

NSC Technical Subcommittee Call Minutes – November 21, 2023

Participation [by region]:

- 3: Luke Hershey, Jeremy Hancher & Lee Ann Briggs – **PA**
- 4: Ryan Ariail – **SC**; Olivia Achuko – **DC**; Erich Cleaver & Derek Bozzell – **KY**; Donovan Grimwood & Crystal Warren – **TN**; Griffin Jones – **FL** and Tony Pendola - **NC**
- 5: Jennifer Feyerherm – **WI**; Dan Sowry – **OH**; Ross Cooper – **IL**; Kaitlyn Devries – **MI**; Jennifer Theodore, Troy Johnson, Samantha Connolly & Emily Ohde – **MN** and Julie Rhodes, Chrystal Wagner & Mark Stoddard – **IN**
- 7: Bob Randolph – **MO**; Abigail Crouse, Cris Brazil & Mary Yesko Baker – **KS**
- 8: Eleanor Divver – **UT** and Bonnie Rouse & Michael Gustafson – **MT**
- 9: Christopher Lynch - **NV**
- 10: Belinda Breidenbach – **ID**; Jim Plosay & Nattinee Nipataruedi - **AK**

Unknown: Andrea O'Brien, David Carter, Jacob Larson, Keely Hutchinson, Mendoliac and Allison Hall

EPA: Elnora Thompson

Tech-Subcommittee: <https://nationalsbeap.org/committees/technical>

**** This presentation was recorded and will be posted on the National SBEAP YouTube channel at <https://www.youtube.com/channel/UC5PupYpZ1W6IG8CtzCINK8Q> ****

Closing the Loop on Electric Sunshine

Donovan Grimwood | Small Business Environmental Ombudsman (SBO)

Solar panels have been around a lot longer than most of us realize. But it wasn't until recently that solar panels became a viable source of clean energy. Even so, nothing lasts forever, so how does one recycle a solar panel and close the loop on one of the most versatile sources of clean energy?

Bio

Donovan Grimwood | SBO

Small Business Environmental Assistance Program (SBEAP)
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Donovan Grimwood started with the TN SBEAP in 1999 and has stayed with that program through about 6 different division changes (currently in the new Division of Stakeholder Engagement).

In 2014, he was named the TN Small Business Environmental Ombudsman, though he still mostly does technical work in the SBEAP. He is active in the National network of other state SBEAPs.

Currently he is Chair of the National Steering Committee of the SBEAPs. He is also active in the NSC Website Advisory Committee, the newly formed Environmental Justice workgroup, the Technical Subcommittee, leads the Metrics workgroup, and is following the current Awards coordinator so as to take over that position as the current one steps down.

Outside of the office, he is a volunteer instructor in the sport of fencing. He holds a BS in Chemistry from Tennessee Technological University.

Future topics:

- **December 19:** Bring your ideas for future topics and speakers to this Technical Subcommittee zoom meeting – annual training & future technical meetings.
- **January 16, 2024:** Climate and the Economic Justice Screening Tool, Mary Yesko Baker
- **February 20:** PM NAAQS final rulemaking discussion (time needed - ?), Regina Chappell & Rhonda Wright, EPA OAQPS
- **Other topics include:** ECHO Notify, updates on the minor NSR (New Source Review) rulemaking – 5 minutes
- **March 2024:** Potential annual training topics – National Compliance Assistance Center updates, managing used/expired hand sanitizer (Angela Hughes, OK DEQ), Recycling lithium-ion batteries and plastic/polymers, Updates on paint/coating materials from the American Coatings Association, EPA's Good Neighbor Plan – adding selective catalytic reduction (SCR) or nonselective catalytic reduction (NSCR) to your compression ignition emergency non-road stationary engine?

