



Analysis of PJM Interconnection Transition Cycle 1

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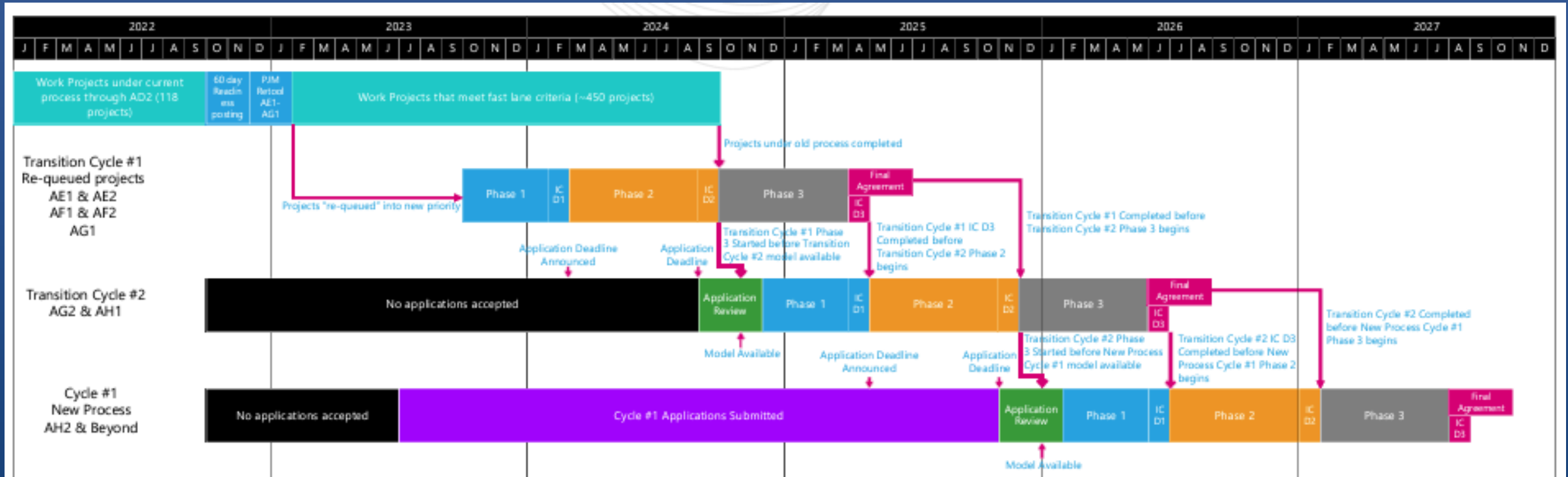
Outline

- Introduction and Background
- Objectives
- Exploratory Data Analysis
- Projects with Lowest Interconnection Cost
- Conclusions
- Appendix
- Acknowledgements

Introduction & Background

- PJM transitioned from a serial to a cluster study approach.
- PJM divided projects currently in the series queue into two clusters:
 - Transition Cluster 1: AE1, AE2, AF1, AF2, AG1
 - Transition Cluster 2: AG2, AH1
- PJM analyzed the first cluster of projects (TC-1) and recently completed Phase 1 analysis.
- This analysis addresses the TC-1 Projects that have just completed phase 1 analysis.

