Energy Storage Interconnection

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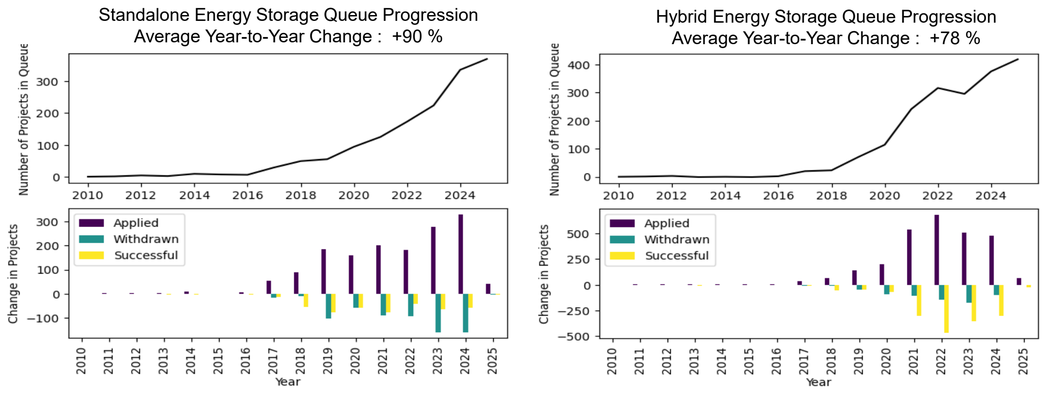
PROJECT PROFILE

Topic: Analytics and Tools | Vertical : Grid Integration and Field Validation
Strategic Pathway : Optimize and Grow
Project Start and Finish : FY25-FY26

PROBLEM

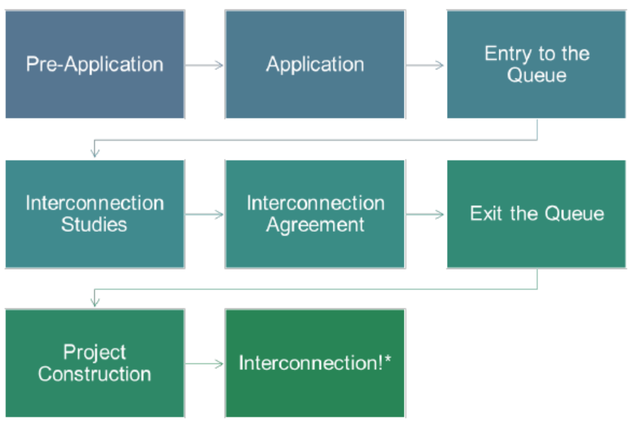
Energy storage is crucial for grid reliability, resilience and affordability. It is a unique resource capable of bi-directional power flow and controllable export/import. However, energy storage projects encounter interconnection challenges:

- Lack of inclusion of storage in interconnection rules.
- The unique features such as no-export, limited export are not fully addressed by current rules.
- Lack of clarity regarding the impacts of inadvertent export from limited and no-export.
- Lack of a detailed analytics to benchmark the interconnection of energy storage in distribution systems.



APPROACH

Developing the analytics to measure the interconnection of storage requires gathering interconnection queue data, parsing the data, creating statistical frameworks to analyze the data.

