Welcome to ESIG's Fall Technical Workshop!

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Providence, Rhode Island

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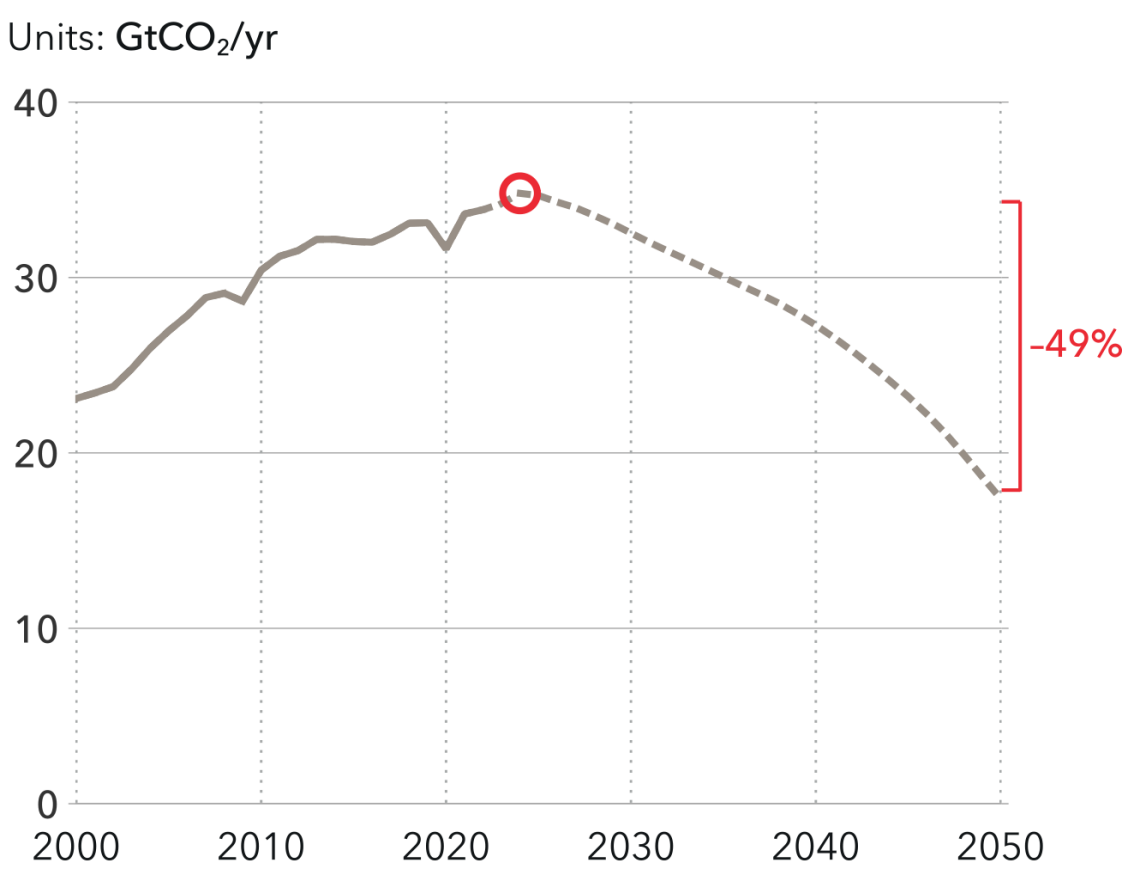
Emissions may peak in 2024

