



Solar Panel Recycling
Compliance Support for a New Industry

David Robinson



How did this work get started?

Situation

- New client with no history
- Request for multimedia environmental compliance support
- No direct experience with solar panel recycling



Thanks to Phoenix Office!
(Ryan Dunning and Dan Pike)

Big scoping questions

- Is client/technology legit?
- What are the regulations?
- Are there any competitors doing this?



Is this a do-able project?

Is the client legit?

- Get help from CEC Accounting/Legal
- Looked up journal articles
- Conversations with client

What are the regulations?

- No special rules (*in Texas*)
- Potentially hazardous waste

Are there any competitors?

- Lots of advertisements
- No regulatory footprint



How big is this market?

Solar Panel Usage (2022)

- Nationally only 2.2% of power
- Regionally up to 16% of power

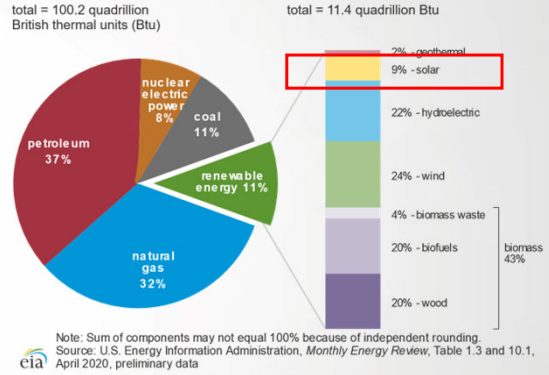
Regional example - California

- 30M MWh/yr of solar power installed
- ~100M solar panels @ 50lbs/panel
- = ~ 2M tons of solar panels

Turnover Rate

- 25 yr nominal lifespan
- Accelerated by damage, defects, etc.

U.S. primary energy consumption by energy source, 2019



What is being recycled?

Framing and equipment

- ~10% of mass

Glass

- Tempered and high purity
 - better transmission
- ~75% of mass

Laminate

- Plastic layers (~10% of mass)
- Solar Cells (~5% of mass)

The Basic Construction of a Crystalline Solar Panel

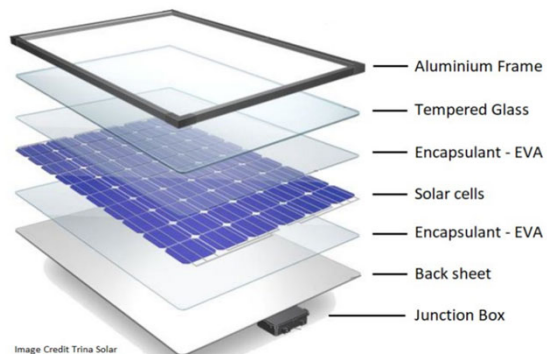


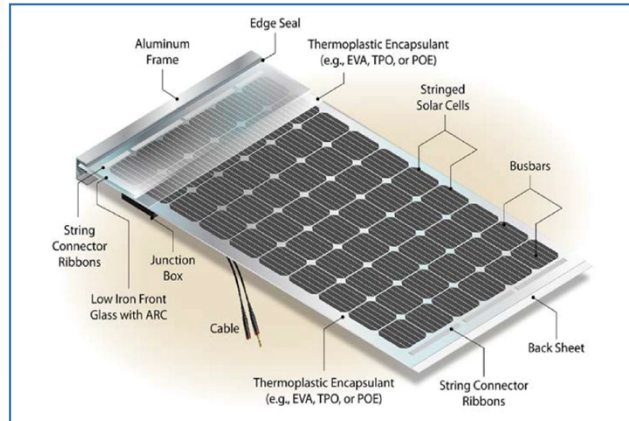
Image Credit Trina Solar



What is being recycled?

Solar Cells (~5% of mass)

- Two main types of Solar Cells
 - Silicon based
 - ~90% of panels
 - Non-hazardous (mostly – Pb)
 - Thin Film
 - ~10% of panels
 - Potentially hazardous
 - CdTe (Cadmium Telluride)
- Electrical connections
 - Silver, Copper, Lead

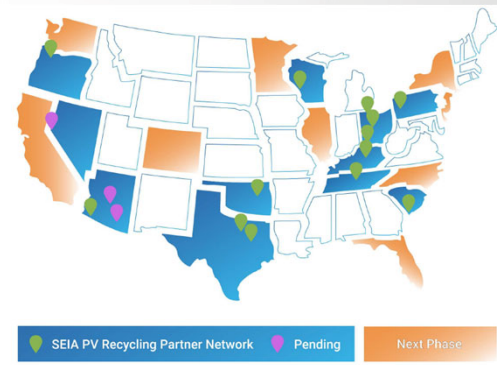


Source: NREL, Crystalline Silicon Photovoltaic Module Manufacturing Costs and Sustainable Pricing, 2019



How are solar panels disposed now?

