Old Concord Road Solar Development:

Site Plan Review

and

Henniker Planning Board Meeting

March 22, 2023

www.NhSolarGarden.com

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Old Concord Road Solar Array Q&A:

NhSolarGarden (NHSG) would like to provide additional narrative to answer any questions as they relate to the project & up and coming public hearing:

- *The Solar project will support the residents of New Hampshire by providing renewable energy to the State via the Community Power programs (RSA 53-E) rolling out across New Hampshire, update the electrical infrastructure with the most up to date equipment and lines while also providing a new stream of tax revenue for the town that has little to no impact on town services*
- *The power can be sold to a New Hampshire Town, School or residents depending on the program the project decides to follow. Currently the intent is to sell the power to a Community Power program to have the largest impact*
- *The Community Power law can be found by going to the following link:*
- *Community Power: https://www.gencourt.state.nh.us/rsa/html/III/53-E/53-E-mrg.htm*

Old Concord Road Solar Array: Example NHSG installations

- *The project will incorporate fixed tilt panels at a 25-degree angle facing south. Below are examples of this type of layout developed by NHSG.*





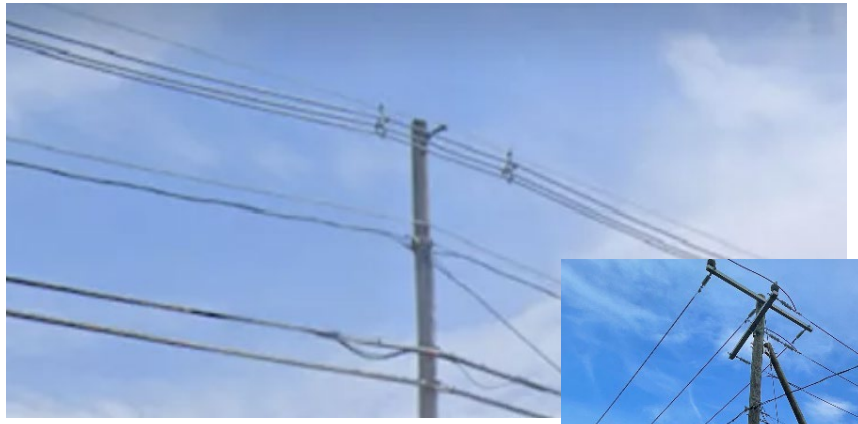



Old Concord Road Solar Array Q&A: Completed permitting steps to date

- *Land control via an 18 month lease option agreement & 25 year lease with extension options*
- *Agent authorization from landowner and NHSG*
- *PILOT analysis with assessor to begin once planning board approval is issued*
- *Eversource interconnection study is underway*
- *NHB – Habitat survey with no hits or required additional surveys*
- *NH DHR – Survey uncovered no additional areas needing surveys*
- *Phase I ESA completed with no environmental issues uncovered*
- *Test pits completed for State AOT stormwater and detention pond analysis*
- *Wetland survey showing the facility is outside the 100ft setback requirements*
- *Initial Site plan completed and attached with all existing conditions and solar farm overlaid*
- *Application includes request for issuance of required Conditional Use Permit*