World energy-related CO_2 emissions will peak in 2024



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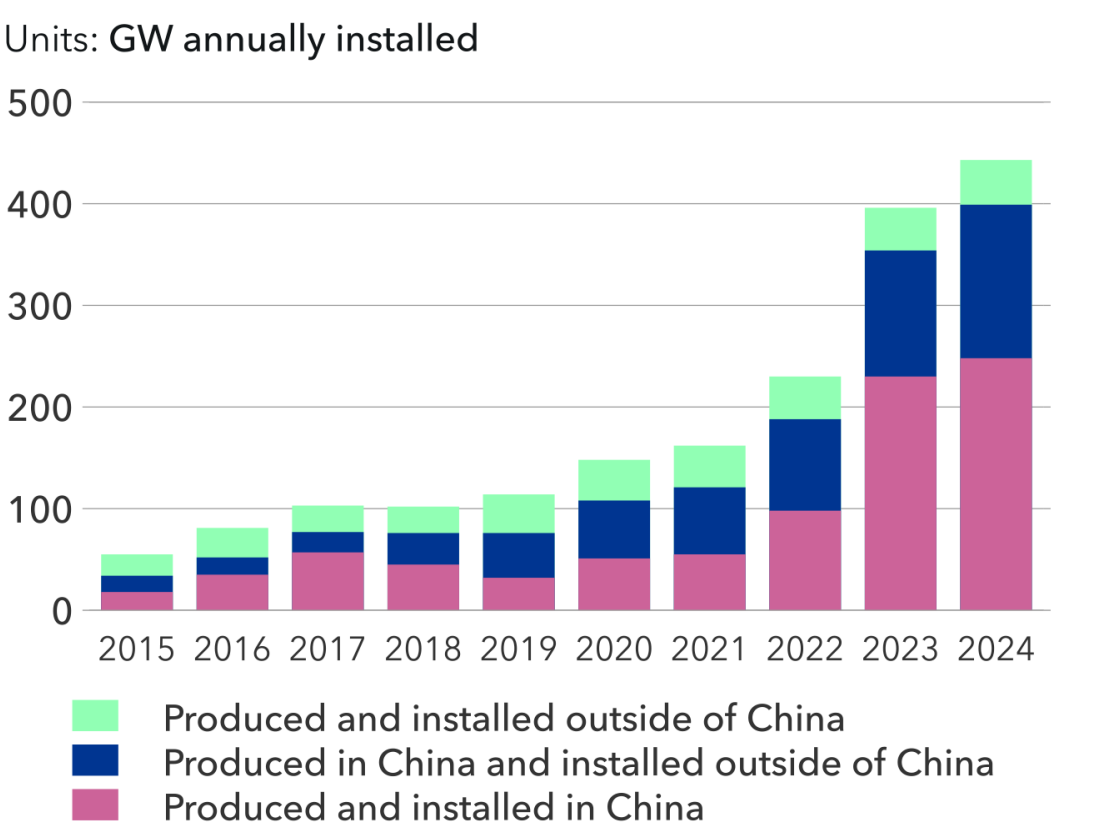
China dominates global solar PV installations



