



Solving the Grid Connection Problem

September 28, 2022

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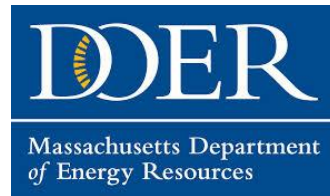
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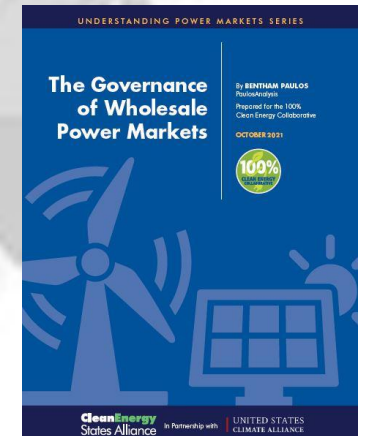
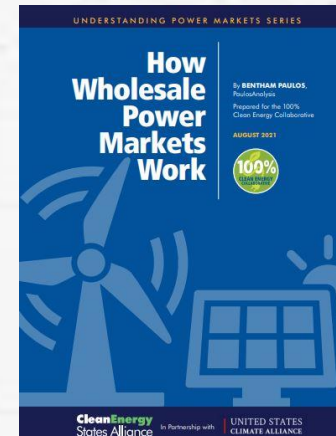
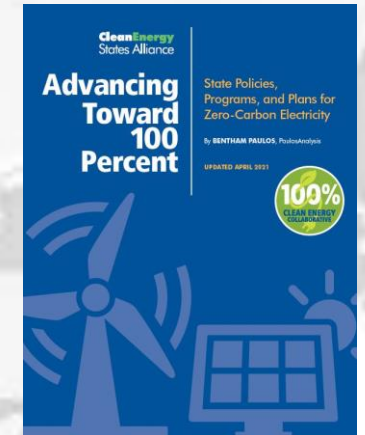
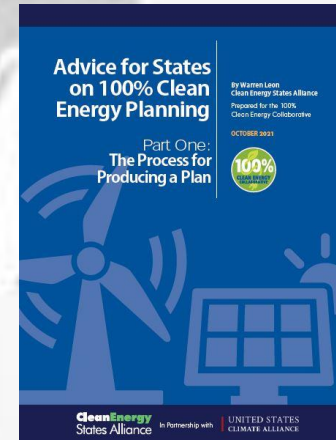


100% Clean Energy Collaborative Resources

The 100% Collaborative produces frequent webinars, a monthly newsletter, and periodic reports. We also host working group meetings for state representatives.

CESA's Guide to 100% Clean Energy States includes:

- Table of 100% Clean Energy States
- Map and Timelines of 100% Clean Energy States
- Summaries of State 100% Clean Energy Plans
- Visual Comparison of State 100% Clean Energy Plans
- State Legislation, Plans, Reports, and Other Documents
- State Monitoring, Reporting, and Verification (MRV) Procedures



Webinar Speakers



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(moderator)