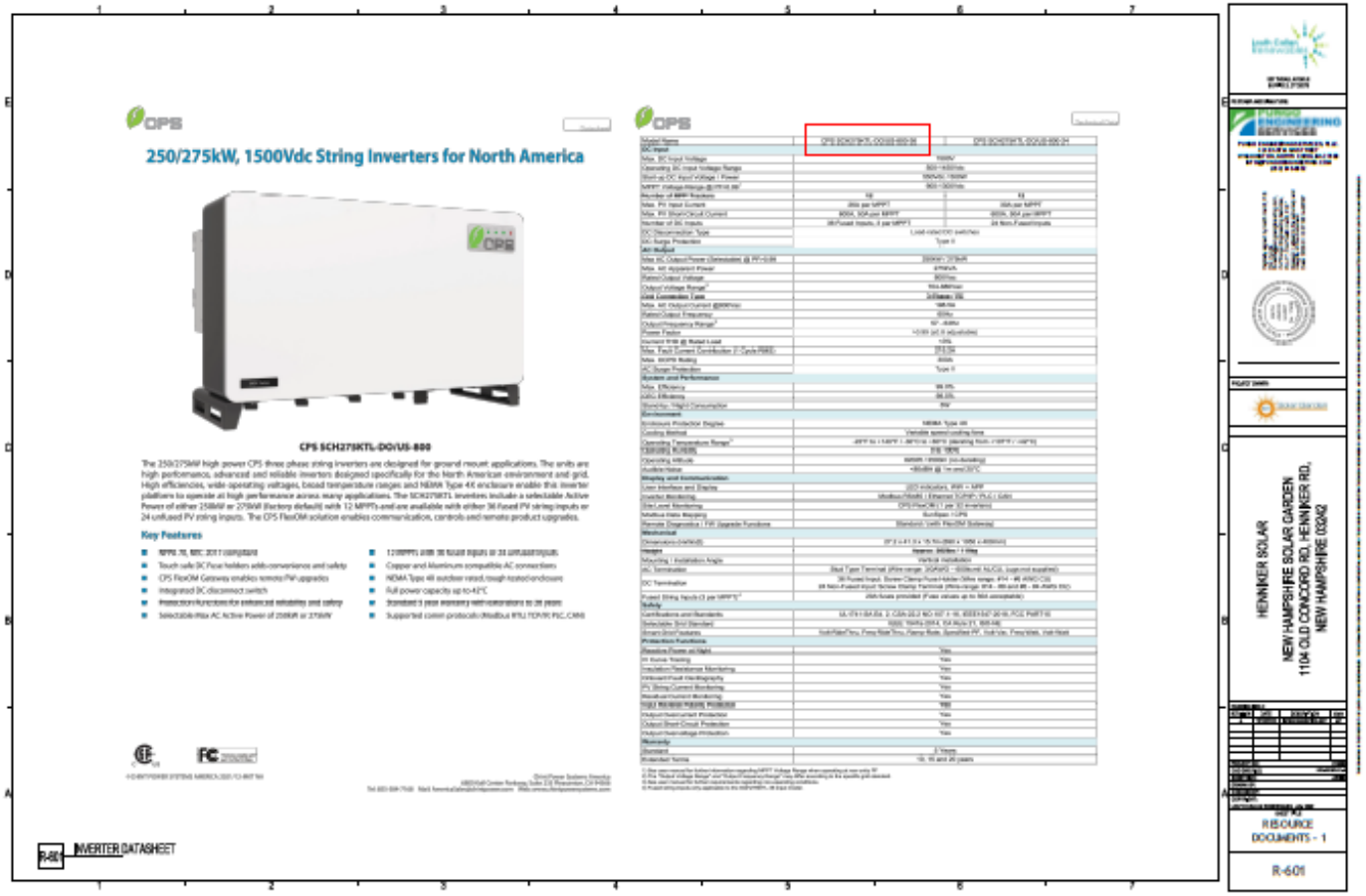
Old Concord Road Solar Array Q&A:

- *See example images of the poles to be installed by Eversource and an example of the transformer.*



Old Concord Road Solar Array Q&A:

- *See plan images of the equipment* required in Eversource application *and an example of a transformer layout.*



Old Concord Road Solar Array Q&A:

- *See below proof of Eversource's engineering underway and all approvals can be provided to the town if requested once Interconnection Service Agreement is signed by both parties.*

Clear Form

EVERSOURCE

Generating Facility Interconnection Request Form
For Interconnection of Distributed Generation
New Hampshire projects > 100 kVa & all non-inverter only

Instructions:
1. Review Eversource NH Guidelines for Generator Interconnection for an overview of the generator interconnection process.
2. Refer to Information and Technical Requirements, for the Interconnection of DER for an overview of interconnection technical requirements
3. Refer to the NH Application to Connect website for additional information
4. Email completed form to: Eversource-NHDER@eversource.com
5. Include your Eversource Project ID # (from your pre-application report) and "*Interconnection Request*" in the subject line of your email.
6. Be sure to include all attachments listed in the checklist below and label them as shown in the Document Filename column.

Customer has received pre-application report from Eversource? ☑ Yes ☐ No *If no, please submit pre-application request form*

Eversource DER Project ID # (found on completed pre-application report) D1349

Checklist

Please ensure that your Interconnection Request includes the following:

Generation Type	Document Filename	Requirements Checklist for a Complete Interconnection Request	Included Yes	Included No
All	Appendix A – Datasheets	Generator(s)/Inverter(s) Datasheet(s) for the correct model(s) #	☑	☐
	Appendix B – Site Control	Site Control Documentation included for the proposed facility address, Parcel ID#, etc. (see page 2)	☑	☐
	Appendix C – One-line	Generating Facility Electrical One-line matching the application and showing the following as applicable: facility name, address, size, POI, NH PE stamp, generators, inverters, GSU, Effective Grounding Equipment, metering equipment, protection equipment, and ISO-NE Inverter SRD settings compliance.	☑	☐
	Appendix D – Site Plan	Generating Facility Site Plan matching the application/one-line and showing the following as applicable: Facility name, address, size, equipment orientation, Eversource access to owned equipment, property lines, POI, and PCC	☑	☐
	Appendix E – PSCAD Model	Facilities greater than 1 MW - A PSCAD model specific to the inverter manufacturer/model (refer to ISO NE PP5-6, Appendix C, found at: https://www.iso-ne.com/participate/rules-procedures/planning-procedures).	☐	☑
Inverter Based	Appendix F – Islanding Info	Islanding Detection Information Document for the correct model(s) #	☑	☐
	Appendix G – TOV Letter	TOV Letter (see section 2.3.1 of Information and Technical Requirement for the interconnection of DER)	☑	☐
	Appendix H – UL1741 Info	UL1741 Certification/Testing Document	☑	☐
Induction & Synchronous	Appendix I – Schematics	AC/DC Schematics	☑	☐
	Appendix J	Documentation of the Independent Review of Existing Generation Site (if applicable)	☐	☑

