



Battery Storage

Energy Waste Meeting
October 23, 2024

Agenda



Welcome - Jayson Velazquez, Chair
of Energy & Technology Adrienne
Farrar Houel, Chair of Waste



Battery Storage Presentation Sara
Harari, CT Green Bank



Updates & Announcements



Upcoming Meetings

Battery Storage Presentation - Sara Harari, CT Green Bank

Solar & Storage End-of-Life

October 23, 2024



Mission & Vision



Connecticut Green Bank is the nation's first state level green bank. Established in 2011 as a quasi-public agency, the Green Bank uses limited public dollars to attract private capital investment and offers green solutions that help people, businesses and all of Connecticut thrive.

Our mission is to confront climate change by increasing and accelerating investment into Connecticut's green economy to create more resilient, healthier, and equitable communities.



Our Goals



Leverage limited public resources to scale-up and mobilize private capital investment in the green economy of Connecticut.

Pursue investment strategies that advance market transformation in green investing while supporting the organization's financial sustainability goals.

Strengthen Connecticut's communities, especially vulnerable communities, by making the benefits of the green economy inclusive and accessible to all individuals, families, and businesses.



Energy Storage Solutions



Energy Storage Solutions

- 9-year declining incentives – Goal of 580 MW behind-the-meter storage for residential and non-residential customers
- Upfront and Performance Incentives
- Statewide goal of 1,000 MW, including front-of-the-meter

CUSTOMER CLASS	2022-2024	2025-2027	2028-2030	TOTAL
Residential	50 MW	100 MW	140 MW	290 MW
Commercial and Industrial	150 MW	140 MW*		290 MW
Total	100 MW	200 MW	280 MW	580 MW

* Pending regulatory approval, expected December 2024

Energy Storage Solutions

- Residential customer classes: Standard, Underserved, and Low-Income Households
- Commercial/industrial customer classes: Small, Medium, Large (based on demand)

		Summer	Winter
Upfront Incentive (Passive Dispatch)	Events per Season	All non-holiday weekdays (~60)	N/A
	Months	June, July & August	N/A
	Event Duration	5 Hours	N/A
	Anticipated Dispatch Window	3 PM to 8 PM	N/A
Performance-Based Incentive (Active Dispatch)	Events per Season	30 to 60	1 to 5
	Months	June through September	November through March
	Event Duration	1 - 3 hours	1 - 3 hours
	Anticipated Dispatch Window	Noon to 9 PM (All Days)	Noon to 9 PM (All Days)

Today's presentation is a condensed version of the report that Power Advisory prepared for the Connecticut Green Bank and which was filed with PURA on July 31, 2024, as part of NRES, RRES, SCEF & ESS dockets.

Objectives:

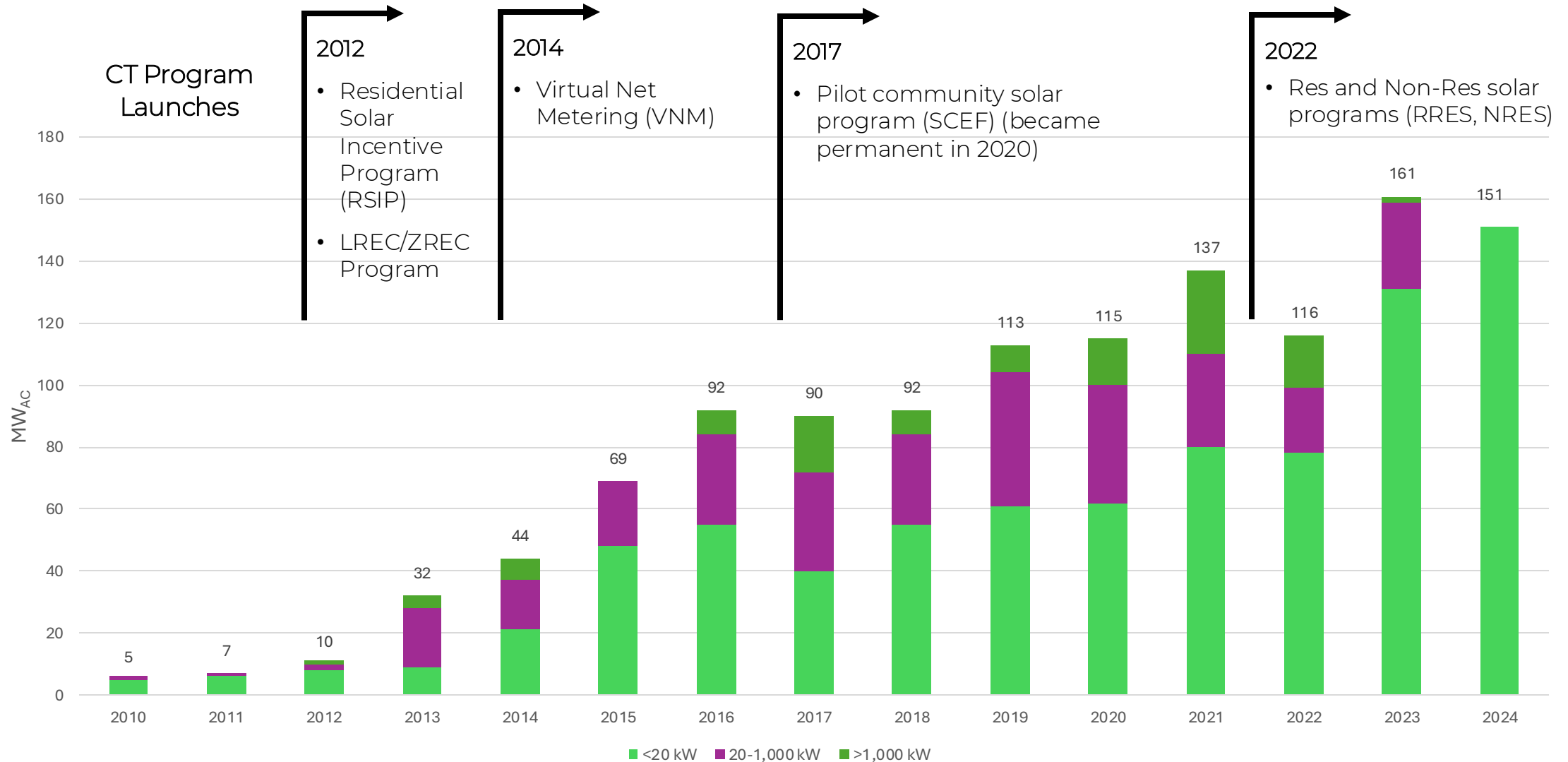
- Identify environmental effects of solar panel and battery waste;
- Research the success or failure of approaches used in other jurisdictions; and
- Generate recommendations