Note: Capacities in AC

Historical data source: GlobalData (2024), IRENA (2024), IEA (2024), Ember (2024)

©DNV 2024

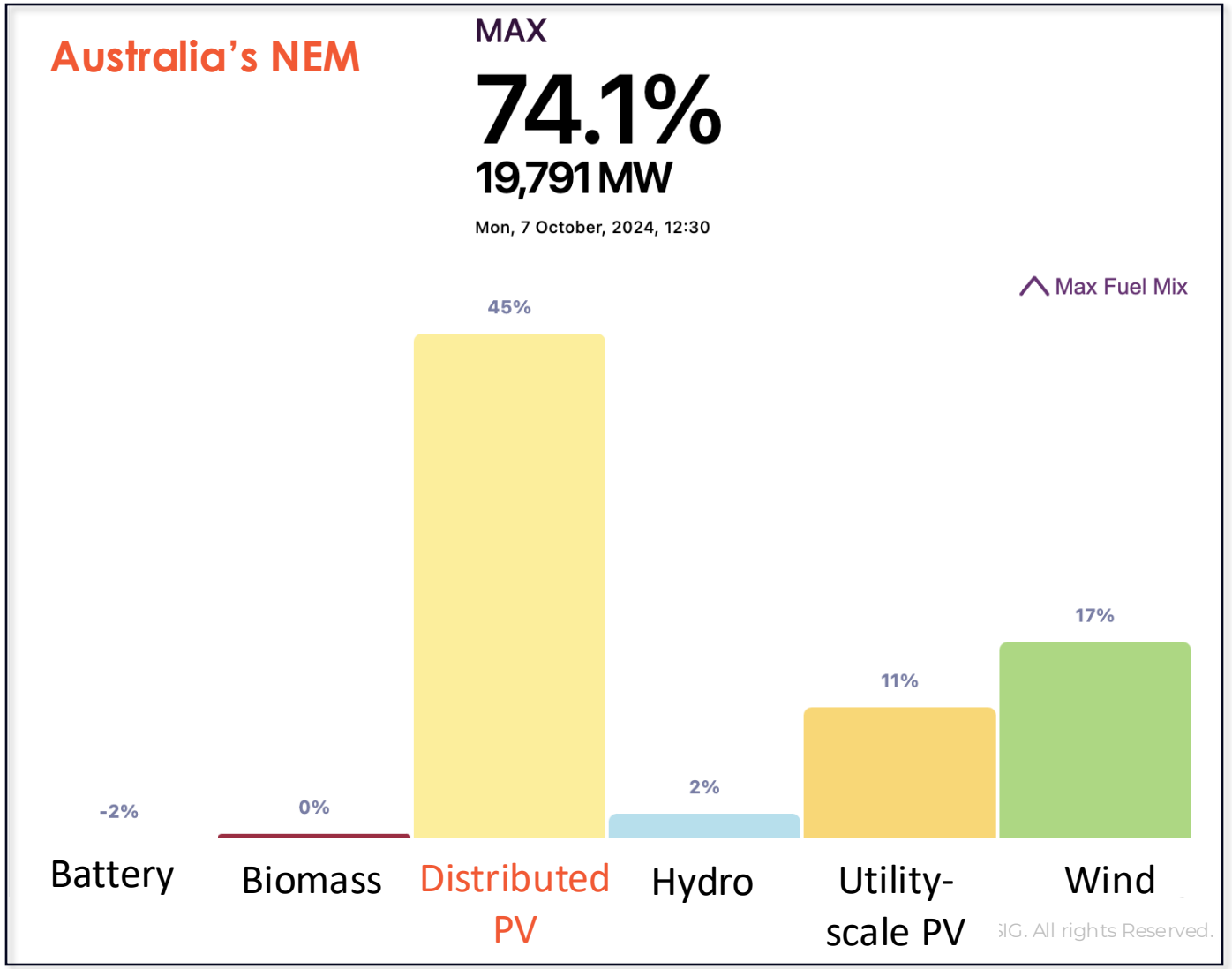
https://www.dnv.com/energy-transition-outlook/download/