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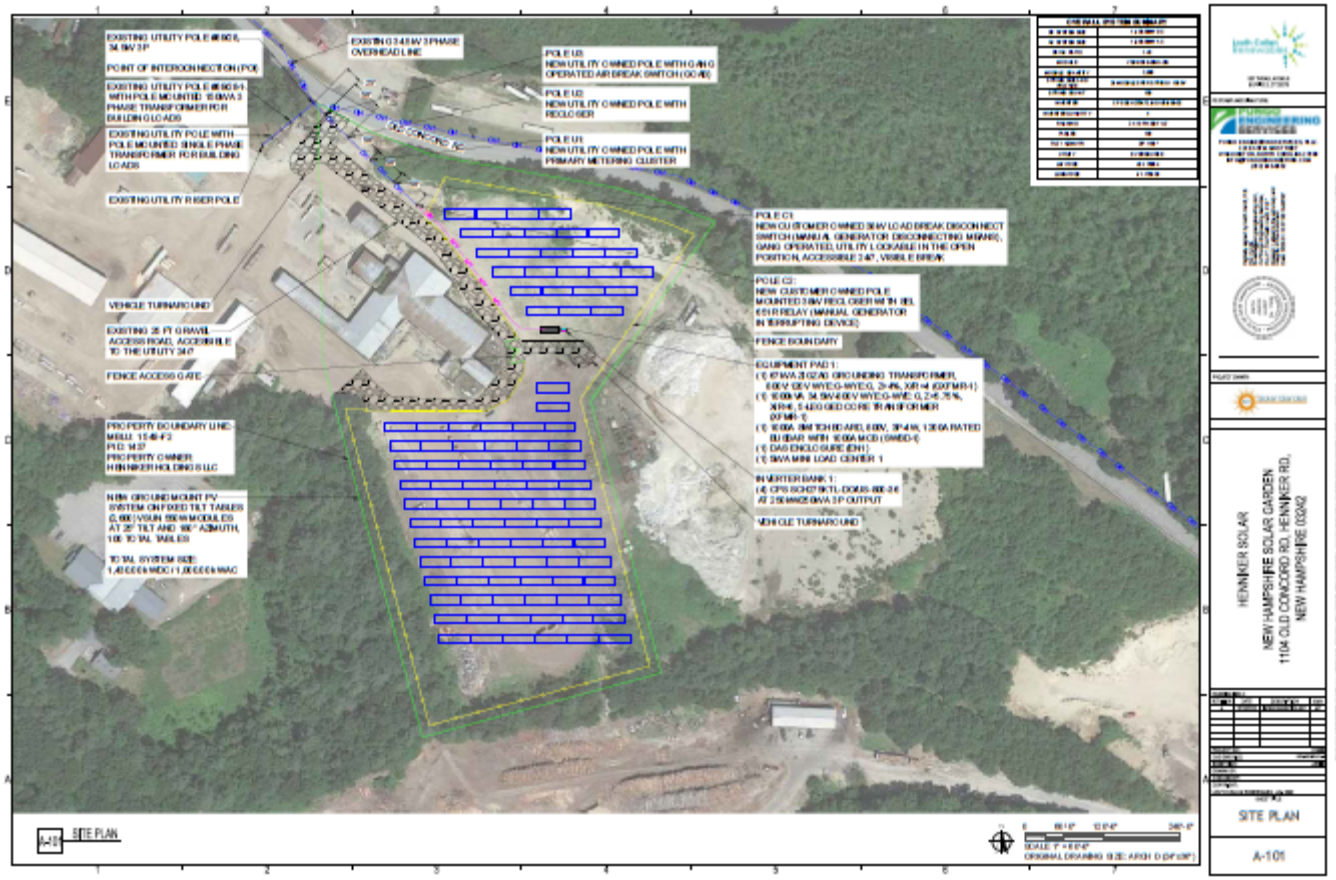


Old Concord Road Solar Array Q&A:

- *Solar panels have anti glare coating and noise calculations by a certified electrical engineer are below. It should be noted that a normal human conversation is traditionally 60 Db and the transformers spec'ed for this project is also 60 Db. The Inverter being spec'ed out has no sound and no moving parts. Temperature is controlled by the outside air, not a fan cooled or liquid cooled system*

MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline
Cell Arrangement	144 [2 x (12 x 6)]
Dimensions	2266 × 1134 × 35 mm (89.2 × 44.6 × 1.38 in)
Weight	32.2 kg (71.0 lbs)
Front Glass	2.0 mm heat strengthened glass with anti-reflective coating
Back Glass	2.0 mm heat strengthened glass
Frame	Anodized aluminium alloy
J-Box	IP68, 3 bypass diodes
Cable	4.0 mm² (IEC), 12 AWG (UL)
Cable Length (Including Connector)	410 mm (16.1 in) (+) / 290 mm (11.4 in) (-) or customized length*
Connector	T6 or T4 series or MC4-EVO2
Per Pallet	30 pieces
Per Container (40' HQ)	600 pieces or 540 pieces (only for US)

* For detailed information, please contact your local Canadian Solar sales and technical representatives.