Queued Up: Understanding the Grid Connection Problem

Joseph Rand

Lawrence Berkeley National Laboratory

Clean Energy States Alliance Webinar

September 28, 2022

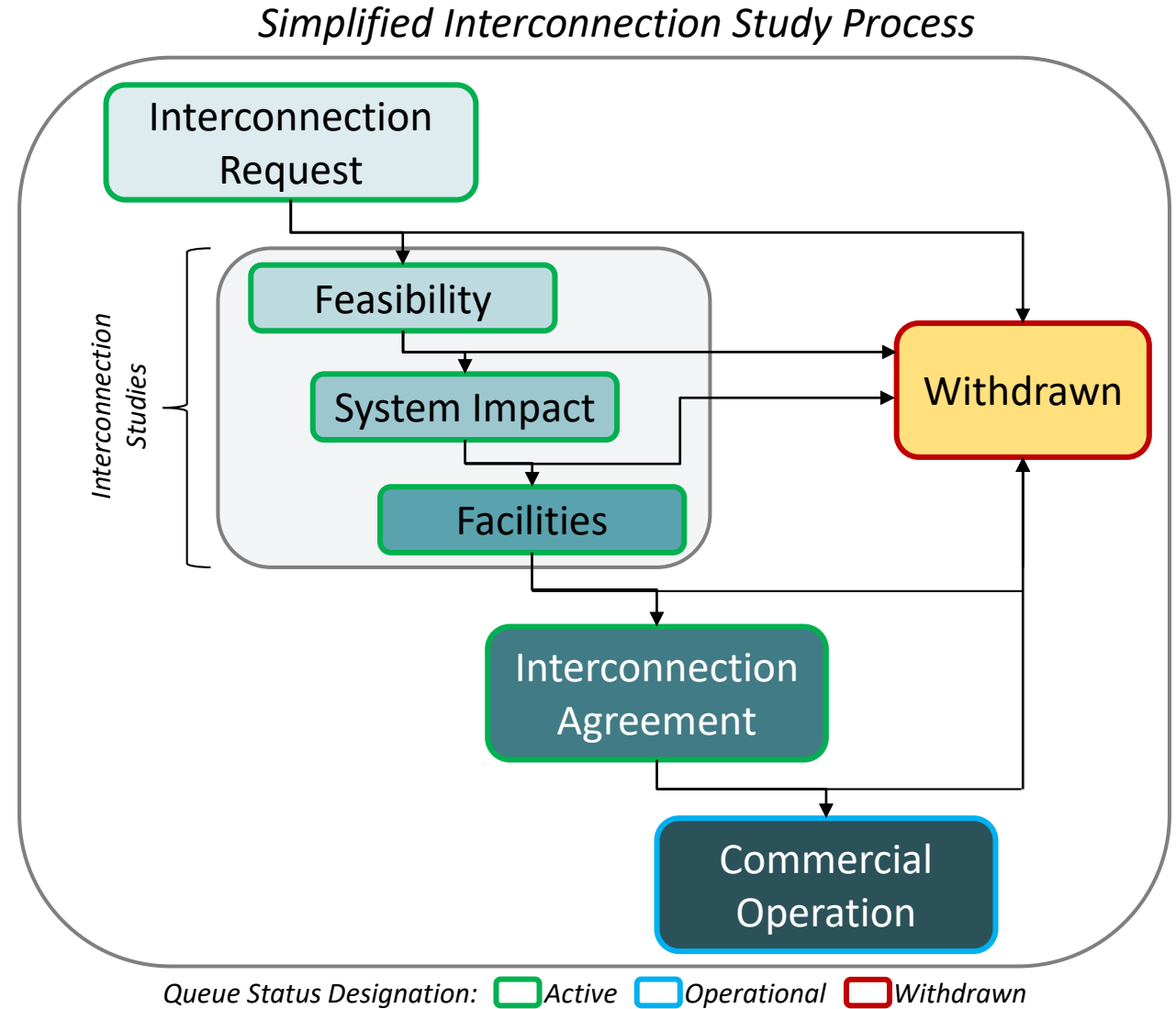
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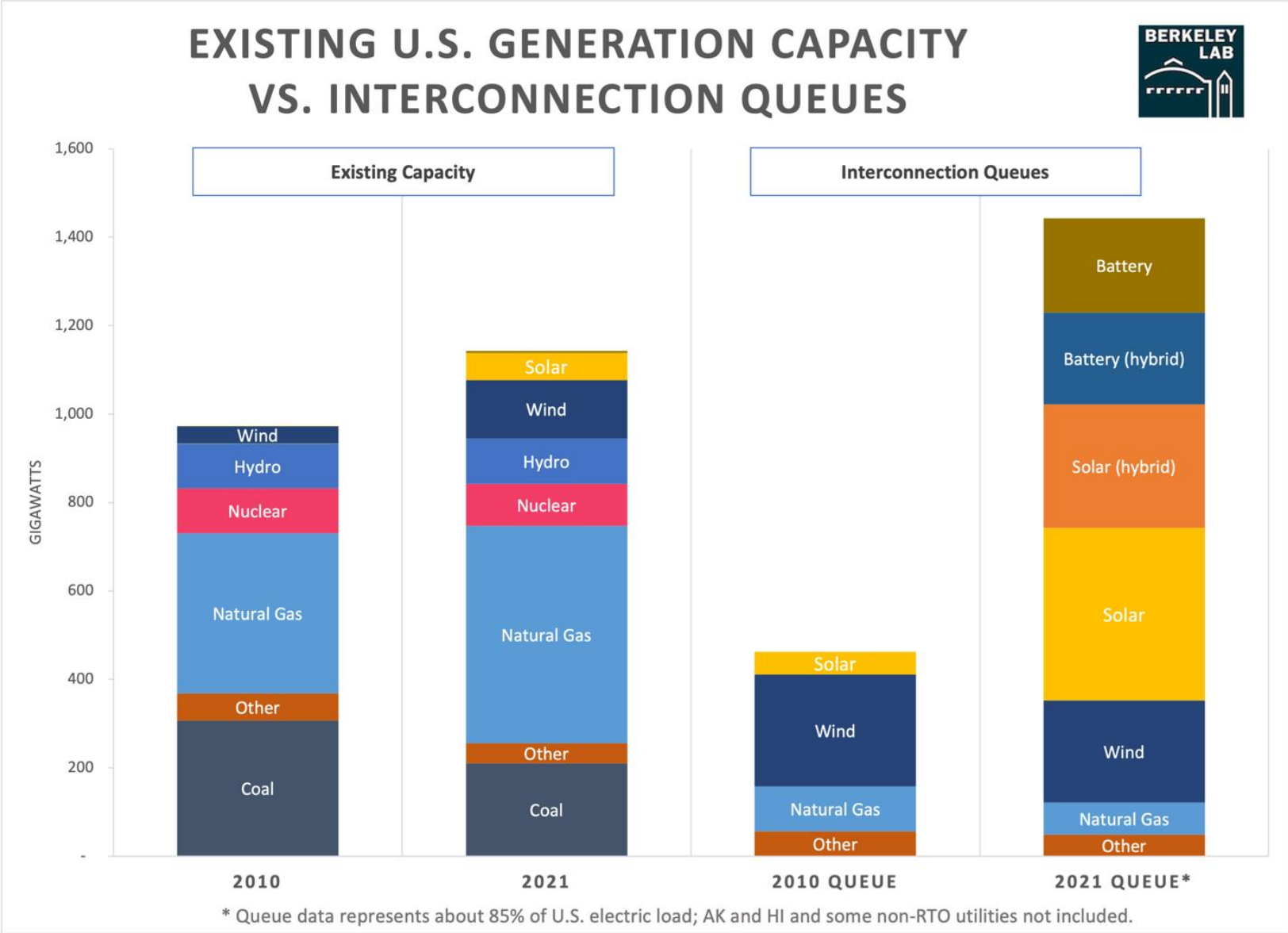