PJM Transition to Cluster Study



Reference: PJM, Thomas, Jack; "Interconnection Process Reform", April 27, 2022

Objectives

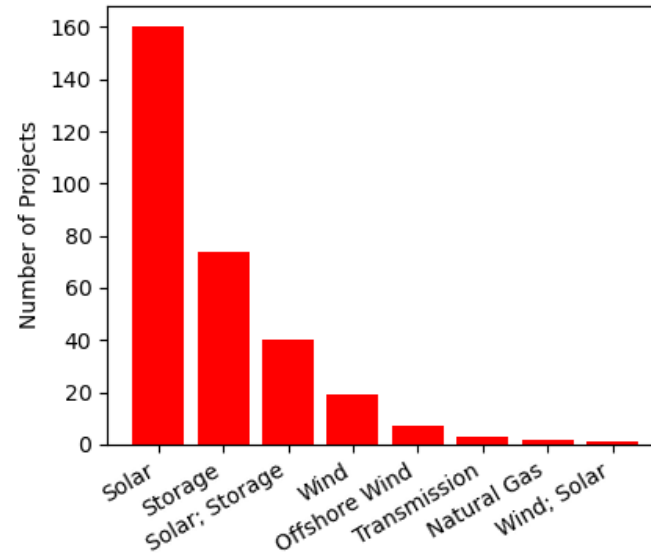
- Determine distribution of projects in the interconnection queue by:
 - Technology
 - MW Capacity
 - Location
 - Interconnecting Utility
- Determine distribution of unit price of interconnection (\$/kW).
- Is there any correlation between interconnections costs and any of these factors?
- Characterize the projects under some unit interconnection cost threshold.

Exploratory Data Analysis

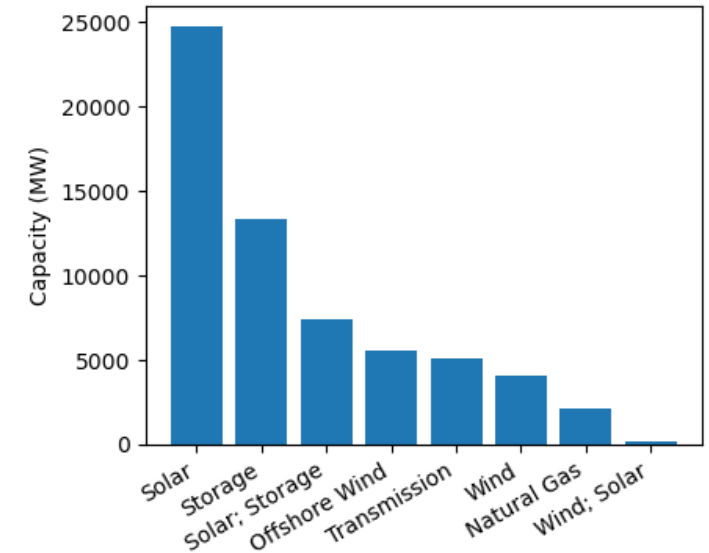
Project Characterization (TC-1)

- 306 total projects in TC-1
- Project technology type and MW capacity is primarily solar, storage, solar + storage.
- 3 Transmission Owners have the most projects applying to interconnect with their systems:
 - ComEd
 - Virginia E&PC
 - AEP
- Illinois, Virginia and Indiana dominate the project locations by total MW capacity.