Assuming that you are buying standard transformers, per NEMA TR-1, a 1000 kva pad mounted transformer's the average allowable audible sound level is 58 db.

Table 4. Audible Sound Levels

Self-Cooled, Two Winding kVA Rating	NEMA® TR-1 Average Decibels (dB)
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-10000	68

Scott Secrest, PE
64 Beacon St., Unit C202
Worcester, MA 01608
781-929-0139
scott.secrest@ssecrestpe.com

Old Concord Road Solar Array Q&A:

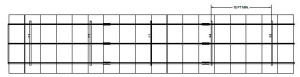
- *The project will include ~2,664 Boviet or Canadian Solar or equivalent solar panels, 275 watt inverters, metal racking and appropriate mechanical hardware of similar color. The project has a life expectancy of 40 years accompanied by 25-year panel warranties and 10-15 year inverter warranties. Below provides the details related to the operations and maintenance plan for the project:*

NH Solar Garden and its project owner contracts with the installation company to include, but not limited to, the following O&M services on an annual basis. Access to the site is via a contractor van or non-CDL truck:

- *Make sure modules are free from dirt/leaves.*
- *Inspect all mounting framework and fixings for integrity*
- *No shading issues have occurred since the installation or last inspection*
- *Space under the array is not obstructed and DC cables are securely clipped*
- *Test over current devices are in good operating condition*
- *All electrical connections are secure and free from corrosion*
- *Enclosures are secure and remote monitoring & security systems are maintained over wi-fi or cable connections*
- *All inverters are performing properly and will make any corrections if necessary*
- *All electrical systems are performing properly and will make any corrections if necessary*
- *Inspect the access road for any damage and repair as needed*
- *Vegetation management will be met by contracting with the landowner to have their animals graze within the solar farm to maintain the vegetation*

Old Concord Road Solar Array:
Example habitat friendly fencing, panel, knox boxes

4-6 ft in height



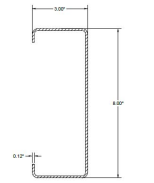
SOLAR ARRAY MODULE - TOP VIEW
NOT TO SCALE

SOLAR ARRAY MODULE - TRACKER
NOT TO SCALE

SOLAR ARRAY MODULE - ISO VIEW
NOT TO SCALE

SOLAR ARRAY MODULE -TRACKER
NOT TO SCALE

SOLAR ARRAY MODULE - SIDE VIEW
NOT TO SCALE



SOLAR ARRAY MODULE - POST X-SEC
NOT TO SCALE

8-12 ft in height

SOLAR ARRAY MODULE - FIXED TILT
NOT TO SCALE

SOLAR ARRAY MODULE - FIXED TILT
NOT TO SCALE

Old Concord Road Solar Array: Project Decommissioning

New Hampshire Solar Garden will prepare a Decommissioning Plan that meets all requirements, including updating said plan every 5 years, for the solar array facility. Over the last few years as these plans became mandatory in other communities, the plan is required to be certified by a professional engineer and delivered to the municipality based on the respective ordinance or CUPs. In addition, our lease agreement with the landowner requires us to completely remove the array and all its associated facilities (i.e., concrete pads). Below is a summary of the typical decommissioning tasks:

- *Remove Rack Wiring*
- *Remove Cable*
- *Remove Panels*
- *Dismantle Racks*
- *Remove and Load Racks*
- *Remove Electrical Equipment*
- *Breakup and Remove Concrete Pads and Ballasts*
- *Remove Power Poles*
- *Remove Fence*
- *Grading and hydroseed and Restore Vegetated surfaces*

The cost for decommissioning is currently estimated at $25,000 per megawatt MW/Ac and the project will be required to provide a form of surety to support the decommissioning plan & costs.

