

1. Here is a map of solar panel recyclers in the country that are supported by [SEIA](#) (Solar Energy Industries Association). I also have a slide showing solar panel collectors/recyclers in the mid-west and their pricing. While solar panels can be recycled, investment is needed for recycling that can get the most out of the panels. Here is an article discussing that: [Research and development priorities for silicon photovoltaic module recycling to support a circular economy](#)



Cost of recycling

- Cleanlites (Lakeville, MN): \$0.55/lb (includes transportation from Cleanlites MN to Cleanlites OH). \$0.48/lb for recycling in OH
- Green Lights (Blaine, MN): call directly for pricing
- The Retrofit Companies (Little Canada, MN): contact for pricing, per lb or per unit
- Dynamic Lifecycle Innovations (Onalaska, WI): around \$.50/lb. for whole units (which includes aluminum frame). Strictly crystalline silicon modules. Can accept thin films, but at an increased charge. [~\$20 per 50 lb panel]
- NREL webinar: \$10-20 per module

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2. Slides on managing solar panels in MN

Regulations for end-of-life for *commercial entities*

- Subject to RCRA (Resource Conservation and Recovery Act) regulation.
- Per RCRA, all waste streams must be evaluated before disposal.
- If evaluated as Hazardous Waste (HW), dispose in a permitted facility or properly recycle
- To promote recycling, MPCA treats panels as we do e-waste: If properly recycled, considered universal waste not HW – so no need for evaluation, reporting, transporting as HW. Material is subject to storage time limits and may be subject to other requirements.

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Regulations for end-of-life for *households*

- Under Federal exemption of household HW from RCRA, if generated from *households* may be disposed of in municipal solid waste without any evaluation.
- Contractors removing: review contracts
- Contractors and installers may retain end of life management responsibility for leased panels
- Regardless of HW classification, solar panels are resource rich (metals, glass, silver) and Minnesota encourages recovery of materials whenever possible.
- Homeowners should contact vendors to take back and recycle.

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3. Comparison checklist of 4 potential models that was created as a guide for those that filled out the recent ranking survey. You'll see it covers orphan panels and green design, for example, and of course who would be responsible for setting aside funds!

4. WA state PS law

Washington

Enacted SB5939 (2017): Manufacturer takeback
Amended in 2020 Session (HB2645)

- Each manufacturer or a stewardship organization must prepare and submit a stewardship plan to the department by July 1, 2022, or within thirty days of its first sale of a photovoltaic module in or into the state.
- Defines PV modules covered in the program to include those directly connected to the grid or utility service, and modules mounted on buildings, plus commercial off-grid applications.



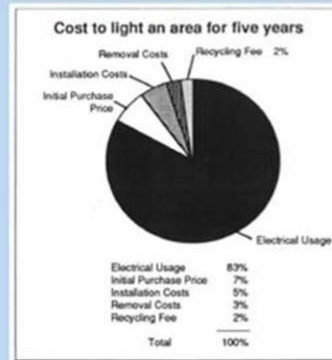
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5. Recycling in context of full life cycle costs

Recycling in context of full life cycle costs

Fluorescent lamps example:

- Recycling was opposed for reasons such as 'stigma,' cost, barrier to efficient lamp use and energy upgrades, insignificant mercury release, etc.
- Opposition disappeared when life cycle cost graphic was created and circulated



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PV Panel recycling in context of life cycle costs?

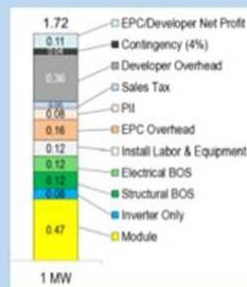
PV Recycling/Transportation Costs:
 \$20-\$24 per 300 Wdc panel or
 \$0.066-\$0.08 per Wdc;
 Equivalent to cost of inverter in
 installation and <5% of system
 installation cost

PV Life Cycle Income:
 Unknown

PV Decommissioning Costs:
 Unknown

(Wdc = Watts dc)

PV Installation Costs per Wdc:
 2018 Commercial PV system cost*



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*Credit for graphic and data in previous slide

Graphic is excerpt of:

Figure 20. Q1 2018 U.S. benchmark: commercial PV system cost (2018 USD/Wdc)

U.S. Solar Photovoltaic System Cost Benchmark: Q1 2018.

Ran Fu, David Feldman, and Robert Margolis

National Renewable Energy Laboratory

NREL Technical Report NREL/TP-6A20-72399, November 2018

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6. Sharebase link to all of our information

<https://app.sharebase.com/#/folder/30124/share/185-F0q16EJe7YVRbiNApIsCl1cAoHc>