Next Call: December 19, 2023

1 pm CDT (2 pm EDT) (3rd Tuesday of month)

Closing the loop on Electric Sunshine

A brief history of solar
panels, how they work, and
how they are recycled and
why



Intro

- Donovan Grimwood
- TN SBEAP and Ombudsman
- Chair of National Steering Committee
- Head of Metrics and National Advocacy Committee workgroups
- Nearly 25 years in SBEAP
- Chemist, fencer, astronomer

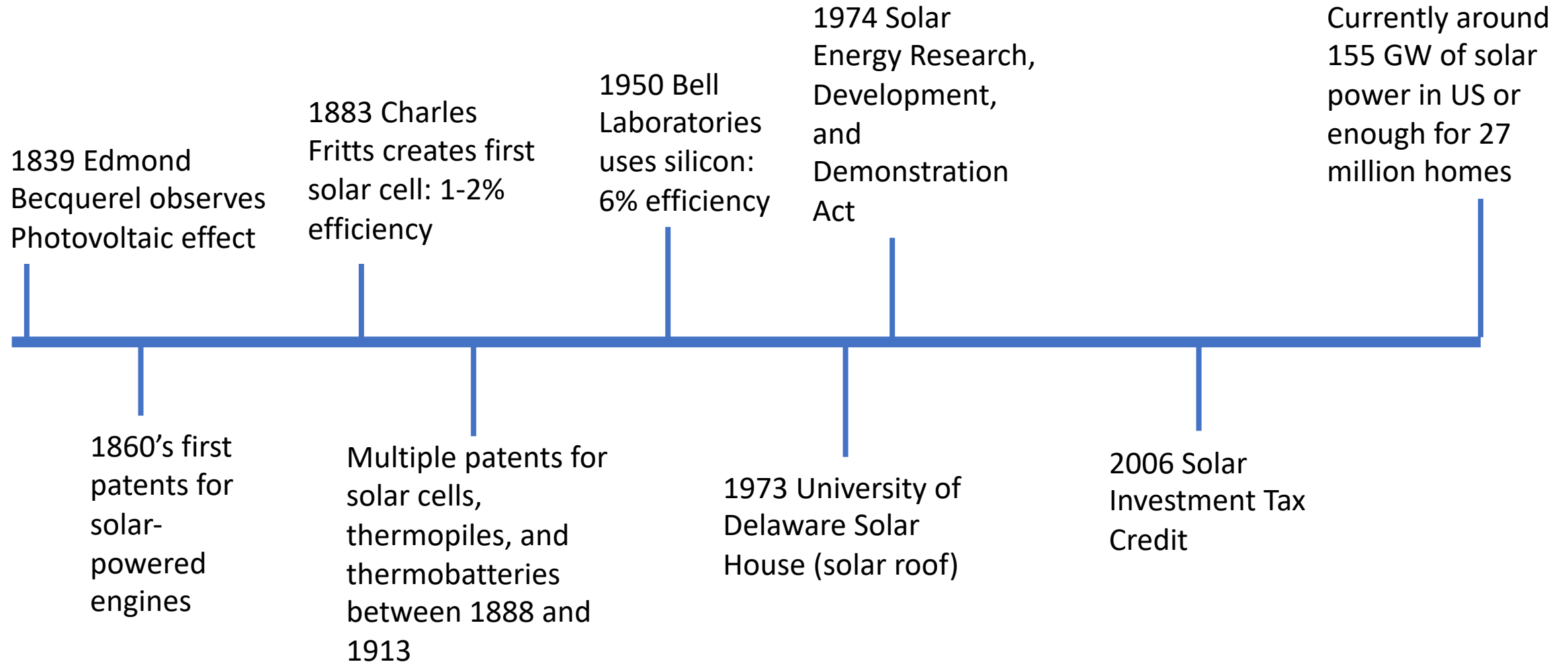


The Sun, the source of power

- A moderate size yellow dwarf
- Outweighs Earth by 1.3 million times
- Temps from 15 million C to 5,973 C... still hot enough to boil diamonds
- Made of gas and plasma (91% hydrogen)
- Each second produces more energy than 100 billion tons of dynamite
- Solar flares and coronal mass ejections can release huge amounts of material (also causes auroras and more)
- Averaged over a year, each square meter of Earth's surface receives 342 watts of solar energy



How to harness that power?