Old Concord Road Solar Array: Project Decommissioning

Below is an example bond/suretv/Letter of Credit NHSG uses

DRAFT LC V.2
DRAFTDRAFT**DRAFT**DRAFT**DRAFT**DRAFT**DRAFT**DRAFT**DRAFT**

LETTER OF CREDIT NO. **[INSERT LETTER OF CREDIT NUMBER]**

ISSUER:
[_____]

BENEFICIARY:
[_____]
[_____]
[_____]

APPLICANT:
[_____]
[_____]
[_____]

LETTER OF CREDIT NO: **[INSERT LETTER OF CREDIT NUMBER]**
ISSUE DATE: **[INSERT ISSUE DATE]**
EXPIRATION DATE: **[INSERT DATE ONE YEAR AFTER ISSUE DATE]**
EXPIRATION PLACE: AT OUR COUNTERS
AMOUNT: [_____]

RE: DECOMMISSIONING OF ___ MW SOLAR ELECTRIC GENERATION FACILITY LOCATED IN _____, NH ("PROJECT")

ISSUER HEREBY ISSUES IN FAVOR OF BENEFICIARY THIS IRREVOCABLE STANDBY LETTER OF CREDIT ("STANDBY") IN THE MAXIMUM AGGREGATE AMOUNT OF $_____ WHICH IS AVAILABLE BY PRESENTATION OF THE FOLLOWING DOCUMENT:

BENEFICIARY'S SIGNED AND DATED STATEMENT ADDRESSED TO THE ISSUER AND READING AS FOLLOWS: "[_____] HAS FAILED TO PERFORM DECOMMISSIONING AND SITE RESTORATION ACTIVITIES AS AGREED IN THE DECOMMISSIONING PLAN DATED [_____]"

PARTIAL DRAWINGS ARE ALLOWED.
MULTIPLE DRAWINGS ARE ALLOWED.

THE EXPIRATION DATE OF THIS STANDBY SHALL BE AUTOMATICALLY EXTENDED FOR ADDITIONAL PERIODS OF ONE YEAR UNLESS ISSUER SENDS NOTICE TO BENEFICIARY AT THE ABOVE-STATED ADDRESS BY CERTIFIED MAIL, COURIER, OR OTHER RECEIPTED MEANS OF DELIVERY AT LEAST SIXTY (60) DAYS PRIOR TO THE THEN-CURRENT EXPIRATION DATE THAT ISSUER ELECTS NOT TO EXTEND THE EXPIRATION DATE OF THIS STANDBY.

Applicant approves this draft LC: _____
(initials)

ISSUER ENGAGES WITH BENEFICIARY THAT DOCUMENTS PRESENTED UNDER AND IN COMPLIANCE WITH THE TERMS OF THIS STANDBY WILL BE HONORED IF PRESENTED DURING BUSINESS HOURS ON OR BEFORE THE EXPIRATION DATE AT [_____]. PAYMENT AGAINST A COMPLYING PRESENTATION SHALL BE MADE WITH ISSUER'S OWN FUNDS AND BY WIRE TRANSFER TO A DULY REQUESTED ACCOUNT OF THE BENEFICIARY.

IN THE EVENT THIS STANDBY IS NO LONGER REQUIRED, THIS ORIGINAL STANDBY AND ALL ORIGINAL AMENDMENTS, IF ANY, MUST BE RETURNED TO ISSUER AT THE PLACE FOR PRESENTATION TOGETHER WITH A SIGNED LETTER ON BENEFICIARY'S LETTERHEAD ADDRESSED TO ISSUER EXPRESSLY AUTHORIZING CANCELLATION.

THIS STANDBY IS ISSUED SUBJECT TO THE INTERNATIONAL STANDBY PRACTICES 1998 ("ISP98"), INTERNATIONAL CHAMBER OF COMMERCE PUBLICATION 590.

COMMUNICATIONS OTHER THAN DEMANDS MAY BE MADE TO ISSUER BY TELEPHONE AT [_____] OR BY TELEFAX AT [_____]. BENEFICIARY REQUESTS FOR AMENDMENT OF THIS STANDBY, INCLUDING AMENDMENT TO REFLECT A CHANGE IN THE BENEFICIARY'S ADDRESS, SHOULD BE MADE TO APPLICANT, WHO MAY THEN REQUEST ISSUER TO ISSUE THE DESIRED AMENDMENT.

_____ _____
AUTHORIZED SIGNATURE AUTHORIZED SIGNATURE

Applicant approves this draft LC: _____
(initials)

Old Concord Road Solar Array: Project Decommissioning

New Hampshire Solar Garden and its project owner will contract with solar recycling companies during the decommissioning stage of the project to remove the panels from the site, remove the recyclable components and then dispose of the components that are not recyclable. These components are similar to electronic waste regulated by the EPA.

RESOURCE RECYCLING
Your trusted source for recycling news and analysis

How the recycling industry is preparing to tackle solar panels

Published: June 15, 2021
Updated: June 18, 2021

by Jared Paben

E-scrap processors are developing strategies for an increasing number of PV modules entering the market. | Hill120 / Shutterstock

In some ways, solar panels present some of the same recycling challenges as old TVs. They carry a high cost to recycle properly, have limited commodity value and contain hazardous metals. At the same time, relatively few downstream processors recycle them, and markets are working against reuse.