More detail about all the topics in today's presentation can be found in the full report, available in the dockets noted above and on the Connecticut Green Bank's website (<https://www.ctgreenbank.com/eol-working-group>)

Market Sizing



Solar Installations in CT, 2010-2024 (MW_{AC})

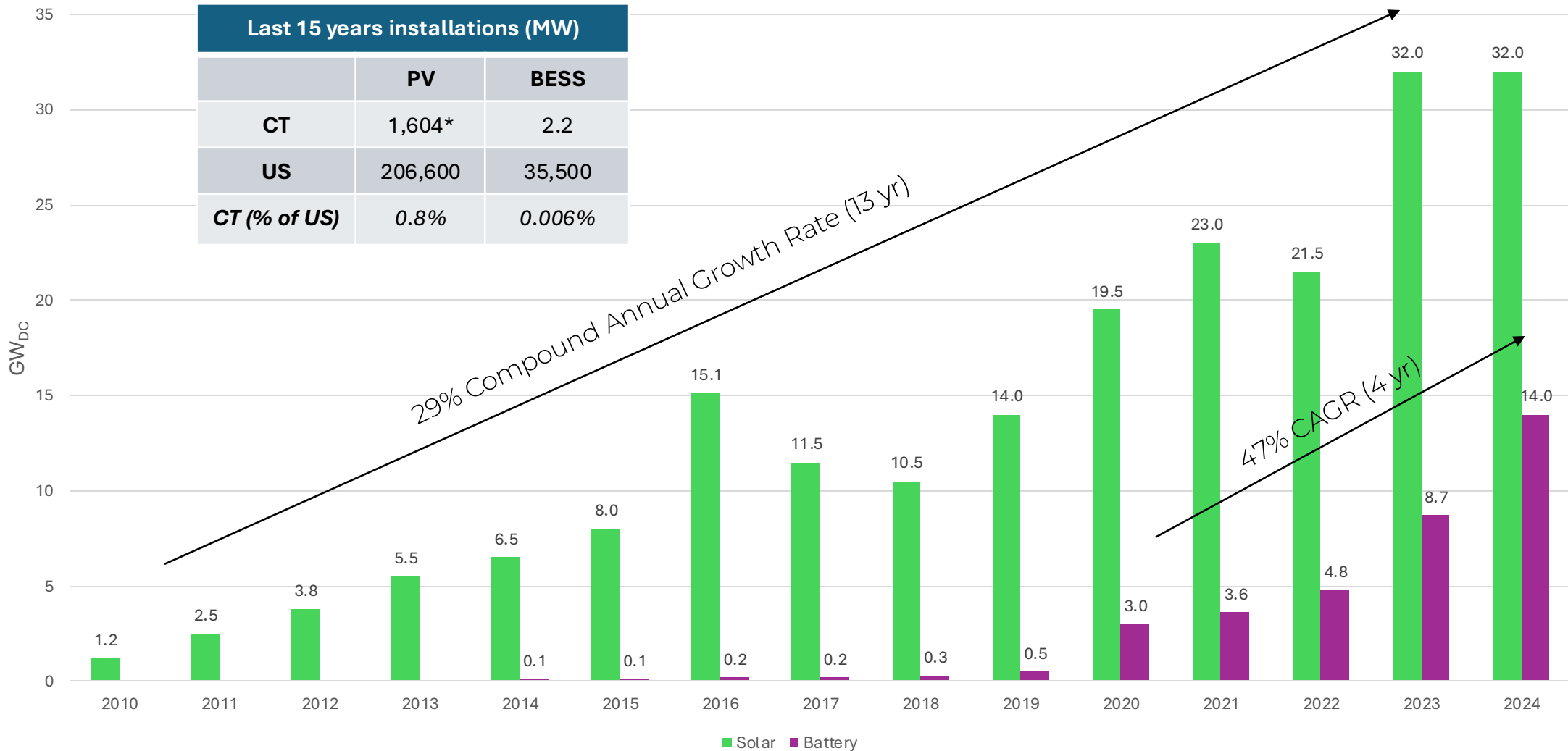