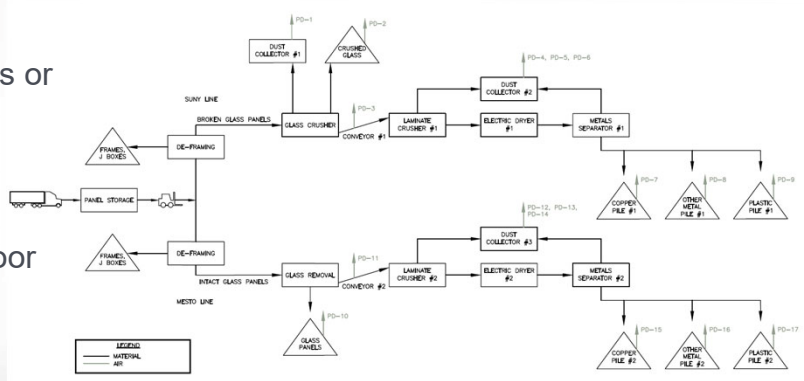
- Landfill (~90% are landfilled)
 - Hazardous waste concerns
- Quasi-Recycling
 - Multiple companies advertise recycling operations in Texas
 - None are authorized by TCEQ
- Other Recycling Operations



What permits are required?

Air emission issues

- Grinding and crushing operations
- No comparable examples or AP-42 references



Stormwater issues

- Outdoor storage of outdoor panels



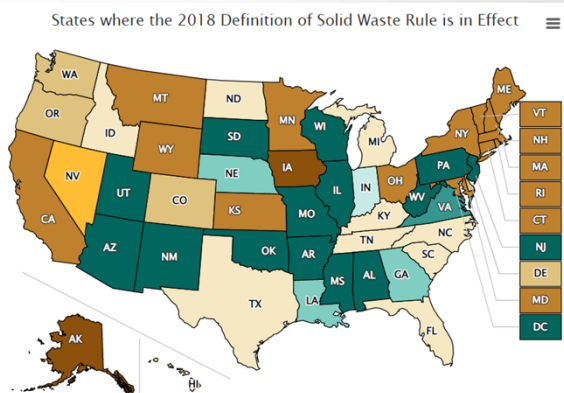
What permits are required?

Hazardous waste issues

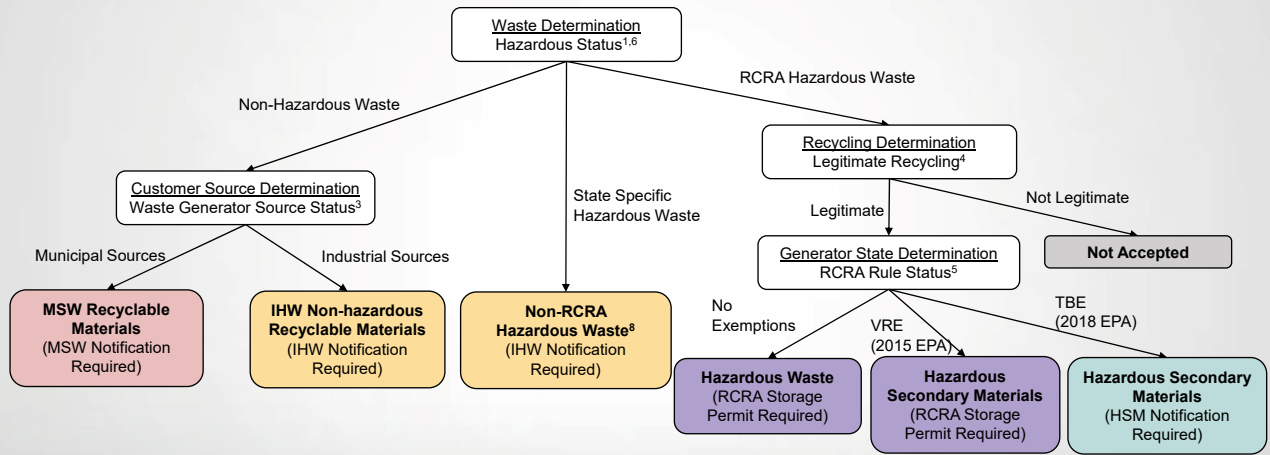
- TCLP testing variability
- State Specific Regulations
- Hazardous Secondary Materials (RCRA exemptions)

Non-hazardous waste issues

- Non-RCRA hazardous waste
- Industrial Waste vs Municipal Waste



Solar panel waste classification



QUESTIONS?