Typical Interconnection Study Process and Timeline

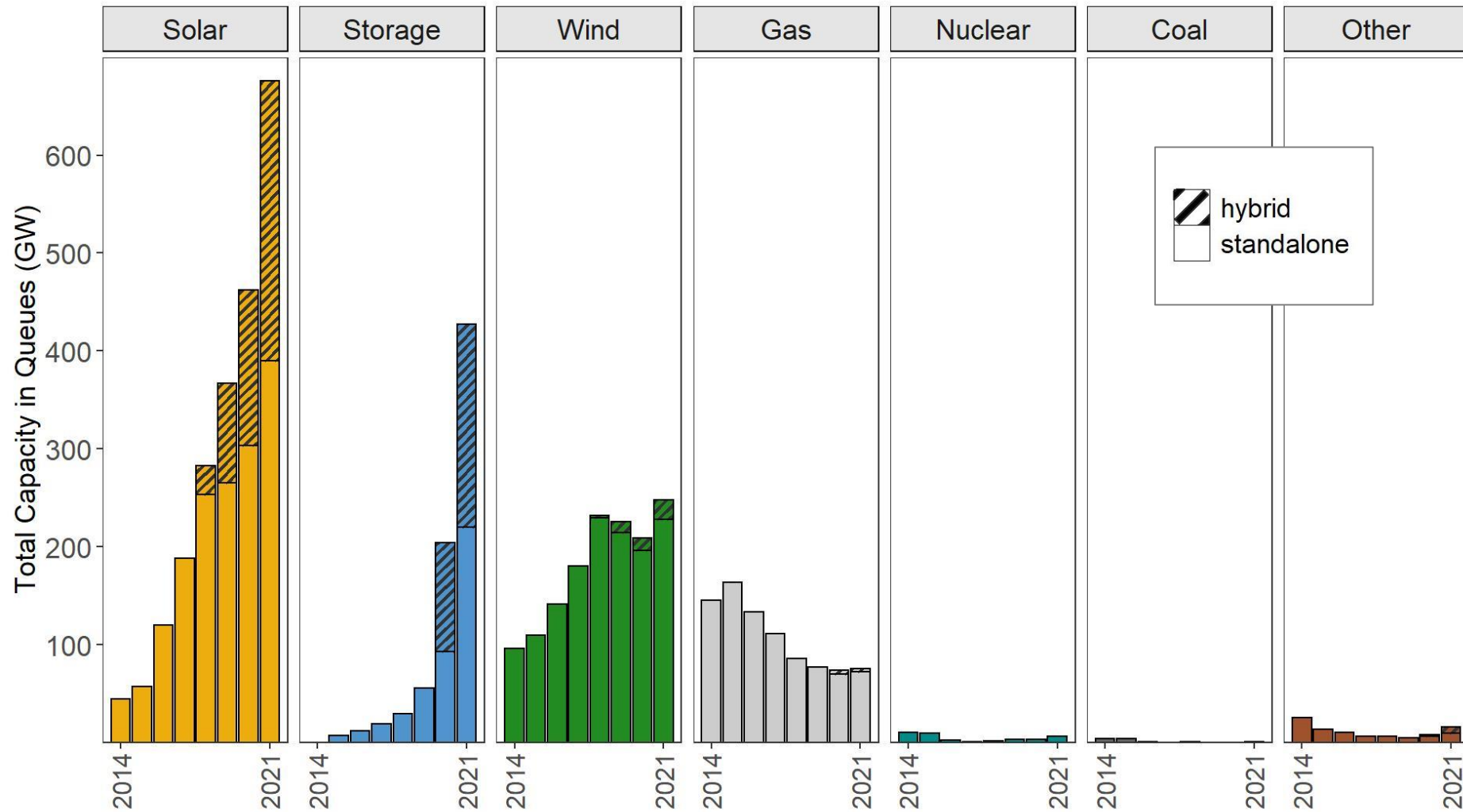
- A project developer initiates a new **interconnection request (IR)** and thereby enters the **queue**
- A series of **interconnection studies** establish what new transmission equipment or upgrades may be needed and assigns the costs of that equipment
- The studies culminate in an **interconnection agreement (IA)**: a contract between the ISO or utility and the generation owner that stipulates operational terms and cost responsibilities
- Most proposed projects are **withdrawn**, which may occur at any point in the process
- After executing an IA, some projects are built and reach **commercial operation**



As of 2021, there were over 1,300 gigawatts (GW) of solar, storage, and wind in interconnection queues - an indicator of a major energy transition underway



