



**INTERCONNECTION  
INNOVATION e-XCHANGE**  
U.S. DEPARTMENT OF ENERGY

## Accelerating Interconnection Through AI Workshop

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*An initiative by the Solar Energy Technologies Office and the Wind Energy Technologies Office*



# Interconnection Innovation e-Xchange (i2X)

**Mission:** To enable a **simpler, faster, and fairer** interconnection of clean energy resources all while enhancing the **reliability, resiliency, and security** of our electric grid.



## Stakeholder Engagement

Nation-wide engagement platform and collaborative working groups



## Data & Analytics

Collect and analyze interconnection data to inform solutions development



## Strategic Roadmap

Create roadmap to inform interconnection process improvements



## Technical Assistance

Leverage DOE laboratory expertise to support stakeholder roadmap implementation



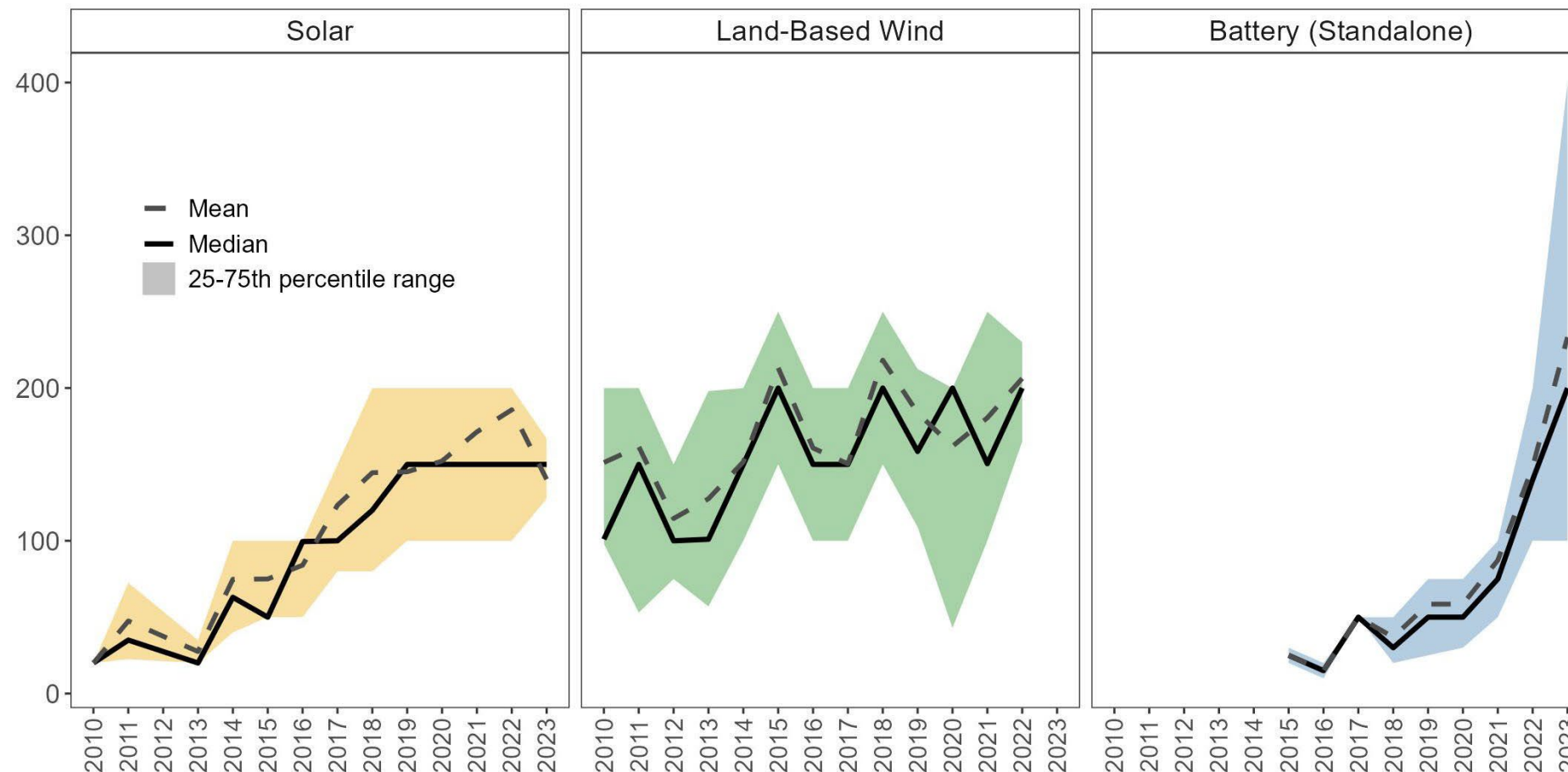
**SETO-WETO collaboration with four national labs (PNNL, LBNL, NREL, and SNL) and other DOE offices (VTO, OE, GDO)**