We hit new highs in 2024

ERCOT wind plus solar penetration record of 75% on 3/29/24. About 1/3 of their generation is from renewables.

CAISO hit a renewables penetration record of 117% in April. Nearly half of CAISO's generation is from renewables (not incl rooftop PV)

https://www.caiso.com/about/news/new-renewables-records-what-they-mean-for-the-grid-and-its-carbon-free-future;
https://www.ercot.com/files/docs/2024/04/30/ERCOT-Monthly-April-2024.pdf;
https://aemo.com.au/Energy-systems/Electricity/National-Electricity-Market-NEM/Data-NEM/Data-Dashboard-NEM



We also had our share of challenges

Kit Noble, Nantucket Magazine, Aug 30, 2024

107 meter blade broke off a 13 MW offshore wind turbine that was being tested and commissioned near Nantucket.

There's a number of offshore wind plant contracts that have been canceled due to supply chains, inflation, and high cost of capital.

GE laid off 900 people in offshore wind. Siemens anticipates $2.2B losses this year.

The Inflation Reduction Act has been boosting industry substantially.

Falling inflation and interest rates will also help.

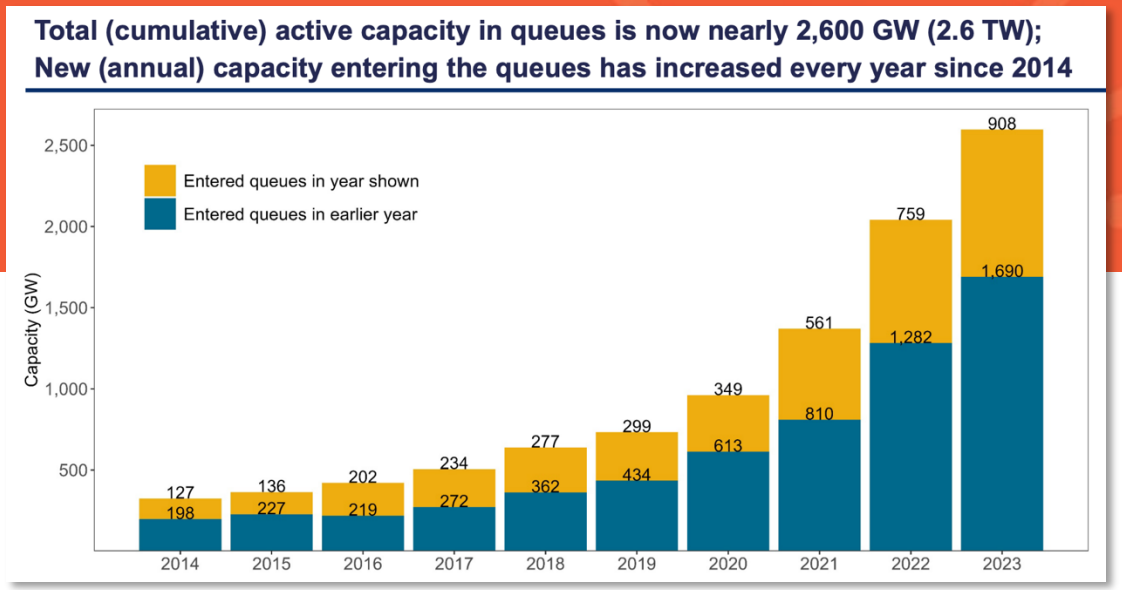
Speed and scale is still an issue

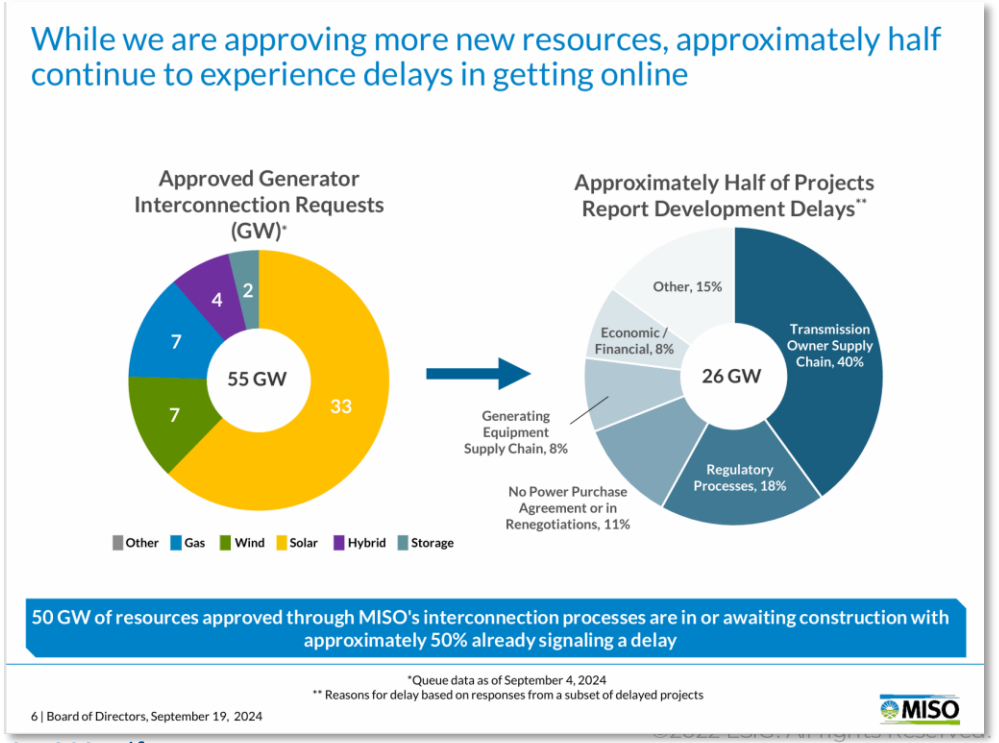
Our total interconnection queue is now over twice the size of our installed capacity.

Yet once resources get through these long queues, there have been delays in construction due to supply chains, etc.

DOE's National Transmission Planning Study was just published, quantifying transmission benefits and identifying high opportunity paths.

FERC Order 1920 passed in May, requiring planners to look out 20 years and consider factors like utility resource plans, state energy goals, queues, and corporate commitments.





J. Rand, LBNL, 2024, https://emp.lbl.gov/sites/default/files/2024-04/Queued%20Up%202024%20Edition_R2.pdf;
https://cdn.misoenergy.org/20240919%20Board%20of%20Directors%20Item%2008%20Reliability%20Imperative%20Update647828.pdf