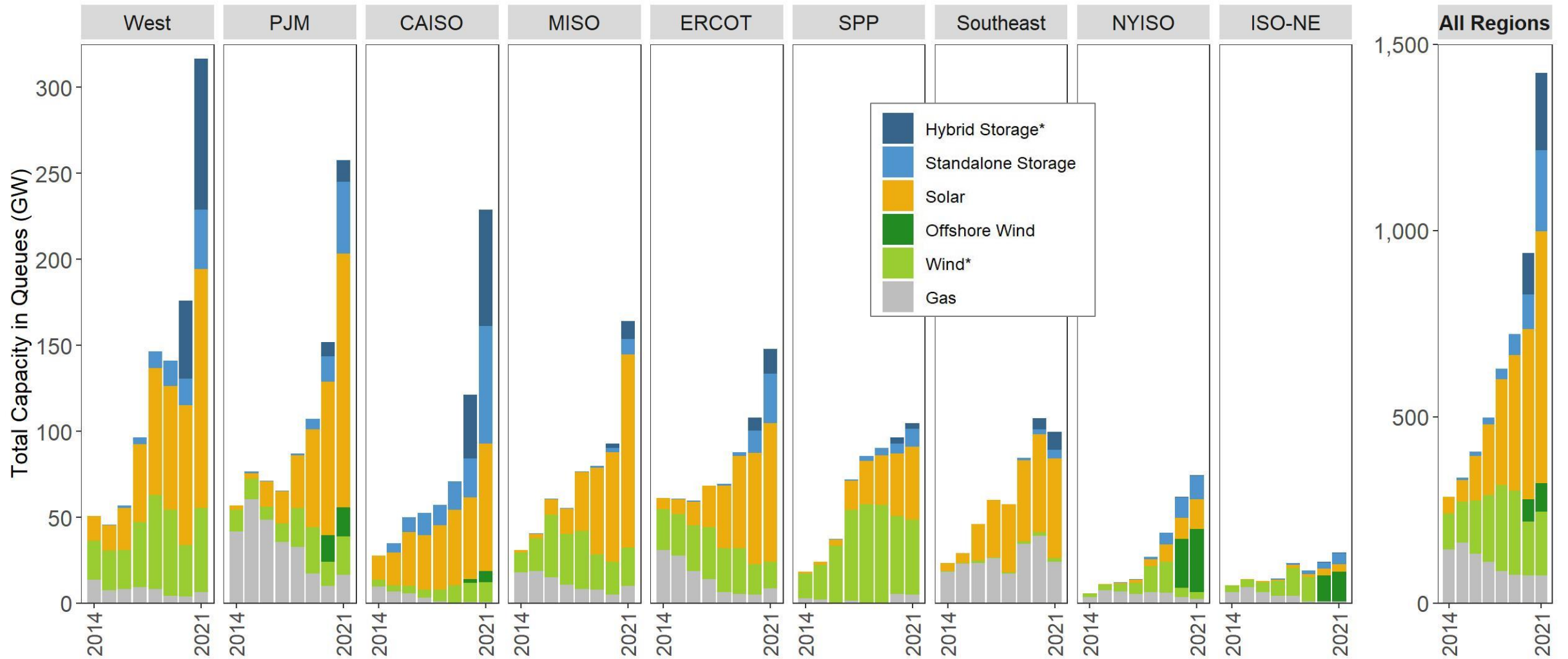
Commercial interest in Solar and Storage has grown, with lots of hybrids; Wind and Gas relatively stable in recent years



- **“Wind”** includes both onshore and offshore.
- **“Other”** includes
 - Hydropower
 - Geothermal
 - Biomass/biofuel
 - Landfill gas
 - Solar thermal
 - Oil/diesel
- **“Storage”** is primarily (98%) battery, but also includes pumped storage hydro, compressed air, gravity rail, and fuel cell projects.

*Hybrid storage capacity is estimated using storage:generator ratios from projects that provide separate capacity data
Storage capacity in hybrids was not estimated for years prior to 2020.
Note: Not all of this capacity will be built

Solar and Storage booming in most regions, especially the West, PJM, and CAISO. Wind growing in the West and offshore, with slight declines in ERCOT, SPP, MISO.