# The mean Solar plant requesting grid connection in MISO in 2022 was 186MW; Battery (+490%) plants have also grown; Wind plant size relatively steady

## Capacity of proposed projects by year of interconnection request

MW



# Hybrids make up a large portion of proposed solar plants in multiple regions; wind hybrids are less common but notable in CAISO + West



## Proposed capacity hybridizing by region

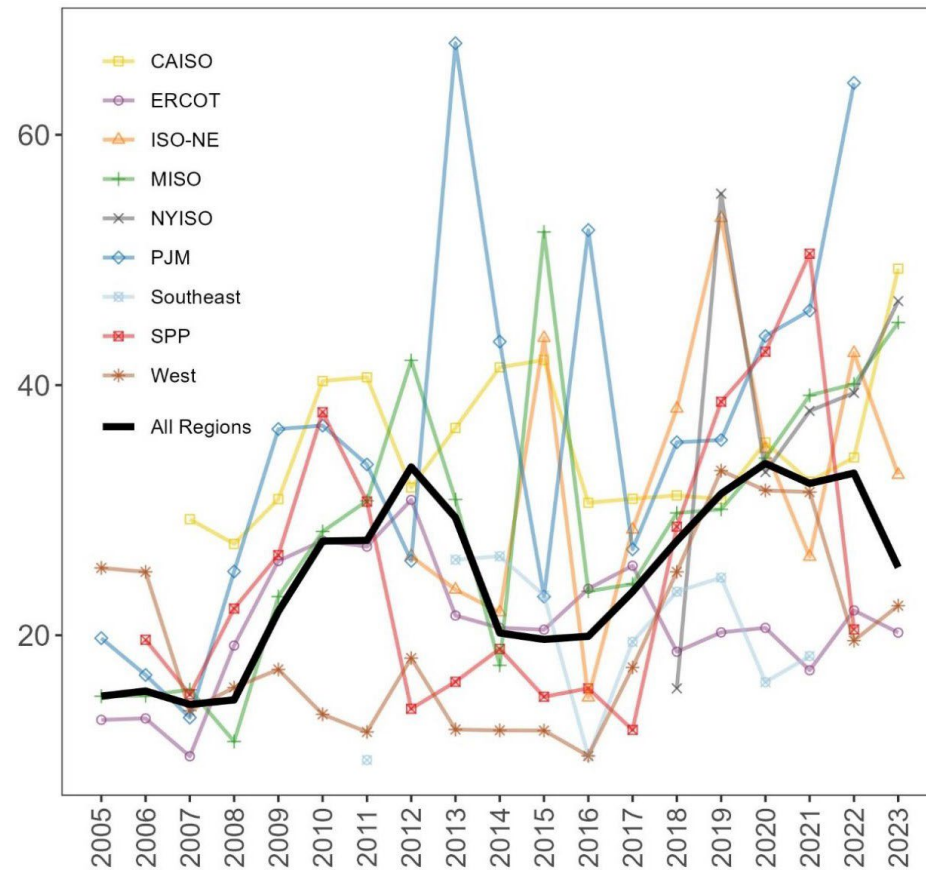
%

Region	% of Proposed Capacity Hybridizing in Each Region			
	Solar	Wind	Gas	Storage*
CAISO	98%	34%	88%	52%
ERCOT	49%	7%	4%	34%
ISO-NE	30%	0%	10%	8%
MISO	20%	6%	0%	48%
NYISO	24%	4%	16%	16%
PJM	24%	1%	0%	37%
SPP	22%	2%	3%	32%
Southeast (non-ISO)	34%	0%	0%	63%
West (non-ISO)	81%	30%	29%	72%
TOTAL	53%	13%	12%	51%