"Solar panels are pretty much the new CRT," said AJ Orben, vice president of Arizona-based We Recycle Solar, referring to cathode-ray tubes, which contain leaded glass and were used in old, bulky TVs.

Interviews with electronics and solar panel recycling industry experts shed light on the challenges the sector faces with photovoltaic (PV) modules, which have the potential to be stockpiled, dumped, abandoned, or illegally landfilled, just as CRTs have in a number of cases.

Partly to head off potential mismanagement by certified recycling facilities, nonprofit group Sustainable Electronics Recycling International (SERI) is working on adding solar panels to its R2 e-scrap certification standard. Nearly 1,000 electronics recycling facilities around the world are certified to the R2 standard.

Meanwhile, more solar panels are continuing to enter the end-of-life stream. However, along with processing complications – and the expected additional regulations – are business opportunities.

"This is just the tip of the iceberg," said John Shegerian, co-founder and executive chairman of nationwide electronics processor ERI, referring to the number of panels his company is currently recycling, about a semi-truck trailer full a week. "This is just warm up to the game."

Complex mix of materials

About 95% of panels sold today are crystalline silicon, which have PV cells made with silicon semiconductors, according to the U.S. Department of Energy. Designed to withstand the elements for decades, solar panels are made up of interconnected PV cells that are encapsulated in plastic and sandwiched between glass and a backsheet. The typical panel has a metal frame, usually aluminum, and external copper wiring.

In an article for Resource Recycling last year, Melissa Ann Schmid of solar power equipment exchange EnergySage explained that crystalline silicon panels are predominantly made of glass but also contain plastic, aluminum, silicon and copper, along with trace amounts of silver, tin and lead.

Recycling companies can easily separate the aluminum frame and external copper wires for recycling. But because the PV cells are encapsulated in layers of ethylene vinyl acetate (EVA) plastic and bonded to the glass, additional processes are needed to recover the silver, copper or high-purity silicon in the silicon wafers.

Processors taking in solar panels are currently employing different strategies.

We Recycle Solar has a large solar panel recycling plant in Yuma, Ariz., a city on the California border, and a smaller one in New York City. Launched five years ago, We Recycle Solar is recycling tens of thousands of panels each week, with material coming from homes, businesses and solar farms.

The company is the largest recycler of solar panels in the U.S., said Orben, although he noted there's only a handful of companies recovering all – or almost all – of the materials in panels.

We Recycle Solar removes the aluminum frame and wiring and shreds the panels. The shredded mix then undergoes secondary chemical processing, electrolysis, and additional processes to separate the metals, silicon and glass for shipments to downstream processors, he said.

"It's taken us five years to really refine what we do," he said.

Resource Recycling Search

The latest recycling industry news

Cart tags: A growing force in fight against contamination
Facing ever-increasing pressure to deliver a cleaner stream to processors, cities across North America are turning to curbside inspection of residential carts. Many are seeing positive results from the efforts.

Google explores how to capture 4.5 billion tons of plastic
A report from Google lays out how mechanical and chemical recycling, a virgin plastic production tax, consumer incentives and more can increase plastics recovery over the next two decades.

In My Opinion: Comparing the nation's first packaging EPR laws
A policy expert at the Sustainable Packaging Coalition (SPC) leans on recent SPC research to explain the differences between recently enacted extended producer responsibility laws in Maine and Oregon.

Brands invest in Ohio plastics recycling operation
Beverage giants and an investment firm are putting millions of dollars behind PET reclaimer Evergreen.

Recycled corrugated producers look to expand in US
Two major producers of containerboard made from recycled fiber are growing their presence in the U.S. Pratt Industries will add on to a Georgia box plant, and Atlantic Packaging is working on a major facility in Illinois.

OCC prices reflect global demand for containerboard
Paper mills that use a lot of recovered fiber were forced to pay substantially more for OCC over the past few months, reflecting the global strength in corrugated packaging demand.

Recycling industry confronts tough labor markets
Recycling operators around the country are struggling to find and retain employees. A handful of stakeholders shared potential solutions they've tried as they look to fill open positions.

See more Resource Recycling headlines

Based in Fresno, Calif., ERI processes solar panels for Redwood Materials, a Carson City, Nev.-based startup targeting recovery of valuable metals from batteries. In April, ERI announced a partnership through which the processor will send all of its recovered batteries and shredded solar panel scrap to Redwood Materials. As part of the agreement, Redwood invested a substantial sum in ERI, according to an ERI press release.

ERI has been working for about three years on R&D for solar panel recycling, Shegerian said. After removing aluminum frames, ERI size-reduces the panels in modified shredders. The key steps in the process are shredding and separating glass from the metals-bearing materials while avoiding unnecessary emissions.

The resulting shredded balls of metals-bearing material are then shipped to Redwood, which uses its technology to separate metals such as copper, silver and lead.