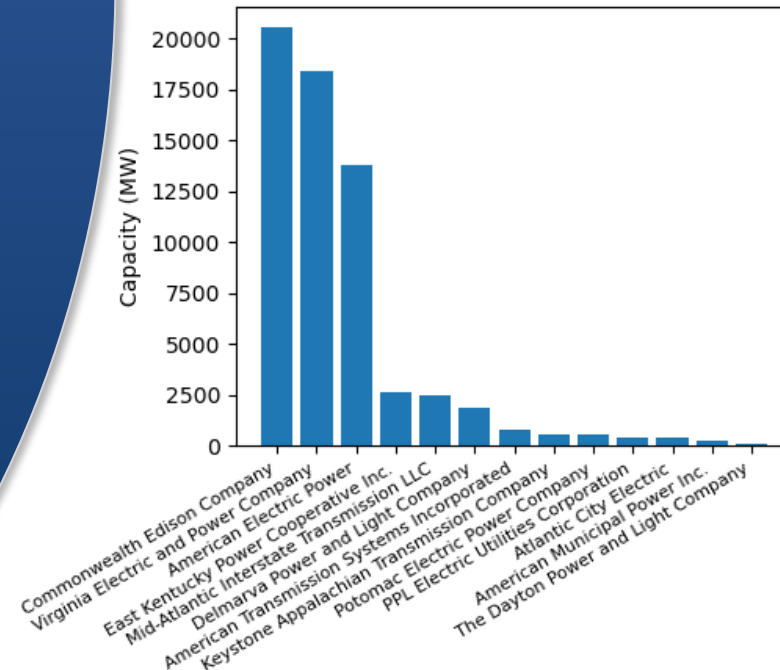
Number of Projects by Resource Type



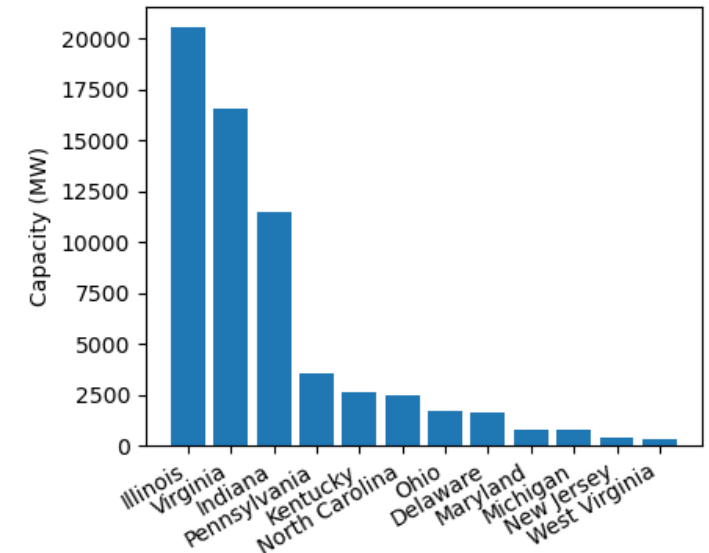
Capacity of Projects in MW's by Resource Type



