste it would be legal for them to be disposed of in Maryland landfills and nothing in the conditions precludes this from happening.
- The US has long used other countries as the end-point destination for our recycling stream. Panels that are end of life in the US can be sent to overseas markets exporting a potential problem elsewhere that may lack environmental considerations. Disposal of electronic waste in some countries (China, India, Ghana) is not governed by environmental standards.

II. Others have already moved to legislate recycling.

Europe updated the Waste Electrical and Electronic Equipment (WEEE) Directive to include PV modules in 2014. National programs are being rolled out in EU member states to comply with the directive by legislating Extended Producer Responsibility(EPR.)

Washington has passed legislation in 2017 (ESSB 5939) "requiring manufacturers to manage and finance the safe recycling of solar units at end of life, at no cost to the owner of the product."

III. Conclusion

SEIA is developing processes to enable recycling and offers a national recycling program to their members only, which is neither mandatory nor free. First Solar has a cradle to grave program to recover solar panels for recycling available to their panel customers. This is a start, but a small fraction of the panel manufacturing world.

SEIA and First Solar should bring their experiences in recycling to the table, collaborating with State legislators to build a balanced, effective recycling program that will ensure recycling of PV panels is the future in Maryland.

Whether Maryland changes the RPS for the state or not, the Governor and the General Assembly need to have access to information in the RPS report, being delivered to them by the PPRP, about the potential for major impact on landfills for the disposal of PV panel waste. Right now, would be the opportune time, while reviewing the RPS pathway for Maryland, to address recycling.

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