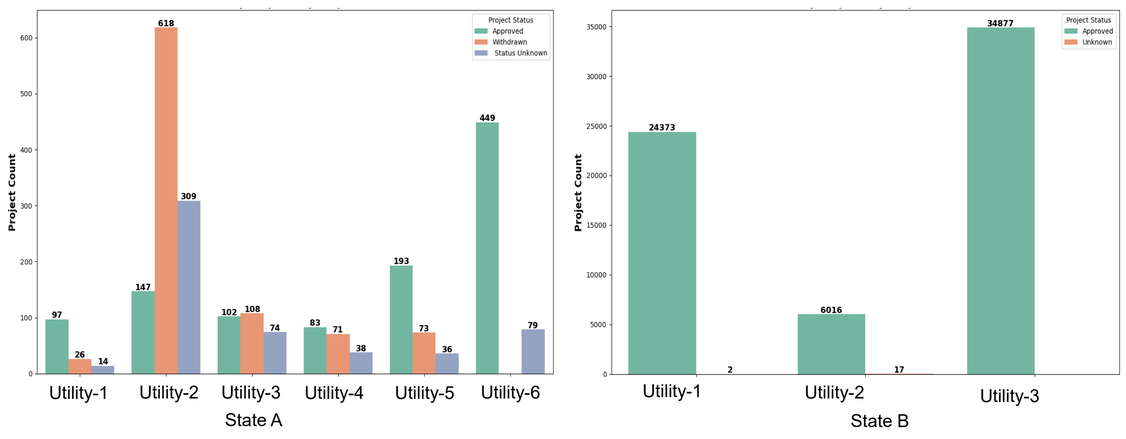


- Collect raw publicly-available interconnection queue data
- Structure raw data to create a standard format for analysis.
- Statistical analysis to extract meaningful insights such as MICT *(Mean-Interconnection Time)*
- Technical and practical recommendations.

** Signifies physical interconnection with authorized permission-to-operate (PTO)*

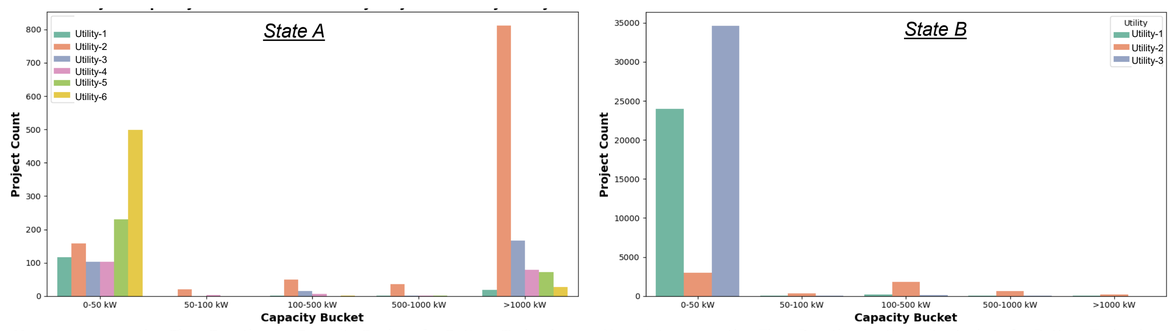
Challenges encountered in the approach:

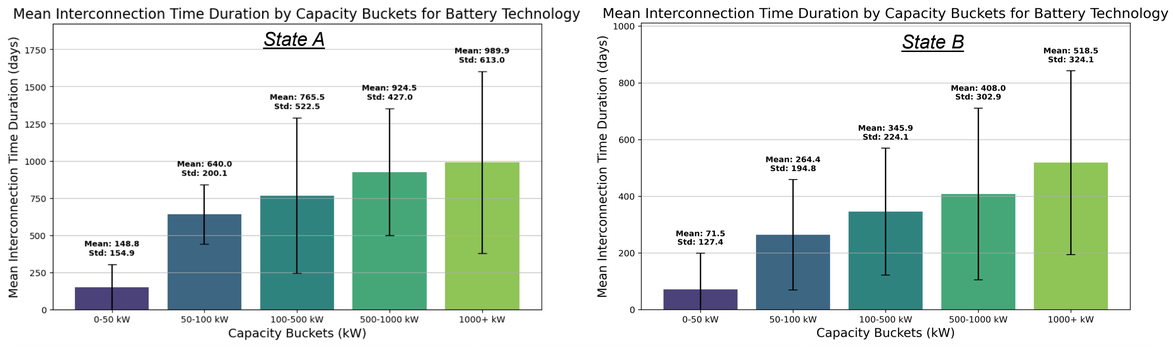
- Gathering the distribution interconnection queue data is extremely challenging due to a severe lack of this data in the public domain.
- Only six states make the distribution queue data publicly available.
  - ➢ New York, California, Massachusetts, Illinois, Hawaii, Connecticut
- Lack of a universal standardization in the interconnection process and the interconnection data reporting format.
- Inconsistent data practices across different utilities and states.