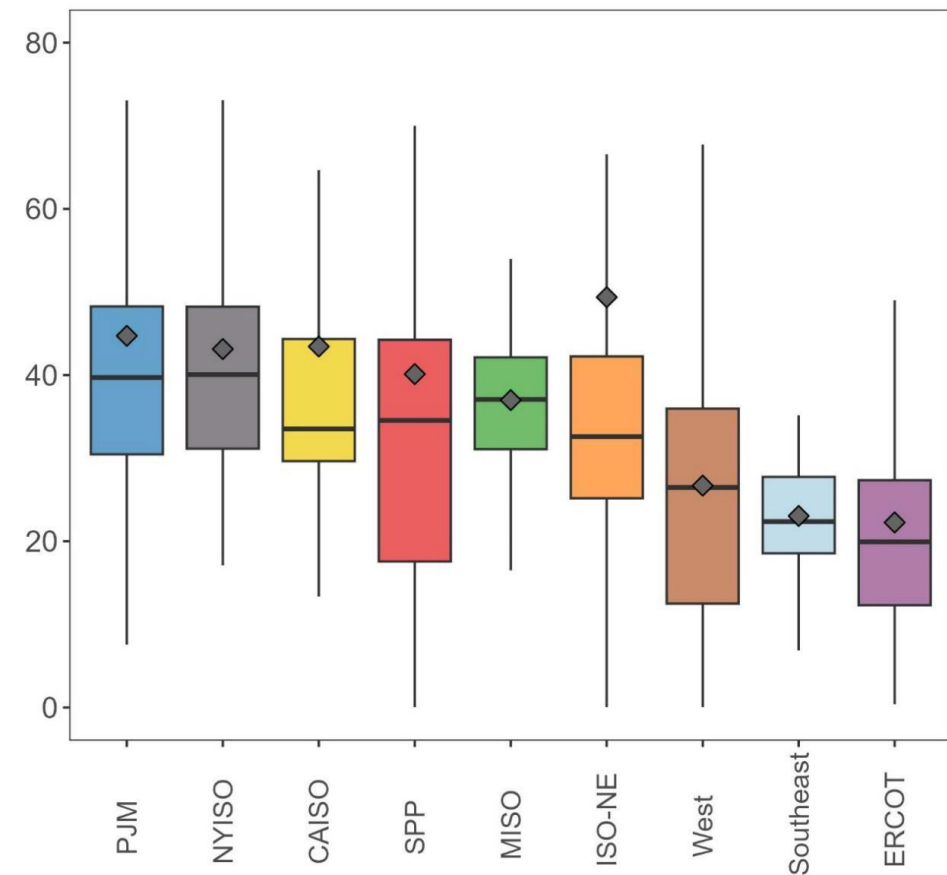
# IR to IA duration is typically longest FERC-jurisdictional ISOs. ERCOT and the non-ISO regions (Southeast and West) have the fastest processing times