Capacity of Projects in MW's by Transmission Owner

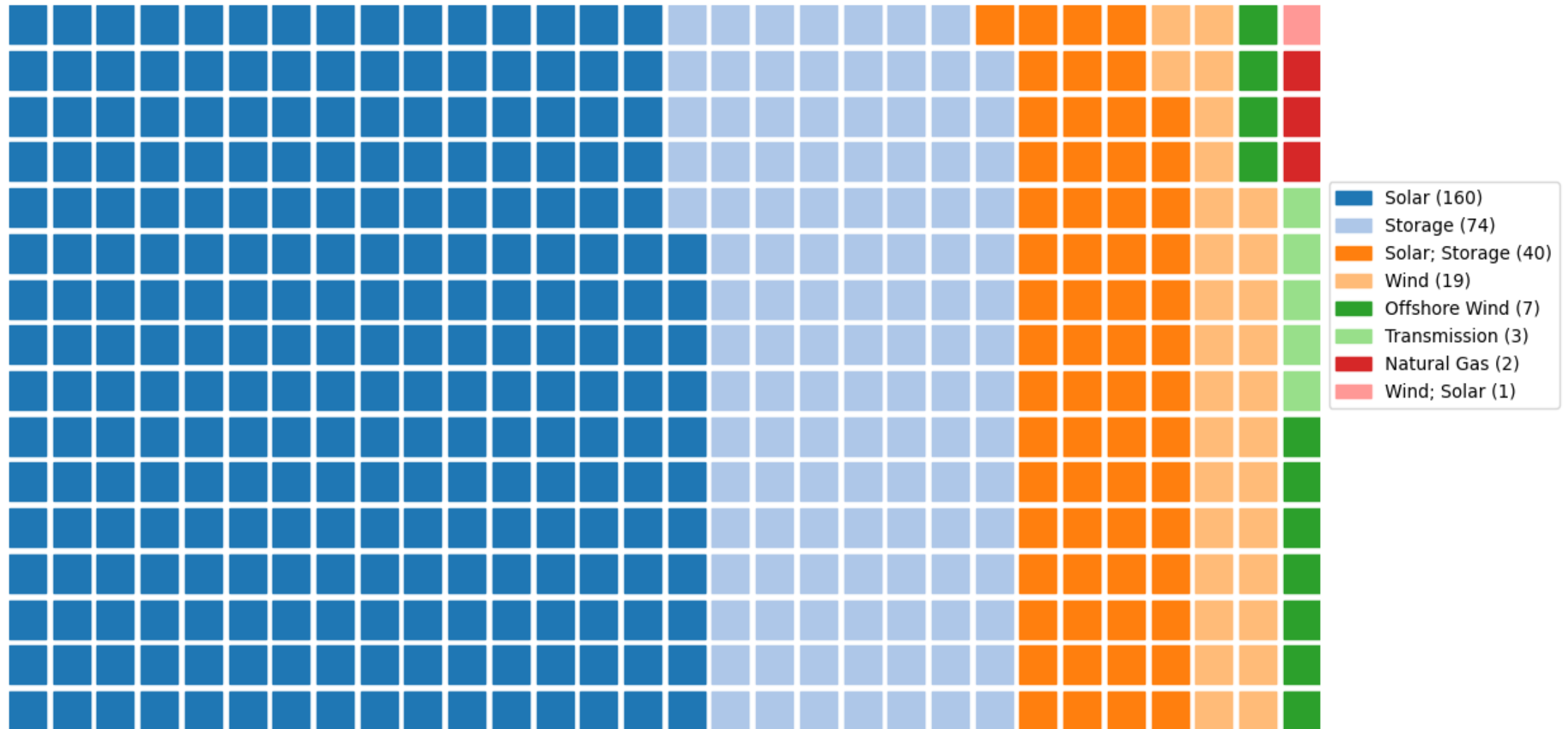


Capacity of Projects in MW's by State



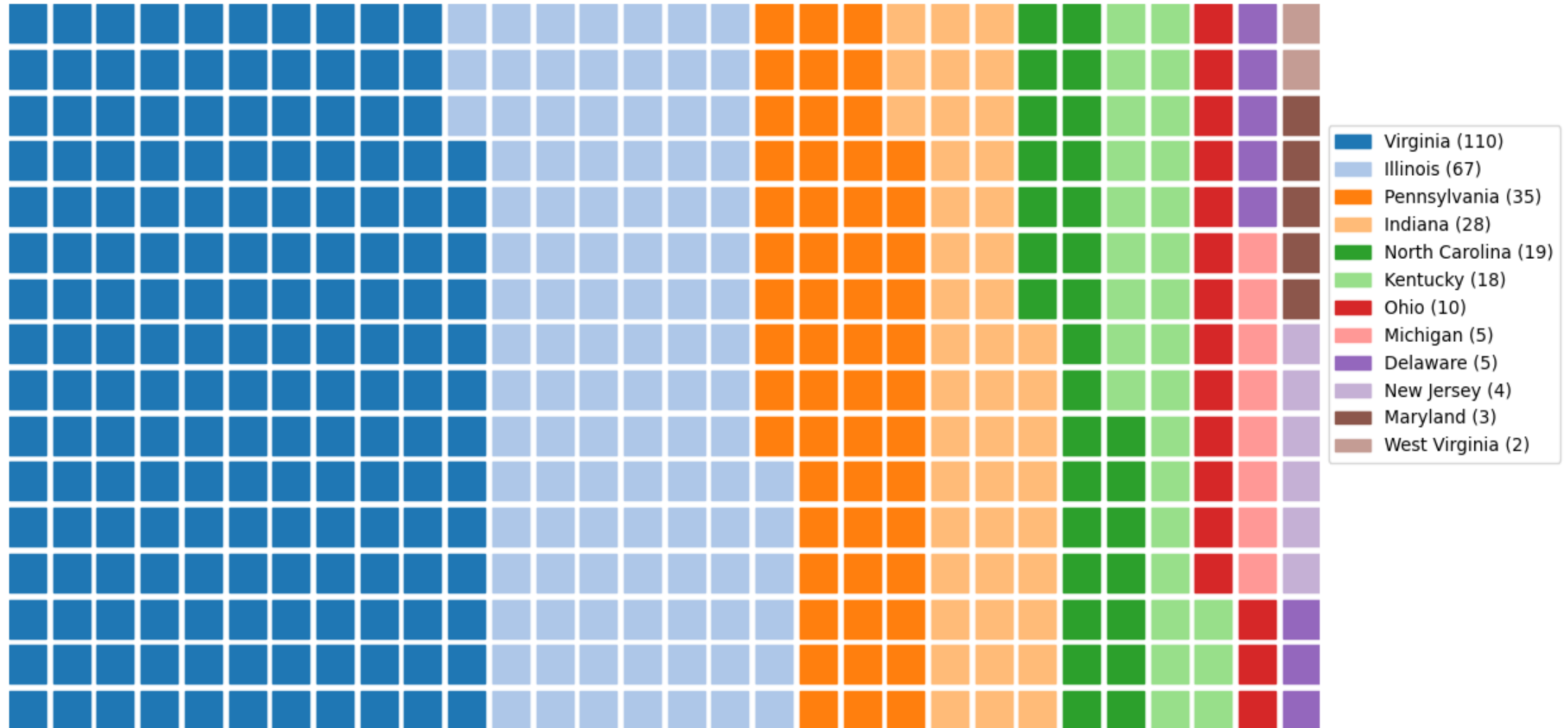
Project Distribution by Technology