Current status of solar power

- Efficiency rate up to 23.6% from Aiko. Other new options including glass/glass at 22.5% (266 W/m²) [[Suntech glass/glass rooftop solution](#)]
- Newest record: 33.9% using silicon-perovskite tandem cells. Above theoretical limit of single junction cells.
- Testing of solar trucks [[Hybrid Scania Truck](#)]
- Estimator calculator:
<https://sunroof.withgoogle.com/>
 - Estimate (as of 2019) of 289 solar installations in Nashville, TN area. Compare to 10.5K in Phoenix, AZ area.
- Want to keep up on incentives for green power?
<https://www.dsireusa.org/>



Current status of solar power

- Estimated that 30% of electrical generation in US will be solar by 2030
- Costs are dropping. Cost of 1 MWh of solar fell between 40% & 86% from 2009-2017
- Ranch/farmland being rented for solar farms
- 250,000 people in solar industry and installer is one of fastest growing professions
- Offsets carbon footprint of production within 6 months to 2 years



Why do solar panels stop working?

- Most panels have an expectation of 25 years of operation
- Degradation and failure due to
 - Light Induced Degradation – normal loss of 0.25% to 0.7%/year
 - Potential Induced Degradation – long term failure due to voltage leakage
 - General Degradation – premature failure due to water ingress or defects
 - Light and elevated Temperature Induced Degradation – sudden 3-6% loss in performance
 - Micro-cracks and hot spots – longer term defect and failure due to broken or damaged cells
 - These are more longer term than manufacturer (1 in 5000) defects or catastrophic failure due to impact (baseball/tree/large hail)