**Median duration IR to IA by executed IA year<sup>1,2,3</sup>**  
Months



**Duration IR to IA for IAs executed 2018–2023 by markets<sup>1,2,3</sup>**  
Months



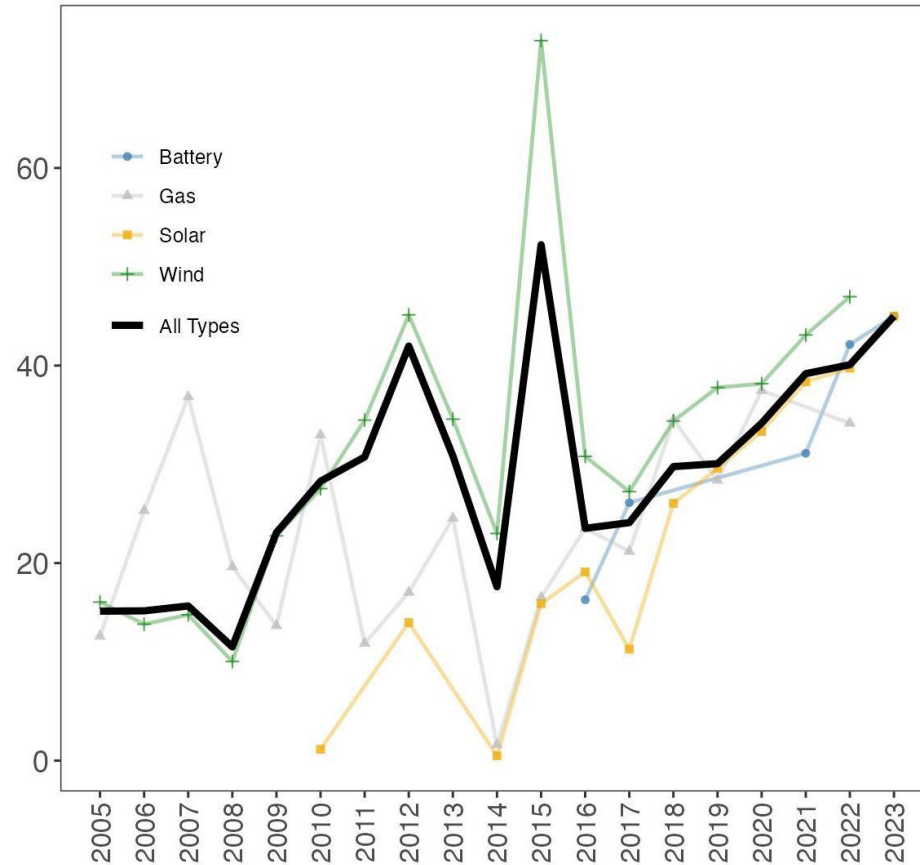
1) Sample includes 3,864 projects from seven ISO/RTOs and five non-ISO balancing areas with executed interconnection agreements since 2005. 2) Not all data used in this analysis are publicly available. 3) Date of IA execution for projects with IA agreement completed in 2023 was not accessible in database format from SPP and PJM (though 160 IAs were executed in PJM in 2023).

Sources: Berkeley Lab

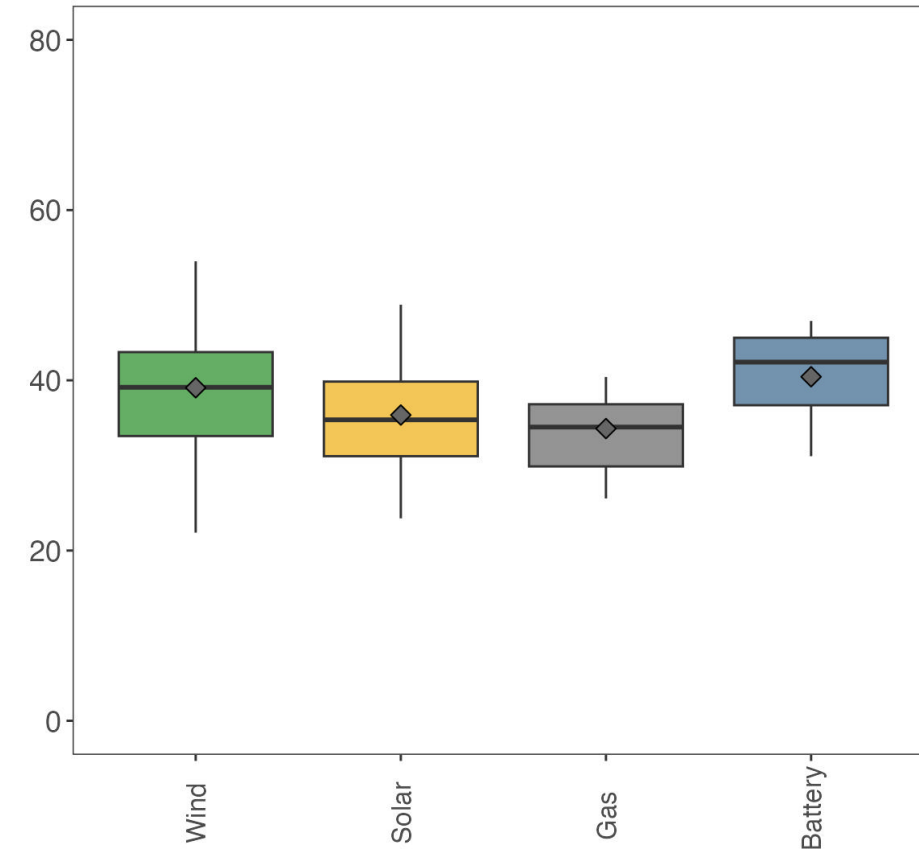
# Wind projects typically face longer interconnection study timelines, but timelines for all generator types have increased in the past decade



**Median duration IR to IA by executed IA year<sup>1</sup>**  
Months



**Duration IR to IA for IAs executed 2018–2023 by technologies<sup>1</sup>**  
Months



1) Includes data from MISO only.