Proportion of Projects in PJM Cluster Study TC-1 by Resource Type



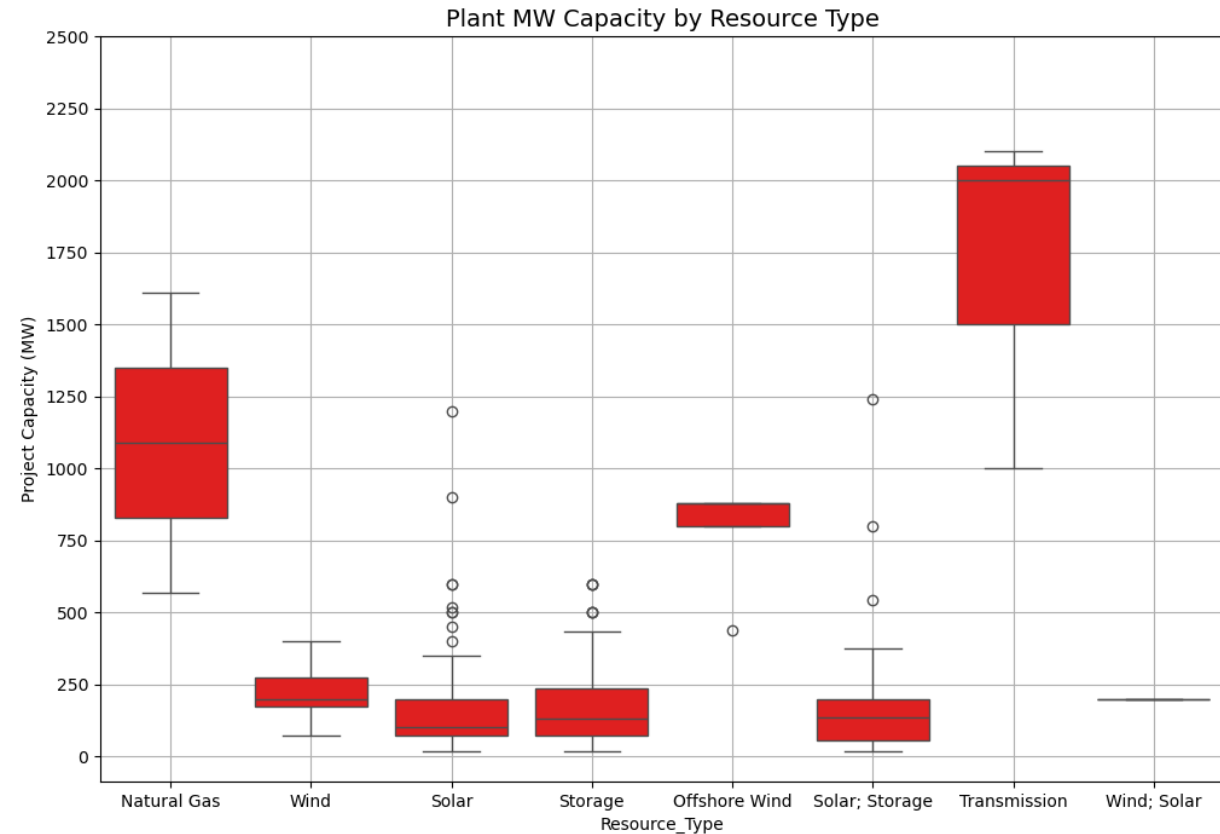
Project Distribution by State

Proportion of Projects in PJM Cluster Study TC-1 by State



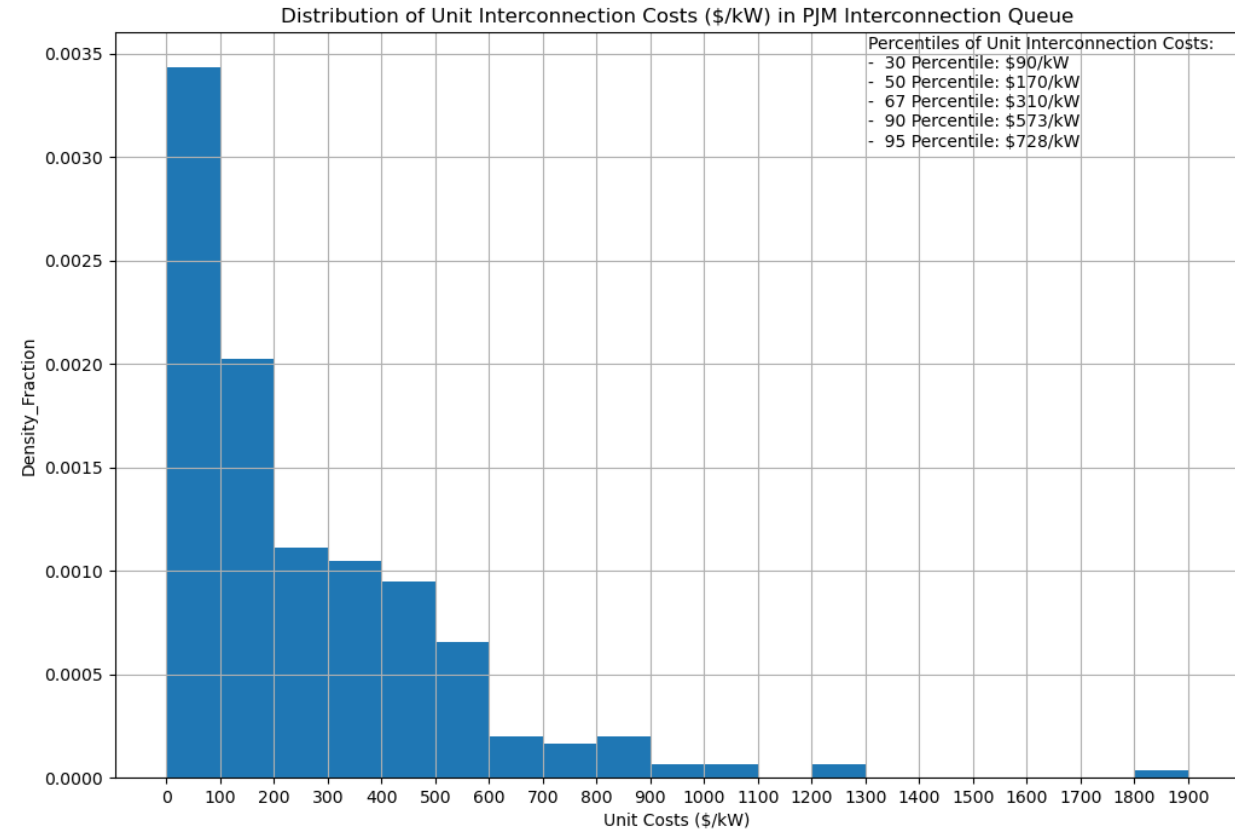
Plant MW Capacity by Resource

- Natural gas, Transmission, and Offshore wind projects have median project capacities greater than 750 MW.
- Wind, Solar, Storage have median project capacities of under 250MW.