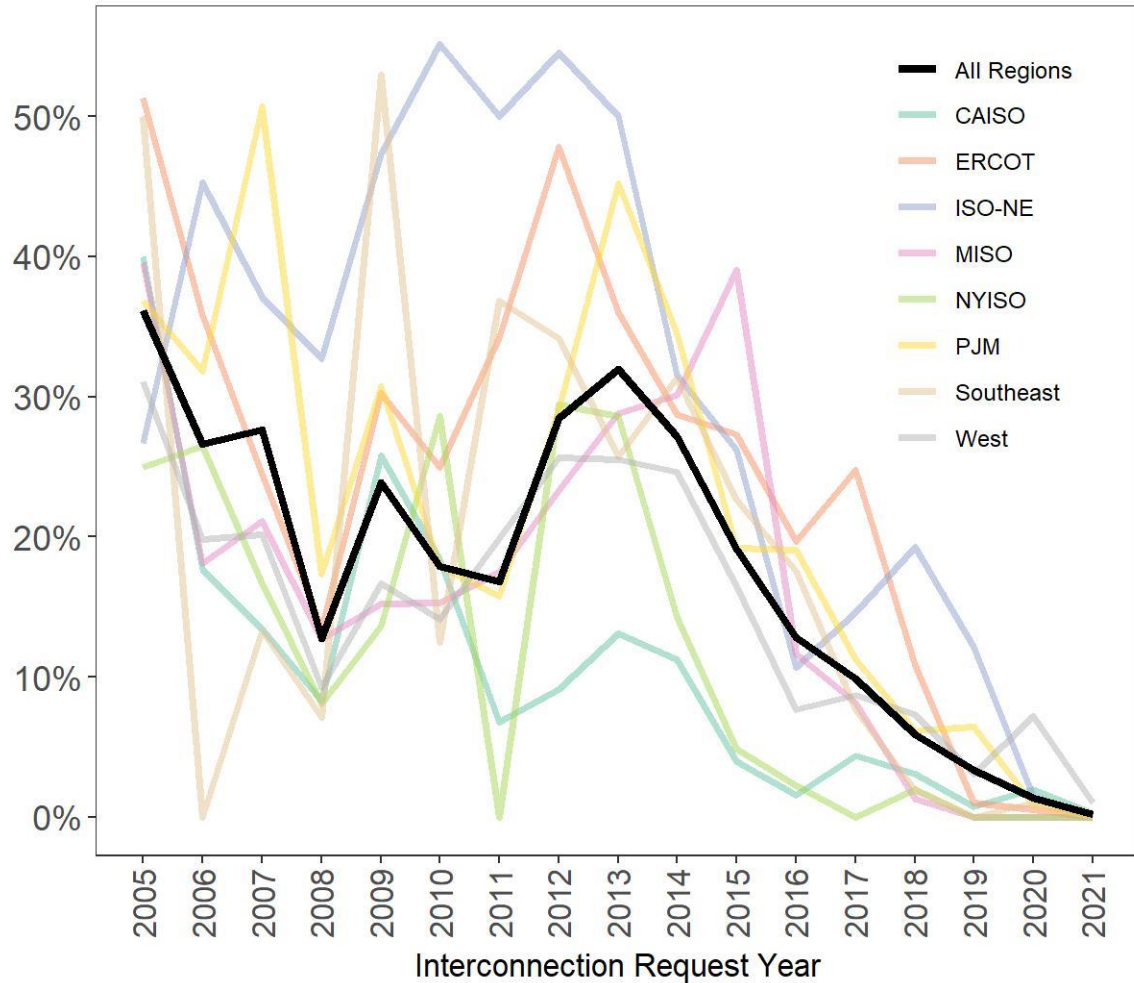


*Hybrid storage capacity is estimated for some projects, and that value is only included starting in 2020. Wind capacity includes onshore and offshore for all years, but offshore is only broken out starting in 2020.

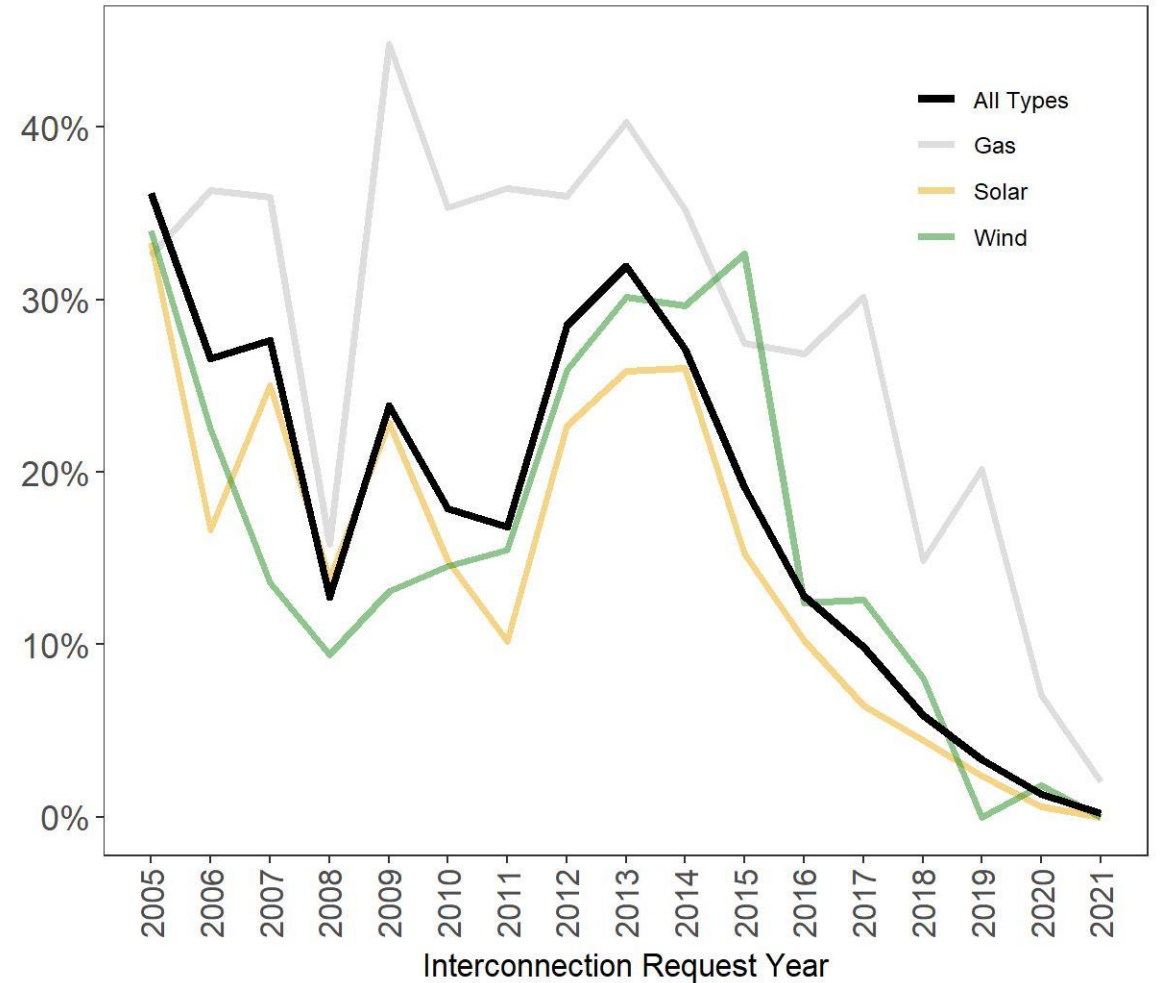
Notes: (1) Hybrid generation capacity is included in all applicable generator categories. (2) Not all of this capacity will be built.