Note: As of July 2024, installed storage projects totaled 1.8 MW of residential and 0.4 MW of commercial.
 Source: ISO-New England 2024 Final PV Forecast, Eversource

Solar Installations in New England, 2010-2024 (MW_{AC})



Solar/Battery Installations in the US, 2010-2024 (GW_{DC})



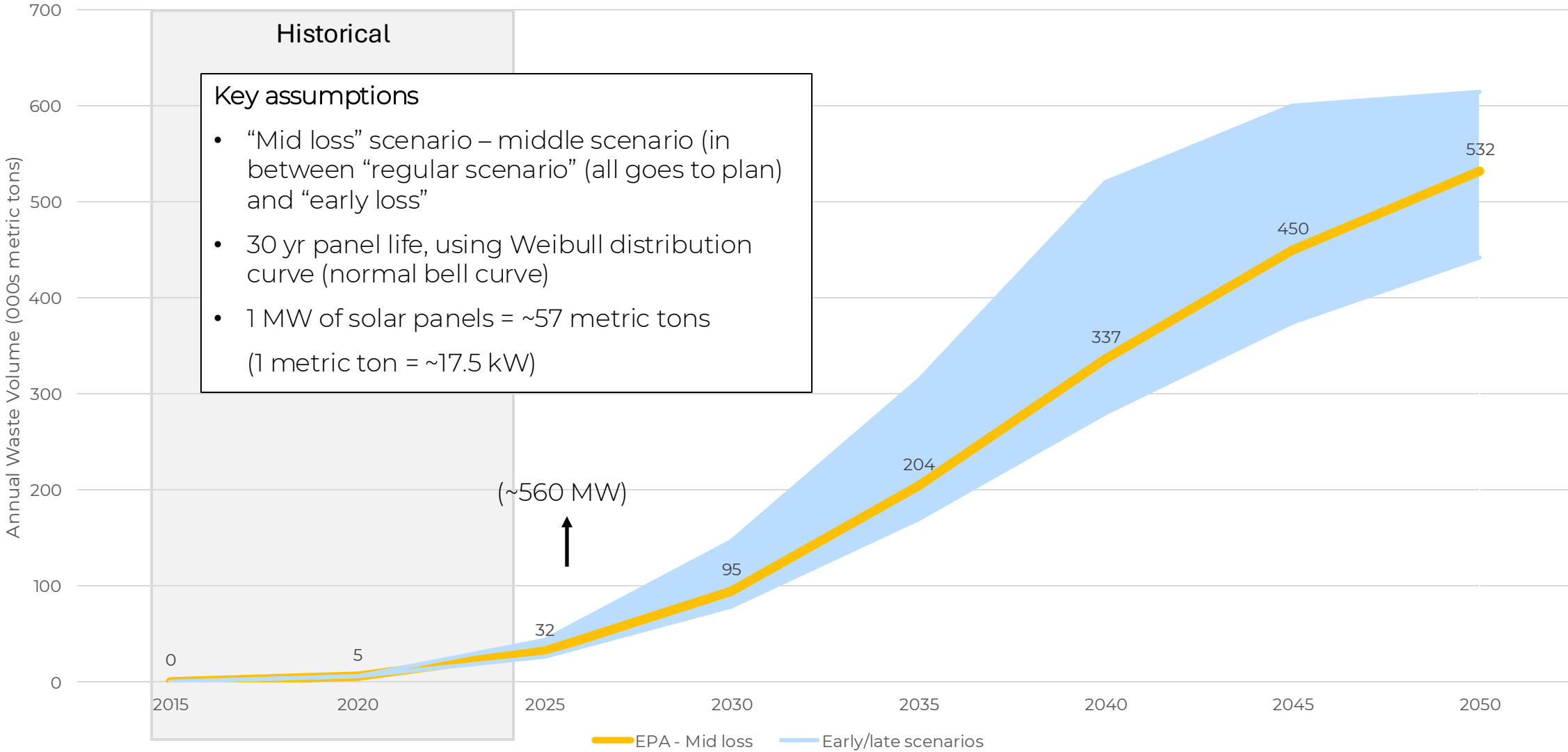
Last 15 years installations (MW)		
	PV	BESS
CT	1,604*	2.2
US	206,600	35,500
CT (% of US)	0.8%	0.006%