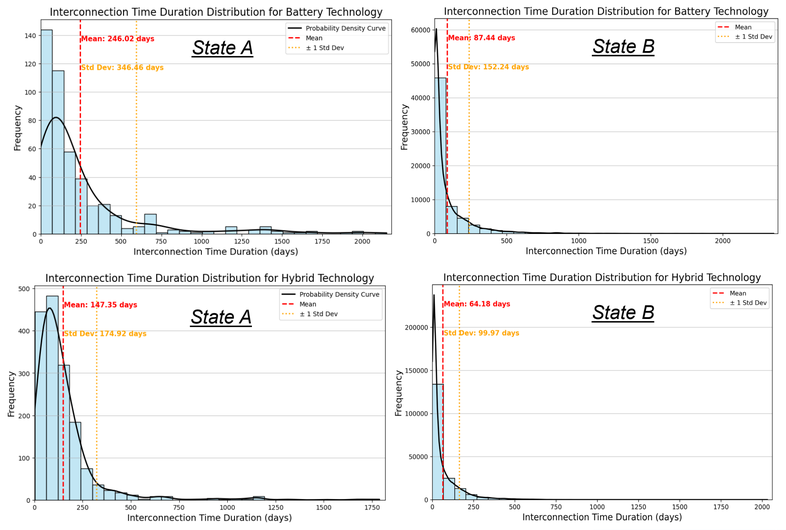
RESULTS

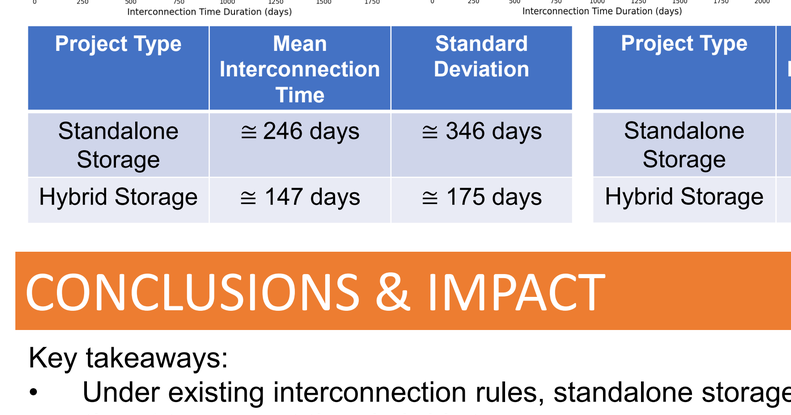
A key benchmarking metric of the interconnection process is the mean interconnection time. It is defined as the time elapsed between the interconnection request and the final approval.





Capacity Bucket [kW]	Mean Interconnection Time (State A)	Mean Interconnection Time (State B)
1. Bucket 1: Very Small-Scale [0-50 kW]	149 days	72 days
2. Bucket 2 : Small-Scale [50-100 kW]	640 days	264 days
3. Bucket 3 : Small-Medium Scale [100-500 kW]	766 days	346 days
4. Bucket 4: Medium-Large scale [500-1000 kW]	925 days	408 days
5. Bucket 5:Large scale [>1000 kW]	990 days	518 days





State A MICT insights:

- Hybrid storage projects are processed roughly 67% faster than standalone storage projects.
- Standalone storage projects have longer-tails than hybrid storage projects.

State B MICT insights:

- Hybrid storage projects are processed roughly 27% faster than standalone storage projects.
- Standalone storage projects have longer-tails than hybrid storage projects.

Project Type	Mean Interconnection Time	Standard Deviation
Standalone Storage	≅ 246 days	≅ 346 days
Hybrid Storage	≅ 147 days	≅ 175 days

Project Type	Mean Interconnection Time	Standard Deviation
Standalone Storage	≅ 87 days	≅ 157days
Hybrid Storage	≅ 64 days	≅ 99 days

CONCLUSIONS & IMPACT

Key takeaways:

- Under existing interconnection rules, standalone storage takes *much longer (1.5-2 times)* to connect than hybrid storage.
- Standalone storage shows *higher variability* in interconnection duration with standard deviation roughly *double* that of hybrid storage. This indicates more uncertainty and inconsistent outcomes.
- Standalone storage has *more extreme days* than hybrid and non-storage technologies. Notable clusters around 750 and 1250 days.
- *Recurrent* bottlenecks in the interconnection of standalone storage projects as evidenced by *longer tails* in the MICT distributions.

FUTURE DIRECTIONS

The ongoing work under this project is focused on

- Developing a mathematical predictive model of the interconnection queue.
- Set of optimization frameworks to inform choices and determine the best approach for mitigating queue backlog with special considerations for energy storage.
- Open-source release of statistical analysis and optimization tools.

This material is based upon work supported by the U.S. Department of Energy, Office of Electricity (OE), Energy Storage Division.

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