But, only a small fraction (23%) of proposed plants in the queues are actually built; wind (20%) and solar (16%) have lower completion rates from 2000-2016 than other types

Completion percentage by region:

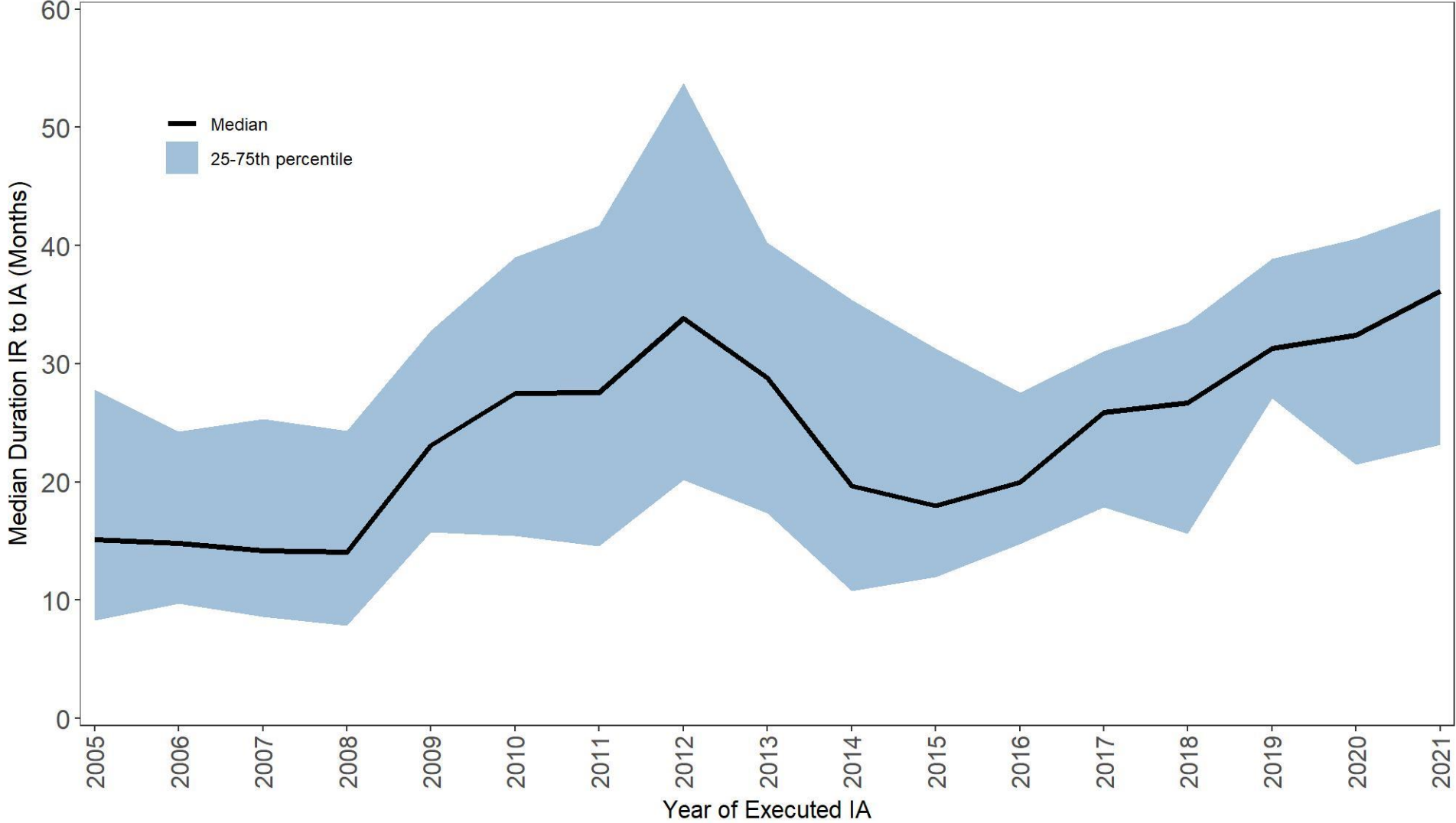


Completion percentage by generator type:



Note: Completion rate is calculated by number of projects, not capacity-weighted. Includes data from six ISOs and 25 utilities.

Backlogged: The typical duration to complete the interconnection study process has increased sharply since 2015, exceeding 3 years in 2021



Notes: (1) Sample includes 2,717 projects from 5 ISO/RTOs and 4 Western utilities with executed interconnection agreements since 2005. (2) Not all data used in this analysis are publicly available.



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More Information:

Visit <https://emp.lbl.gov/queues> to download the data used for this analysis and to access an interactive data visualization tool

Acknowledgements:

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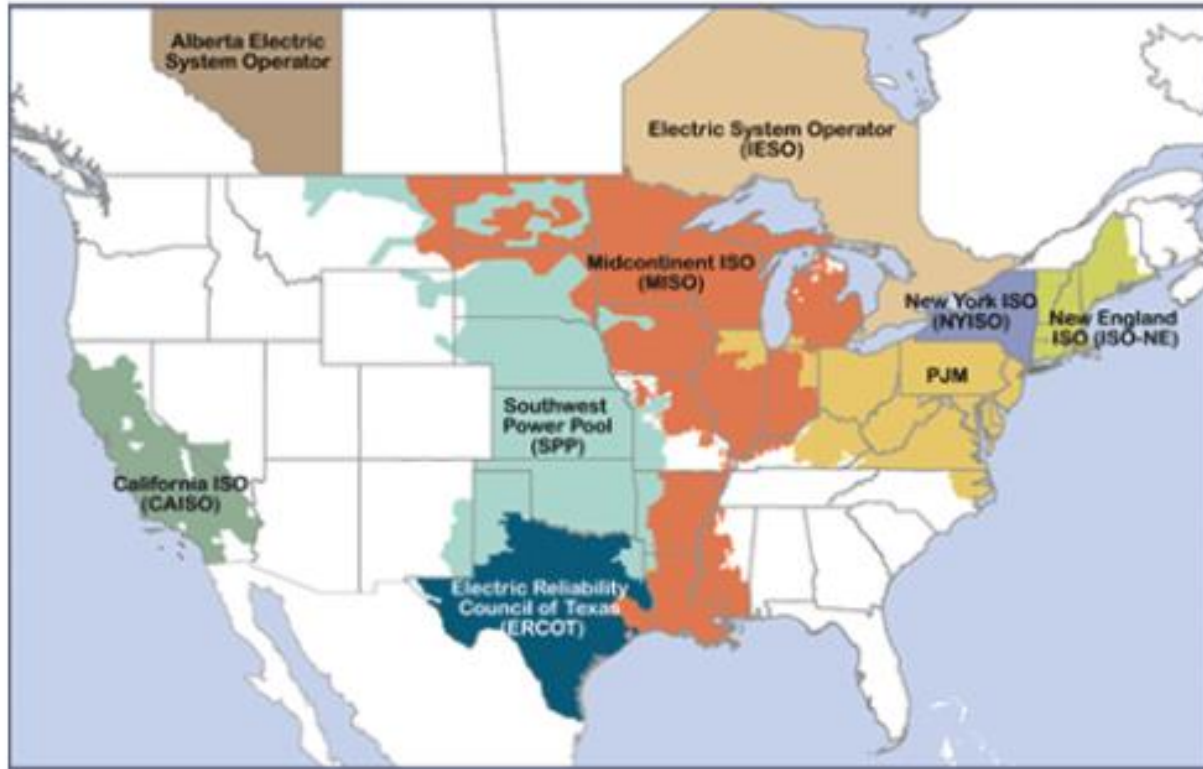
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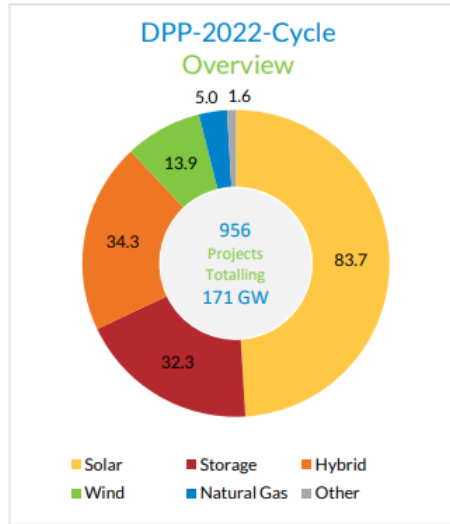


Regional Transmission Operators (RTO)/Independent System Operators (ISO)

Clean Grid alliance footprint in orange



Midcontinent Independent system operator (MISO)



MISO Queue before Sept. 15, 2022:
118 GW (97% renewables, storage)

MISO Queue submission closed on Sept. 15, 2022:
171 GW (96% renewables, storage)

Total Queue – 289 GW
(MISO peak load approx. 120 GW)

Fuel	# of Requests	GW
Solar	469	83.7
Storage	231	32.3
Hybrid	163	34.3
Wind	66	13.9
Natural Gas	21	5.0
Other	6	1.6
Grand Total	956	170.8

Solving the grid interconnection challenge in MISO

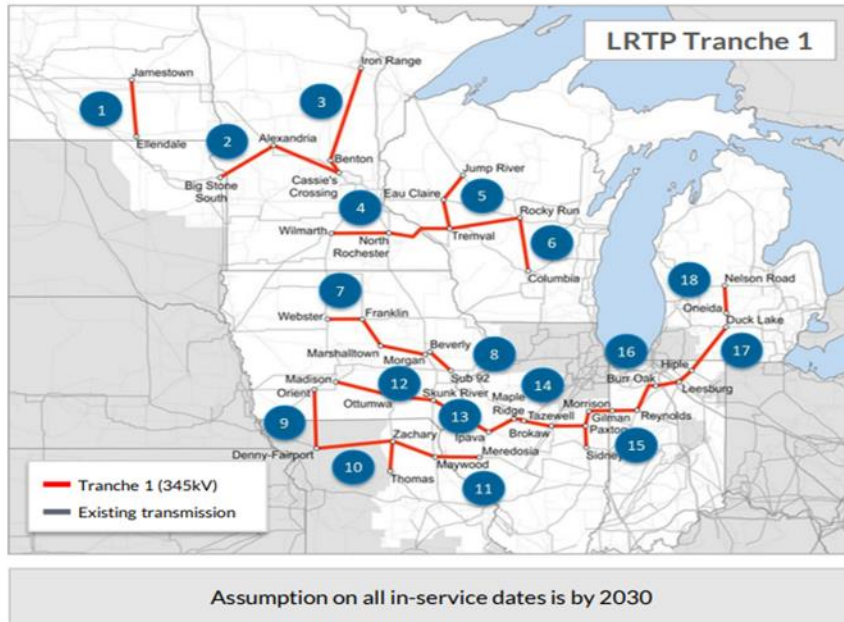
- MISO has done interconnection queue reform about 5 times in the last 20 years:
 - shorten timelines, require higher/more deposits, more land control, etc.
- Remaining key challenges:
 - no penalty for TO missing interconnection study deadlines
 - VERY SLOW SPP and PJM Affected System Studies affecting MISO ICs
 - operating assumptions for storage resources in interconnection study
 - large number of MW in group studies require large transmission solutions; difficult to get models to solve
 - cost allocation (JTIQ/seams; MISO South)

Solving the grid interconnection challenge

What can you do?