Another e-scrap company processing solar panels is Echo Environmental, which operates a 166,000-square-foot recycling and reuse facility in Carrollton, Texas, near Dallas.

Receiving a million-plus pounds of solar panels a year from manufacturers and others, Echo crews first remove the aluminum frame and clip off wires for recycling, said Tommy McGuire, president of Echo Environmental.

Echo then shreds the modules before using a milling process to separate a portion of clean glass, which is sold for use in fiberglass insulation and reflective paint. The remaining metals-bearing material is mixed into shredded circuits boards from electronics and shipped for smelting.

Complications around 'hazardous'

Complicating the end-of-life equation is the fact that some types of panels are considered hazardous because of their concentrations of toxic metals. The South Carolina Department of Health and Environmental Control produced a fact sheet listing the different types that may be considered hazardous, noting that non-hazardous panels can be disposed of in municipal solid waste landfills.

Among the types requiring special handling are thin-film cells, which are less common than crystalline silicon panels. First Solar, a solar panel manufacturer that has run a recycling program since 2005, makes cadmium telluride thin-film solar cell modules. According to First Solar, the recycling process involves shredding and milling in a hammermill. After that, the EVA laminate is separated from clean glass. Separately, a third-party company performs a metal precipitation process to recover cadmium and tellurium.

McGuire of Echo said because of the hazardous metals and additional handling requirements involved, Echo advises its customers with cadmium-containing thin-film cells to send them straight to First Solar's recycling facility in Ohio.

By and large, Echo's testing shows other panels aren't hazardous waste, he noted. But they still need to be handled carefully.

"Your typical PV module doesn't have a lot of hazardous implications, but similar to electronics, we certainly don't want them filling up our landfills," McGuire said.

Orben of We Recycle Solar said his company's testing shows that over two-thirds of panels are considered hazardous waste under the federal Resource Conservation and Recovery Act (RCRA) because of their lead or silver concentrations. About 90% of those same panels are considered hazardous under California standards because even if they haven't exceeded acceptable lead or silver levels, they've exceeded state copper or zinc limits.

We Recycle Solar's Yuma plants has a hazardous waste permit, according to the EPA, which noted that corrosive waste, cadmium, lead and silver are handled there.

In addition to the hazardous material considerations, recycling solar panels presents challenges in terms of economic viability.

"Current technology, infrastructure, and processes associated with recycling PV modules are not optimized for cost-effective recovery of high value materials," according to a March 2021 report from the National Renewable Energy Laboratory (NREL) and the Electric Power Research Institute. "As a result, the cost of recycling is often outweighed by cheaper more accessible disposal options."

Solar panel processors must charge fees to accept solar panels to offset their processing costs.

Orben said We Recycle Solar spends up to $25 per panel in processing costs to yield between $2 and $4 in value from aluminum, copper, lead, glass, silver and silicon. OEMs have lightweighted and used less valuable metals in newer generations of more-efficient products, which is great news from the manufacturing and consumer perspectives but not for recyclers, he said.

Meanwhile, Orben doesn't foresee processing costs coming down significantly in the future as a result of economies of scale. A lot of the costs will still be tied to labor, which is only expected to become more expensive.

He noted that there remains a financial incentive for waste generators to pay to recycle panels when the alternative is hazardous waste disposal, but that leverage slips away when cheaper municipal solid waste landfills are an option.

Additionally, not all collectors understand the economics of properly handling the material, Orben noted, creating cost pressures from the outset.

We Recycle Solar frequently gets calls from transfer stations, landfills and other recyclers that have accepted solar panels at no cost or low cost (such as 10 cents a pound) because they think they contain a lot of valuable materials.

McGuire of Echo Environmental added that solar panel commodity value is predominantly in the aluminum frames, with the wires and clean glass product also generating some amount of revenue.

Echo's process of mixing shredded PV cell material with shredded circuit board scrap that's shipped to a smelter reduces the value of the circuit board mix by several cents per pound, but the practice also keeps the material out of landfills, allows metals to be recovered and offsets smelters' needs for fluxing agents, he said.

ERI's Shegerian noted that, for now, his company's Fresno plant is the only ERI facility processing solar panels. But ERI's other facilities across the country are getting calls about solar panel recycling on a daily basis.

"The opportunity is massive, but to do it the right way is going to cost a lot of money," Shegerian said.

Resale market headwinds

Solar panels are designed to produce electricity for decades, so reselling a used panel may appear the best option economically and environmentally, and that exchange does happen.

At the same time, processors said, certain market and tax policy forces are also working against reuse.

McGuire said Echo has the ability to test the energy output of used panels so they can be resold. That works well for higher-value modules, he said, noting that there are international markets for secondhand modules, as well as one-off domestic projects.

But panels that didn't pass manufacturers' quality control checks can't be resold, he noted. And when contractors perform de-installs and aggregate and ship solar panels to Echo, what arrives is often a mismatch of different types of panels, making it tough to keep a consistent inventory, McGuire said.