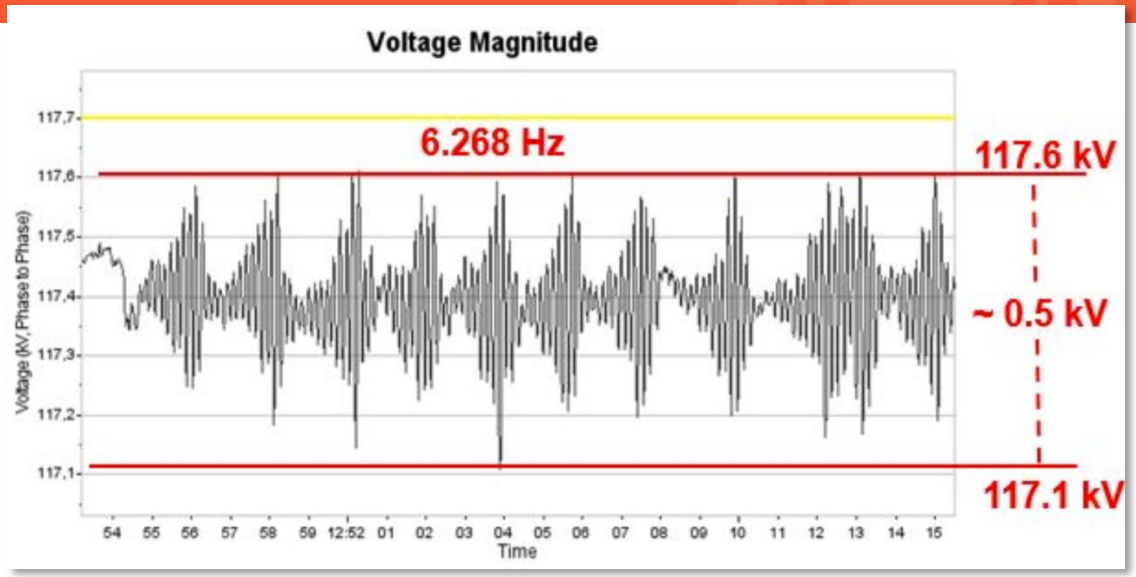
Oscillations are a growing concern

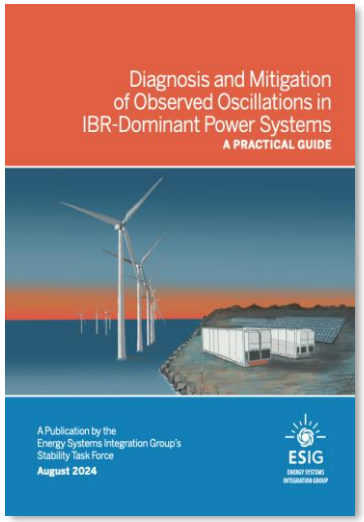
We've always dealt with oscillations but today we have added new types of oscillations with different root causes.

Oscillations can be harmless. They can also trip and damage equipment, and possibly lead to blackouts.

Oscillations Project Team held a workshop in March and just published this guide for practitioners to diagnose and mitigate oscillations.

Improved practice can solve some issues, but additional research is very much needed.



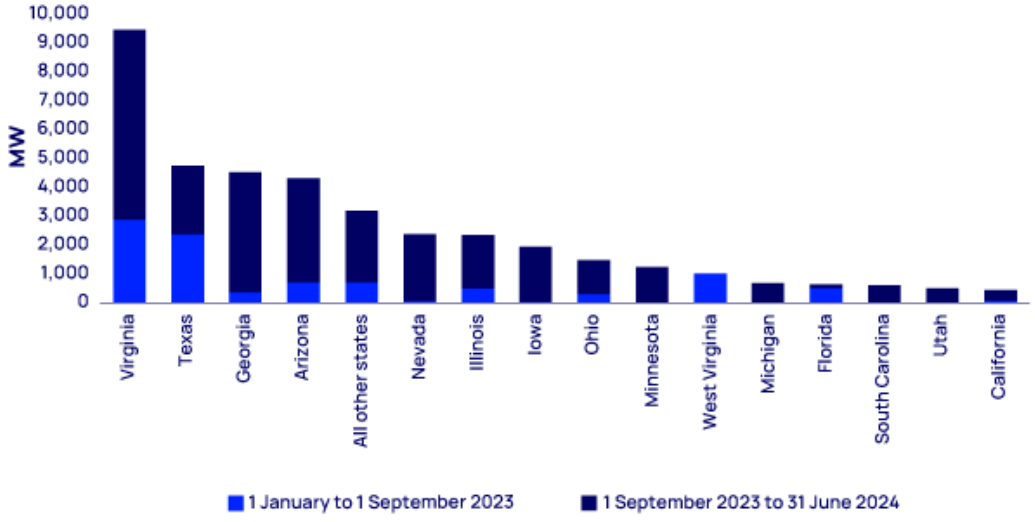


R. Korhonen, et al, *TSO Experience with Converter Driven Stability Management in Outage Planning*, 23rd Wind & Solar Integration Workshop, Finland, Oct. 2024.