# Transmission Roadmap

## Four Interconnection Goals with 35 Solutions

### Goal #1: Increase Data Access and Transparency

### Goal #2: Improve Process and Timeline

### Goal #3: Promote Economic Efficiency

### Goal #4: Maintain a Reliable, Resilient, and Secure Grid

- Solutions are a collection of strategies rather than a rigid package of prescriptive fixes.
- Some solutions are complementary: to be effective, they would need to be implemented in tandem with others.
- Other solutions are exclusive: adopting one might obviate the need for another.
- Solutions may be topically specific (e.g., Cost Allocation)

Roadmap does not assess the costs of implementing the solutions.

# Transmission Roadmap

## Goal 2: Improve Process and Timeline

**Challenge:** Backlogs and delays are the result of rapid growth in interconnection requests and inefficiencies in process. What changes can be made to handle larger quantities of requests while reducing study process timelines and maintaining access?

### Topical Area

### Example Solutions

#### Queue Management

Key tradeoff: *rationing quantity* of proposed projects while *maintaining competition* and open access industry principles

- *Automate* data input, study validation, and customer communications (short-term)
- Better utilize *fast-track options* for interconnection (medium-term)
- Consider *market-based approaches* to rationing (long-term)

#### Affected System Studies

Key tradeoff: creating more *consistent and harmonized* interregional processes while *maintaining independence* of individual balancing areas

- Increase *collaboration and standardization* on affected system studies (short-term)
- Develop processes for *joint transmission planning* efforts on neighboring affected systems (medium-term)



# Measurable Success Targets for 2030

Target Value by 2030

Recent Value



**Reduced interconnection process time**  
Average time from request to agreement

< 12 months

33 months (2022)



**Lowered cost uncertainty**  
Standard deviation of interconnection costs

< \$150/kW

\$551/kW (2020-  
2021)



**Increased Completion rates**  
Completion rate for projects that entered  
facility study phase

> 70%

45% (2016)



**Maintained system reliability**  
Number of system disturbances due to  
modeling inaccuracy

Zero

4 (2022)

## Goal #1: Increase Data Access and Transparency

**Solution 1.1:** Improve the scope, accessibility, quality, and standardization of **data on projects already in interconnection queues**

**Solution 1.3:** Develop tools to manage, analyze, and visualize transmission and interconnection data

## Goal #2: Improve Process and Timeline

**Solution 2.1:** Implement and enforce more stringent commercial readiness requirements

**Solution 2.3:** Automate parts of the interconnection process, such as data input and validation and some customer communications

**Solution 2.7:** Harmonization of affected system study procedures, data inputs, methods, software tools, study criteria, and mitigation options

**Solution 2.11:** Provide access to **independent engineering, administrative, and legal services**

**Solution 2.13 & 2.16:** Workforce development and upskilling.

## Goal #3: Promote Economic Efficiency

**Solution 3.4:** Align data inputs, assumptions, and process timing between interconnection and transmission planning processes

**Solution 3.6:** Develop and harmonize **new, transparent best-practice study methods** to adapt to a changing generation mix and changes in load

## Goal #4: Maintain a Reliable, Resilient, and Secure Grid

**Solution 4.1:** Require **submission of verified EMT models** for all IBRs during the interconnection process and **develop screening criteria** to determine when EMT studies are necessary within a region.

**Solution 4.4:** Advance the **computational speed** of interconnection reliability assessments

**Solution 4.8:** Evaluate **cyber and physical security concerns** during the interconnection process.

## Current DOE Actions to Implement Roadmap Solutions



**Solar and Wind Interconnection for Future Transmission (SWIFTR) Funding Opportunity - Released March 19**



**i2X Forum for Implementing Reliability Standards for Transmission (i2X FIRST) – Launched May 28**



**i2X Solution e-Xchange focused on the Transmission Roadmap's Goal Areas – Started**



**Collaboration among DOE Offices and other federal and state agencies**



*Join . Engage . Collaborate*

# Questions?

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