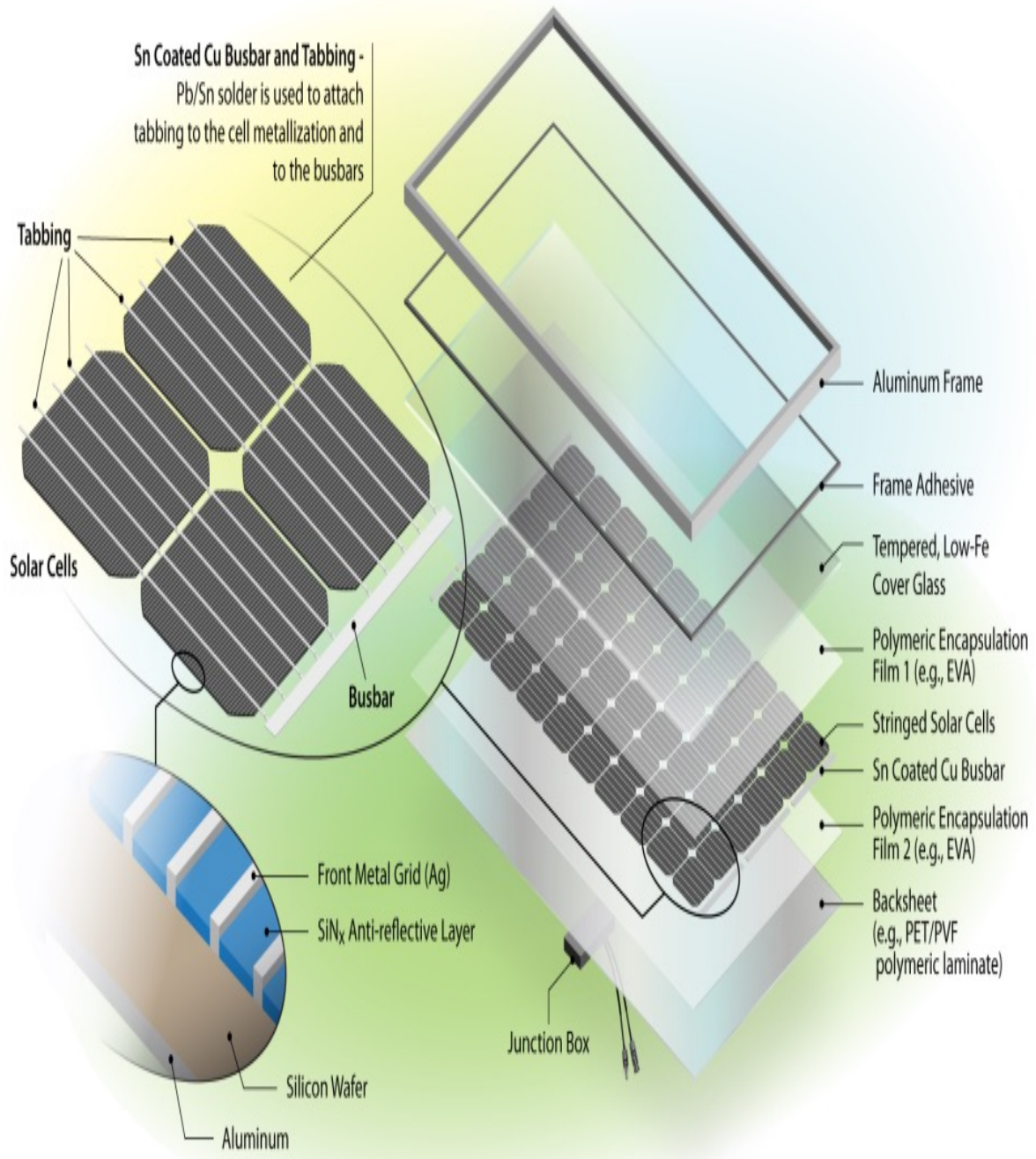


The need for recycling of solar

- Early wave of surge in decommissioned solar panels occurring
- Larger wave expected in 2030s
- By 2050, 60 to 78 million tons (worldwide)
- Some panels, especially some older ones may have heavy metals
 - Lead based solder
 - Silver metal grid to help conductivity
 - Tin coated copper busbars
 - Other metals: Cadmium, aluminum, tellurium, antimony, gallium, indium



Time to recycle... the process



- Removal of frame and junction box
- Separation of the glass and silicon wafer through thermal, mechanical, or chemical processes
- Separation and purification of silicon and metals via chemical and electrical methods
- Still in the early stages with no large scale facilities
- Facilities that can accommodate e-waste often used
 - One dedicated to cadmium-telluride cells for thin-film (Likely First Solar)



Time to recycle... the process issues

- Adhesive may need high temperatures to loosen as polymer seal is designed to protect from exposure to weather
- Al, glass (about 75% of weight of solar panel), copper wire, and plastic junction boxes are well established recycling methods and industry
- Ag, internal copper components, Pb, Cd, Sn, Te, Sb, Ga, In are present in some modules and may be more difficult to recycle. Plus, some are considered toxic
- Other components: inverters, racking, battery backup. Inverters as e-waste, racking with similar scrap metal, battery via battery recycling programs



The clock is ticking...

- By 2030, expected to have 1 million tons of solar panel waste.
 - Comparison: 2018 MSW was 292.4 million tons
- By 2050, second largest number of end-of-life panels (around 10 million tons)
- Some panels have enough metals to trigger RCRA HW rules (Subtitle C)
 - Can use transfer-based exclusion if recycling and regulations followed
 - Oct. 23, 2023: New EPA rulemaking to improve recycling of solar and lithium batteries
- EPA lists 5 states: CA, HI, NJ, NC, and WA as having specific solar panel regulations or policies (may be more).



Time to recycle...
the benefits

- International Renewable Energy Agency estimates that by 2030, value of recoverable materials from end-of-life panels will be about \$450 million to maybe \$15 billion by 2050
- Equivalent of materials needed to produce 60 million new panels



Leading resources and ideas

- First Solar: plan ahead for easier to recycle solar panels
 - Manufacturer of solar panels with 90% recyclability
 - Estimates that semiconductor material can be recycled 41 times for a use time of 1,200 years!
 - Estimate of 500 MW recycled in 2023 and established recycling program in 2005 (one of first in industry in US)
- PV Cycle: EU Funded non-profit started in 2007
 - EU regulations require 85% collection and 80% recycling of the materials used in PV panels, under the Waste Electrical and Electronic Equipment (WEEE) Directive, which was extended to solar products in 2012.

Additional resources

- Where to recycle?
 - <https://www.energy.gov/eere/solar/solar-manufacturing-map>
 - <https://search.earth911.com/>
 - <https://www.seia.org/initiatives/seia-national-pv-recycling-program>
- Additional Resources
 - <https://www.epa.gov/smm/sustainable-materials-management-smm-web-academy-webinar-shining-light-solar-panel-recycling>
 - <https://www.epa.gov/hw/solar-panel-recycling>
 - <https://www.epa.gov/hw/end-life-solar-panels-regulations-and-management>