- **Support new transmission** - it will enable state carbon reduction and clean energy goals, provide reliability and resilience, and access to low cost generation
- **Educate** decision makers, staff, general public why new infrastructure (renewables, storage, transmission) is needed
- **There's a LARGE GAP** in utility/corporate/state announced goals/requirements and progress toward meeting them – **need to concentrate on implementation and deployment. The grid MUST be ready to accommodate new renewables and storage, otherwise states will not meet their goals.**

Tranche 1 represents the first iteration and includes 18 projects across the MISO Midwest subregion estimated at \$10.3 billion



ID	Project Description	Est. Cost (\$M, 2022)
1	Jamestown – Ellendale	\$439M
2	Big Stone South – Alexandria – Cassie's Crossing	\$574M
3	Iron Range – Benton County – Cassie's Crossing	\$970M
4	Wilmarth – North Rochester – Tremval	\$689M
5	Tremval – Eau Clair – Jump River	\$505M
6	Tremval – Rocky Run – Columbia	\$1,050M
7	Webster – Franklin – Marshalltown – Morgan Valley	\$755M
8	Beverly – Sub 92	\$231M
9	Orient – Denny – Fairport	\$390M
10	Denny – Zachary – Thomas Hill – Maywood	\$769M
11	Maywood – Meredosia	\$301M
12	Madison – Ottumwa – Skunk River	\$673M
13	Skunk River – Ipava	\$594M
14	Ipava – Maple Ridge – Tazewell – Brokaw – Paxton East	\$572M
15	Sidney – Paxson East – Gilman South – Morrison Ditch	\$454M
16	Morrison Ditch – Reynolds – Burr Oak – Leesburg – Hiple	\$261M
17	Hiple – Duck Lake	\$696M
18	Oneida – Nelson Rd.	\$403M
Total Project Portfolio Cost		\$10.3B

FERC Notice of Proposed Rulemaking (NOPR): *Improvements to Generator Interconnection Procedures and Agreements*

- **Proposes changes to the *pro forma* interconnection procedures and *pro forma* generation interconnection agreement in FERC's regulations**
 - These *pro forma* procedures and agreement are minimum requirements that all FERC-jurisdictional transmission providers must adopt
- **NOPR proposals generally fall into four buckets of reforms**
 1. Process reforms to move from “first come, first served” to “first ready, first served”
 2. Increased commercial readiness requirements for generators to enter/remain in queue
 3. Reduced flexibility for transmission providers in completing study requirements, and obligations to provide additional studies and information on request
 4. Updates to incorporate new technologies like energy storage and Grid Enhancing Technologies
- **Initial comments due Oct. 13; reply comments due Nov. 14**



“First Ready, First Served”

- **Move from serial “first come, first served” to a cluster-based “first ready, first served” approach**
 - Intended to address delays caused by interdependence of interconnection requests
 - Groups interconnection requests received during submission windows for study
 - Interconnection study and network upgrade costs shared among generators within a cluster
- **Generators would be required to demonstrate “readiness” to join and remain in a cluster**
 - Intended to address “speculative” requests clogging interconnection queues
 - Increased study deposits with more at risk in the event of withdrawal
 - Specific requirement to demonstrate commercial readiness (or submit deposit in lieu of demonstration)



Transmission Provider Obligations

- **More stringent requirements to process interconnection studies on time**
 - Eliminate flexible “reasonable efforts” standard and replace with firm deadlines
 - Establish penalties for failure to meet deadlines
- **Requirements to provide additional information to assist customers**
 - Option for resource planning entity to request a “resource solicitation study” (e.g., study of a portfolio of resources in an integrated resource plan)
 - Option for customers to request an informational interconnection study
- **New *pro forma* “affected systems” process to guide study of upgrades needed on neighboring transmission systems**



Incorporating Advanced Technologies

- **Accommodating hybrid resources/additions of energy storage**
 - Allow multiple resources behind a single point of interconnection to use a single interconnection request and agreement
 - Allow addition of resources without changing requested level of service or losing queue position
 - Require transmission providers to use realistic assumptions regarding operation of wind/solar plus storage at single site
- **Option for interconnection customers to request study of alternative transmission technologies**
 - Advanced power flow control, transmission switching, dynamic line ratings, static synchronous compensators, and static VAR compensators
- **Requirement for generators to submit operational data and demonstrate capability to “ride through” grid disturbances**



For More Information – Available at aee.net/aee-reports

**UNDERSTANDING FERC'S
PROPOSAL FOR RELIEVING
INTERCONNECTION
DELAYS**

September 2022



Thank you for attending our webinar

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Upcoming Webinars

- Introduction to Floating Wind Technology and Markets (10/13)
- Evaluating the Capabilities of Behind-the-Meter Solar+Storage for Providing Backup Power during Long-Duration Power Interruptions (10/20)
- State Leadership in Decarbonizing the Building Sector, Featuring California and New York (10/26)

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