Working Groups and Task Forces Structure

System Planning WG Josh Novacheck	System Ops & Market Design WG Aidan Tuohy/Erik Ela	DER WG Obadiah Bartholomy	Reliability WG Jason MacDowell	Research & Education WG Tom Acker
Resilience Benefit Quantification for Transmission Planning TF Warren Lasher	Resource Adequacy TF Derek Stenclik	Demand Response Project Team Derek Stenclik	High Share of IBR TF Julia Matevosyan	
Integrated Planning TF (joint with DER&RWG) Matt Schuerger	Markets for 100% Clean Electricity TF Robin Hytowitz	Buildings TF Sean Morash	GFM Testing Project Team Shahil Shah	
Planning for 100% Clean Energy TF Elaine Hart	Flexibility TF Aidan Tuohy	EV Load Forecasting Guide Matt Schuerger	Oscillations Project Team Nick Miller	
Long-term Load Forecasting TF (joint w/ DER) Julieta Giraldez			Services Project Team Matt/Julia/Deepak	
Integrating Across Siloes of Transmission Planning Tim Kopp			Benefits of GFM BESS Project Team Ryan Quint	
	Large Load TF (Across all WG) Sam Morris		i2X Forum for Implementation of Reliability Standards for Transmission Julia Matevosyan	

New Large Loads Task Force!



Wood Mackenzie
https://www.woodmac.com/horizons/gridlock-demand-dilemma-facing-us-power-industry/

- All 25 utilities responding to an EPRI survey reported data center requests of > 50% of peak demand.
- Dominion connected 15 data centers totaling 933 MW in VA in 2023. They have more than 4 GW of data centers in VA now. These represent ¼ of their electricity sales.
- PJM needs to build > $5B in transmission for data centers. Today these costs are spread across all PJM customers.
- Co-location: Amazon bought a 960 MW data center campus at the Susquehanna nuclear plant. Because it's not network load, it doesn't pay transmission charges.
- FERC's technical conference on 11/1.
- Microsoft signed a $16B PPA to restart a 835 MW unit of Three Mile Island.
- Google and Amazon working with small modular nuclear reactors.

New Large Loads Task Force will have a large number of subgroups

This will include data centers, hydrogen production, industrial electrification, EV charging

Data collection: Characterization of large loads including grid impacts

1. Load forecasting – when, where, how big, how flexible, how certain
2. Interconnection process – managing data, processes, speculative requests
3. Interconnection performance requirements – ride through requirements, oscillations
4. Modeling requirements for interconnection – models for planning studies
5. Transmission planning – considering both generation and load
6. Market participation models – wholesale market price signals; flexibility services
7. Resource adequacy – flexible interconnections, price-sensitive loads

Will coordinate with LBNL effort on regulatory and contractual aspects

Overview of "ESIG week"

- Pre-workshop: Breakthrough Energy sponsored Integrated Planning Workshop
- **Plenary**: The Promise and Challenges of Offshore Wind

<u>Tuesday</u>

- Morning: FERC Order 1920 – Methods and Compliance for Regional Transmission Planning
- 3A: Modeling Protection and Application of Grid-Forming Technology
- 3B: Carbon Tracking and Emissions Transparency
- 4A: Planning and Interconnection of Large Loads
- 4B: Distribution System Resilience and the Role of DERs
- 5A: Reliability with High Levels of Inverter-based Resources
- 5B: 100% Clean Energy or 100% Clean Electricity: The Importance of Energy Sector Coupling

Student and young professionals reception at 5:30pm

Main Reception at 6:30pm

Overview of "ESIG week" (2)

Wednesday

- Morning: Cutting Edge Practices in Integrated Planning
- 7A: Advances in Resource Adequacy
- 7B: Finding Flexibility in Demand
- 8A: EMT Practices and Applications
- 8B: Interregional Transmission
- **Closing Plenary**: Gas-Electric Coordination

Thursday

- DOE i2x Interconnection Standards Workshop
- Electricity Markets under Deep Decarbonization Workshop
- Research and Education Working Group; System Planning Working Group; DER Working Group

Reception at Level 99 at 6pm

Friday - Offshore Wind Tour

See Lacey or Ryan to sign up!