*Assumes a DC:AC ratio of 1.3

Source: Wood Mackenzie, American Clean Power, Power Advisory estimates

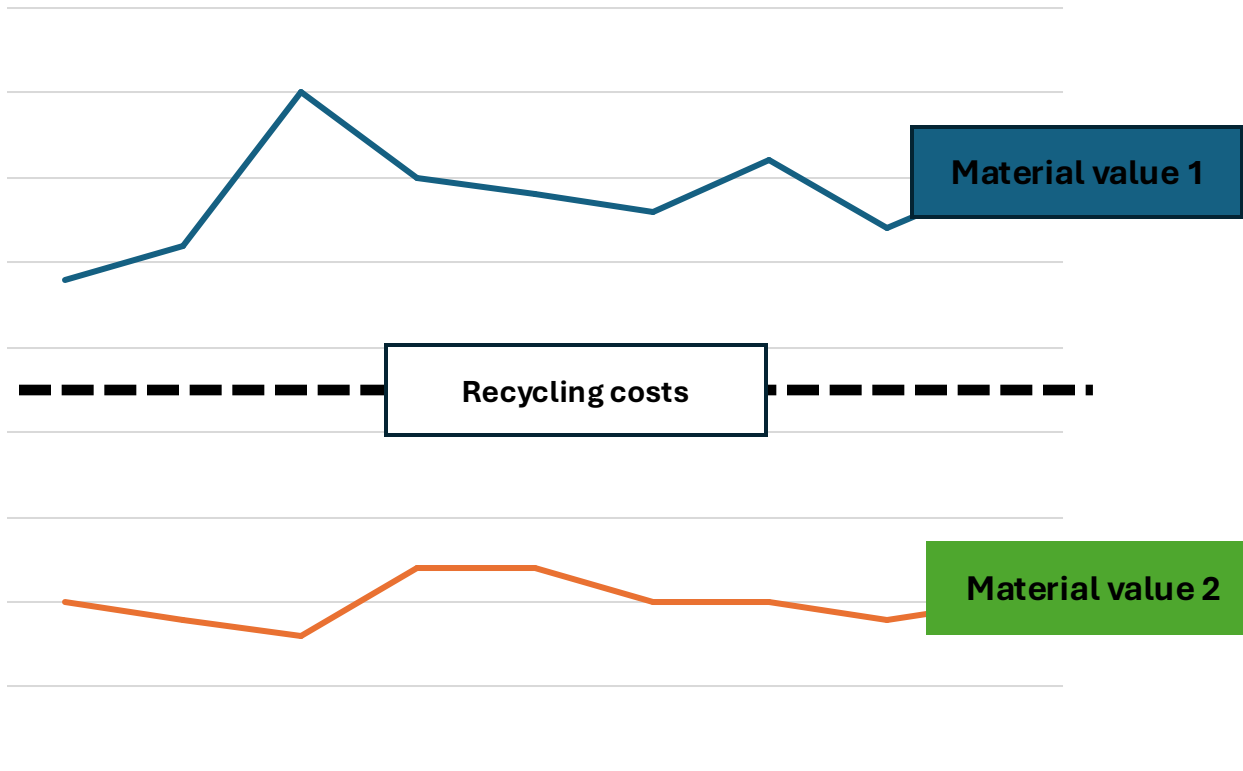


US Annual PV Waste Volume Forecast



Value-Positive vs. Value-Negative Recycling Markets

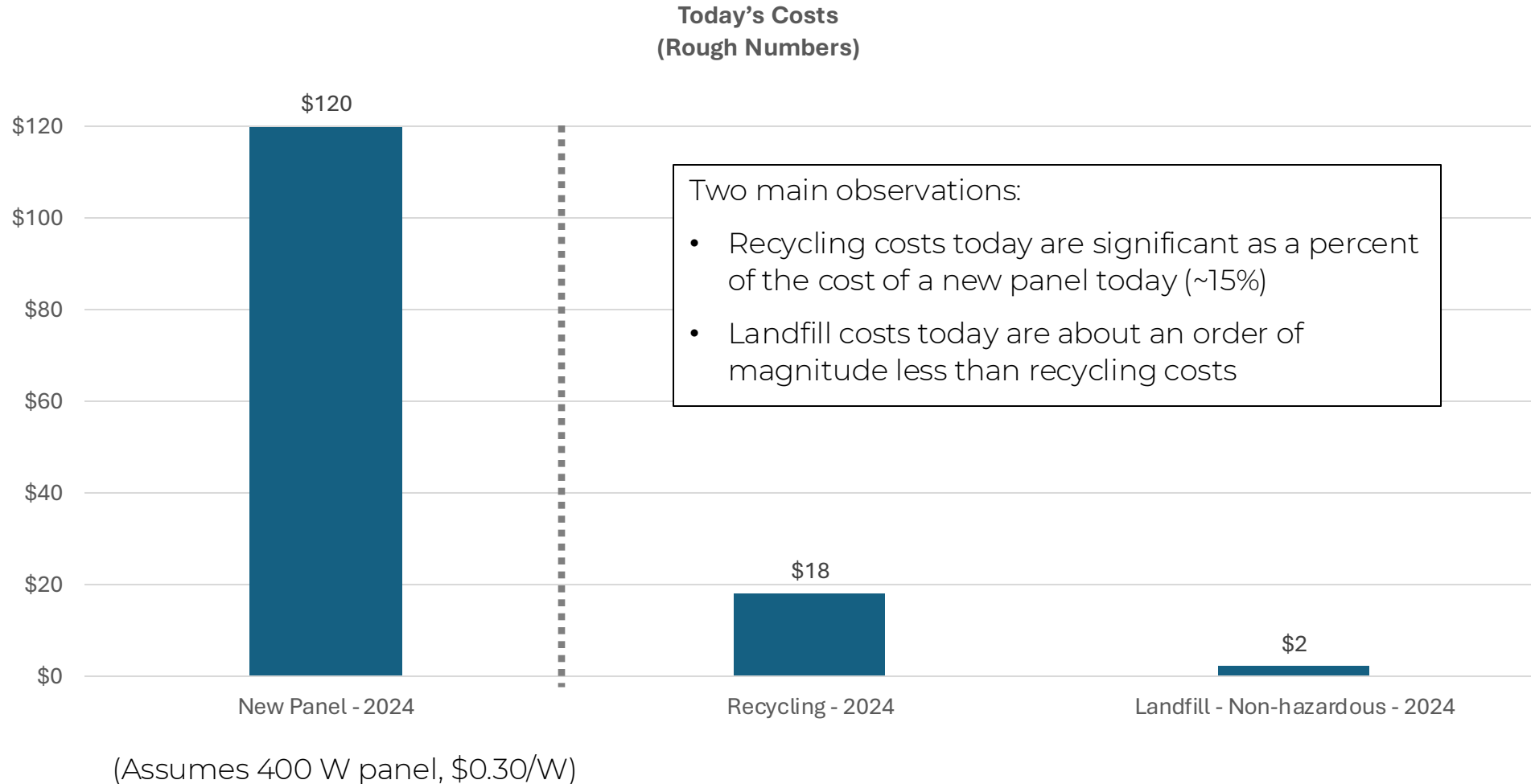
Material values vs. recycling costs



- A recycling market is **value positive** if the value of the recovered material a recycler is producing typically is higher than the costs to process the feedstock, sometimes referred to as a “**profit center**” (see “Material value 1” at left)
- A recycling market is **value negative** if the value of the recovered material is lower than the processing costs, referred to as a “**cost center**” (see “Material value 2”)
- If recycling costs are higher than the value (value negative market) a recycler will charge to accept material (often called processing fee, gate fee or tipping fee)
- If costs are lower than the value (value positive market) the recycler can share the value with the upstream supplier
- In both cases the level of the fee or the share of the value depends on the competition
- The solar panel market is currently value negative while some battery markets are value positive (depending on chemistry and commodity costs)