Additionally, the pace of panel innovation hampers resale because prices for new panels have come down in line with efficiency boosts. According to the U.S. Energy Information Administration, the average value of PV modules shipped in 2019 (the most recent year for which data is available) was 41 cents per watt of electricity generated at peak performance. A decade earlier, the average was $2.79 per peak watt.

We Recycle Solar does resell solar equipment. But Orben also likened the problem to that facing some segments of the electronics market, "Having a 15-year-old panel that still produces is a lot like having a Pentium 3 today," Orben said.

Further holding back the secondary market is U.S. tax policy. McGuire noted that the federal government provides tax credits for homeowners installing new PV systems – for 2021, the credit is 26% of the cost of a system.

"It's really an uneven playing field, because you can't get that tax credit on secondhand modules," McGuire said.

Enter the regulations

More solar panels are expected to enter the waste stream in coming years.

According to the U.S. Energy Information Administration, shipments of new panels have increased substantially over the past 15 years. In 2019, enough PV modules were shipped to produce over 16 million peak kilowatts of electricity, a nearly 14-fold increase over the amount shipped a decade earlier.

Many of them will be decommissioned well before the end of their usable lives, because of performance improvements and lower costs for new panels (Shegerian of ERI said power producers may replace them in five years or less because the ROI is so compelling).

A report from the International Renewable Energy Agency (IRENA) and International Energy Agency Photovoltaic Power Systems Programme (IEA-PVPS) estimates that, by 2050, cumulative global PV panel waste will have reached 60-78 million metric tons, up from about 43,500-250,000 tons in 2016.

The report calls for the passage of PV-specific waste regulations, among other measures. Some of that has already occured. For example, Europe has adopted laws forcing solar panel producers to finance the collection and recycling of their products.

In 2017, Washington state became the first state to pass a bill establishing an extended producer responsibility (EPR) program for solar panels. Starting in July 2023, the law will require manufacturers to fund collection and recycling of the panels.

In California, the Department of Resources Recycling and Recovery (CalRecycle) has considered adding solar panels to its electronics recycling program. The department is working with other branches of state government to draft a paper, expected to be released this year, on end-of-life management of PV panels.

In the meantime, the California Department of Toxic Substances Control (DTSC) late last year approved regulations (which were based on 2015 legislation) classifying PV modules as a universal waste, not a hazardous waste, easing regulatory burdens associated with collecting and shipping them. That being said, the panels are still considered hazardous if testing shows they exceed hazardous metals concentration limits in California or federal law, and universal waste handlers are required to do that testing when they discard the panels.

McGuire of Echo said he'd like to see regulations lead utilities to build the cost of recycling into their solar projects. Echo receives a lot of broken or defective panels from manufacturers, but he has yet to see a million pounds come in from a solar farm decommissioning/replacement project, he noted.

"I think it's very counterintuitive to the entire mission of solar if that stuff ends up in a landfill," he said.

Set to be integrated into R2

Meanwhile, SERI has begun a process to add solar panels to the R2 recycling standard, a step that would provide clear guidelines and requirements for e-scrap companies looking to handle the material.

After the newest version of the standard, R2v3, was finalized in 2020, SERI formed a workgroup of solar industry stakeholders to look at the issue. Among the 24 members of that workgroup were Dwight Clark of We Recycle Solar and Echo Environmental's McGuire, who helped lead the group.

That workgroup met for six months before presenting its conclusions to SERI's R2 Technical Advisory Committee(TAC), which on May 19 gave the go-ahead to begin the process of drafting language for solar panels. The new R2 text could take two-plus years to draft and finalize.

Corey Dehmey, SERI's executive director, noted that R2v3's new structure allows for the addition of appendices for specific materials. A new solar panels appendix would be mandatory for R2-certified companies taking in PV panels, he said.

"[Adding PV modules would be] giving the world a way to recognize processors that are handling them in an environmentally sound manner," Dehmey said in an interview. "Processors are going to tell you they're handling them right. How do you know?"

Dehmey noted that the NSF/ANSI 457-2019 standard has been created to cover the life cycle of PV modules and that the Global Electronics Council has adopted that standard for its EPEAT-listed products. But there isn't a standard focused specifically on end-of-life recycling.

McGuire said the adding PV modules to R2 would help ensure certified facilities send solar panels – or residuals from them – to proper downstreams.

Shegerian was also supportive. ERI's facilities are certified to both R2 and e-Stewards, another electronics recycling standard widely used in North America.

"It's always helpful when more certifications come in and help put guardrails around what really the word 'responsible' is," he said.

This story has been corrected and updated. The story previously said the 2021 solar panel tax credit for homeowners was 22%, but legislation signed into law in December 2020 changed that credit to 26% for 2021. The story text and related link have been corrected and updated.

A version of this story appeared in E-Scrap News on May 13.