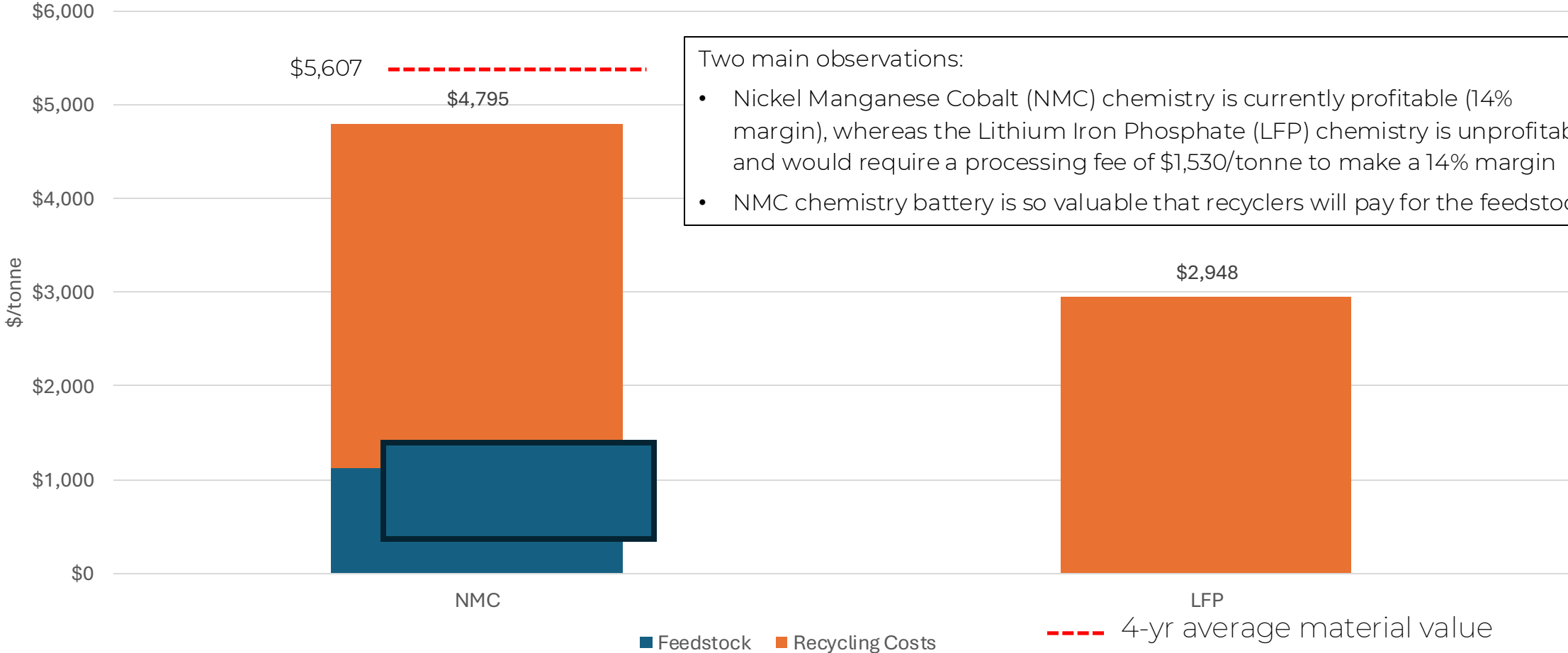


Indicative Pricing – Solar Panels



Indicative Pricing – Batteries

Revenues from Recovered Materials Minus Recycling Costs

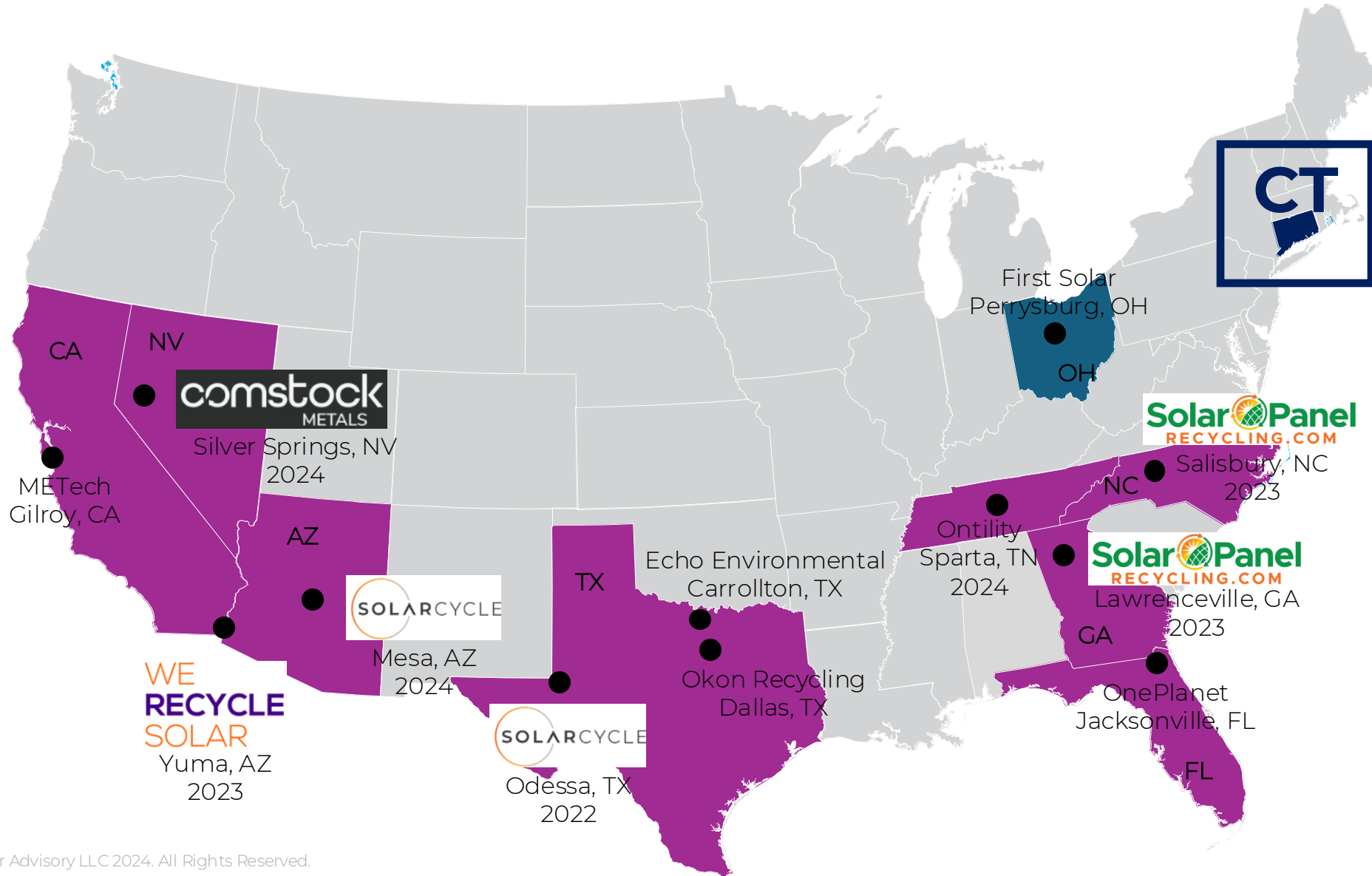


Two main observations:

- Nickel Manganese Cobalt (NMC) chemistry is currently profitable (14% margin), whereas the Lithium Iron Phosphate (LFP) chemistry is unprofitable and would require a processing fee of \$1,530/tonne to make a 14% margin
- NMC chemistry battery is so valuable that recyclers will pay for the feedstock



Select Solar Panel Recycling Factories



First Solar is closer to Connecticut, but that is a Cadmium Telluride technology which has not been deployed in CT

End-of-Life Policy



State of Affairs in Connecticut and Elsewhere

Current industry standard for end-of-life panels and batteries – commercial systems

- At present, in both Connecticut and across the country, few installations of solar panels or batteries have a plan for recycling the equipment at end of life. Rather, in the case of larger commercial systems, there is typically a decommissioning plan that calls for a construction waste company to remove the system, but with no requirement – or budget – to recycle the panels or batteries. These decommissioning plans are driven by the investor and/or lender of a given project. Unless the installed array is located on an otherwise regulated facility or location, there is generally no regulatory or legal mandate
- As more and more recycling companies emerge in this relatively nascent industry, announcements are being made of partnerships between recyclers and both manufacturers and asset owners. Publicly traded companies in particular are moving in the direction of recycling, in part because of ESG reporting requirements they have

Current industry standard for end-of-life panels and batteries – residential systems

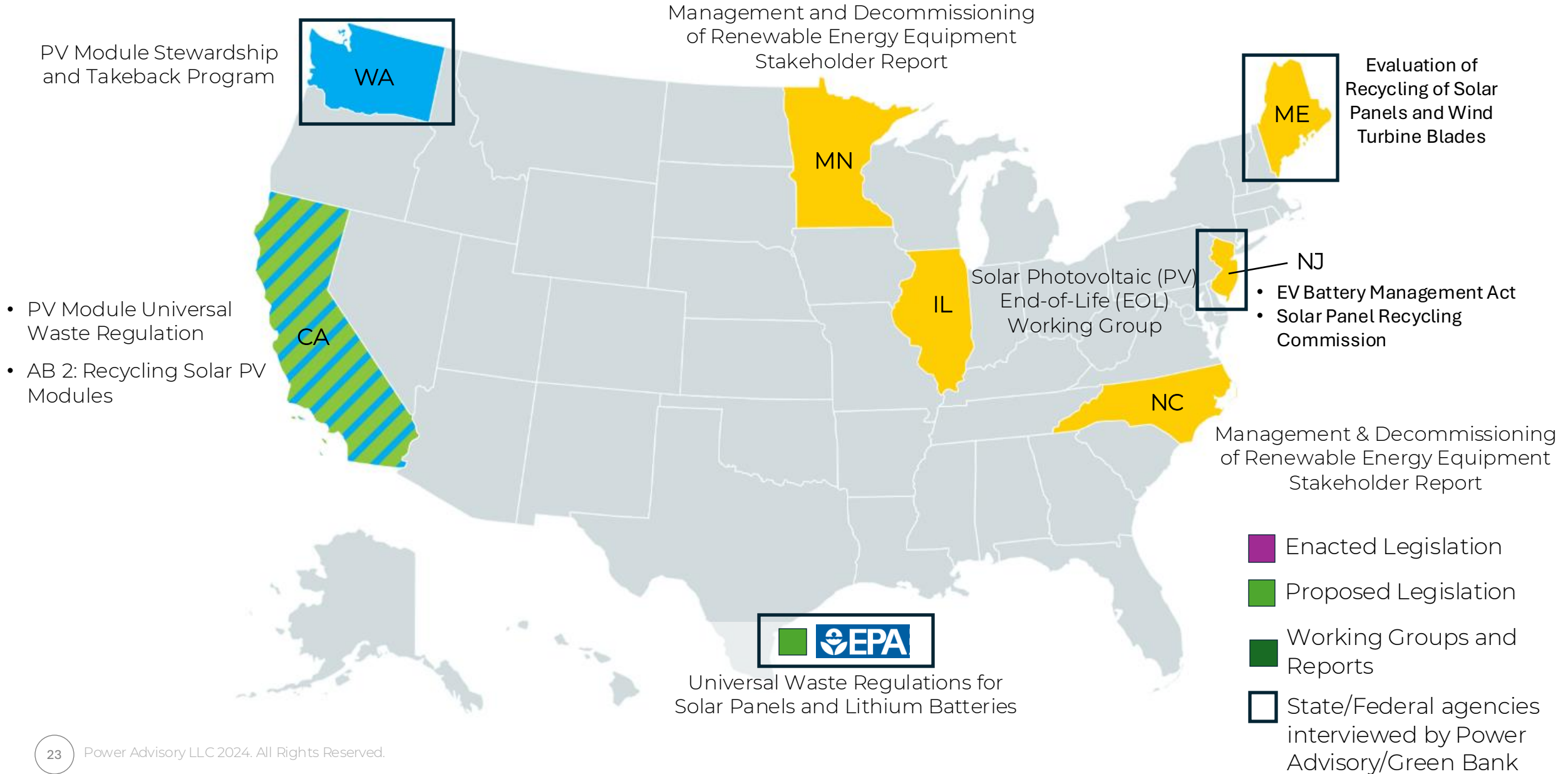
- Similar to commercial systems, few residential solar panel or battery systems have a plan for recycling at end of life
 - For third-party-owned systems, the asset owner typically expects that the

State of Affairs in Connecticut and Elsewhere

Policy development

- In the US, policies around end-of-life solar panels and batteries are in an early formative stage. In no state has the legislative framework for solar panel or battery recycling been fully implemented
- **Solar panels**
 - Only one state has enacted a policy that addresses solar panel recycling: Washington State. That law, based on the Extended Producer Responsibility (EPR) framework, was passed in 2018; with implementation/enforcement only set to begin in July 2025, there is no definitive track record on implementation to date
 - California classified solar panels as “Universal Waste” which means they can be legally disposed in conventional landfills but only after verifying that the panels do not contain hazardous materials. California has proposed a recycling law, based on the Advanced Fee Administration (AFA) framework, but it is still in the legislative process
- **Stationary Batteries**
 - The first ever law related to electric vehicle battery management was passed by New Jersey in January 2024; however, it does not cover stationary batteries (i.e., those that were the subject of our study)

End-of-Life Policies



Common End-of-Life Management Frameworks

Type	Decommissioning Bonds	Extended Producer Responsibility (EPR)	Advanced Fee Administration (AFA)
Description	<ul style="list-style-type: none"> End-of-life management decisions for utility-scale PV modules made and financed by the owners of the modules, normally with decommissioning bonds (which are required by some jurisdictions). If modules are not being reused or refurbished, owners are responsible for determining whether a PV module is a hazardous waste and can make EOL management decisions accordingly. 	<ul style="list-style-type: none"> The program requires a manufacturer (or other identified party, such as a distributor) manage the takeback and recycling of PV modules or batteries. Costs (or profits) are typically identified in Stewardship plans required at program outset, and ultimately borne by the manufacturer at EOL. 	<ul style="list-style-type: none"> States and/or independent third parties manage dedicated revenues which can be funded through a variety of programs such as advanced recycling fees charged at the time of sale, utility bill fees, or taxes. The funds would be disbursed to manage recycling programs or to reimburse contractors who administer private programs.
Responsible Party	<ul style="list-style-type: none"> Asset Owner 	<ul style="list-style-type: none"> Original Equipment Manufacturer (OEM) 	<ul style="list-style-type: none"> One of, or some combination of: asset owner, OEM, developer, distributor, installer, ratepayer, taxpayer
Timing of Costs	<ul style="list-style-type: none"> Owner puts in place a decommissioning bond at time of COD, and funds are used at end of life 	<ul style="list-style-type: none"> Costs to recycle materials are borne when services are needed, but there are various methods for ensuring that requirements are met such as financial assurance during project planning. 	<ul style="list-style-type: none"> Costs are typically borne by asset owners through a fee at the time of purchase. Because PV module lifetimes are longer than other recycled products, this can cause a mismatch between revenue and expenses for management programs that may need to be addressed.
Examples	<ul style="list-style-type: none"> Status quo across the US today NC Utility Scale Solar Management Program / SC Decommissioning Requirements (Proposed) 	<ul style="list-style-type: none"> Washington’s PV Stewardship & Takeback Program (OEM plans are due 2025) New Jersey’s Electric and Hybrid Vehicle Battery Management Act (passed Jan 2024, plans due likely in 2027) 	<ul style="list-style-type: none"> California’s E-Waste Advanced Fee Administration (Proposed)

Overview of Recommendations from End-of-Life Working Group

Infrastructure type	End-of-life management framework		
	Extended Producer Responsibility	Advanced Fee Administration	Decommissioning bond
Solar – residential-scale		X	
Solar – commercial-scale			X
Battery storage – residential-scale	X		
Battery storage – commercial-scale	X		

Questions & Answers

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Updates & Announcements

Upcoming Meetings

- Energy & Technology
 - Public Utilities Regulatory Agency (PURA) 101 w/Chair Marissa Gillett
 - Wed, November 20, 2024, 3:00-4:00 PM

We are creating a **NEW** email listserv for CEEJAC!



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<https://confirmsubscription.com/h/j/DAF1B876FCA74F4B>