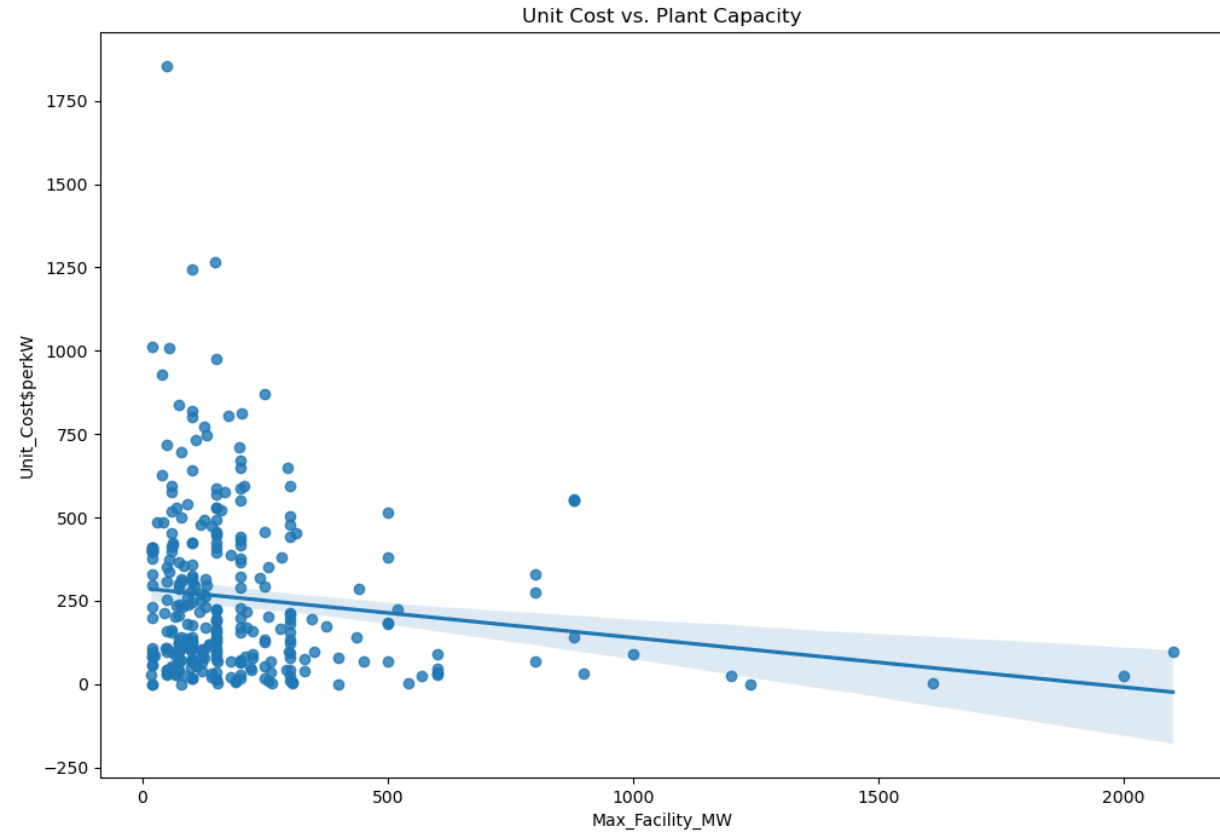
Interconnection Project Unit Cost Distribution (\$/kW)

- 30 percentile: \$ 90/kW
- 50 percentile: \$ 170/kW
- 67 percentile: \$ 310/kW
- 90 percentile: \$ 573/kW
- 95 percentile: \$ 728/kW



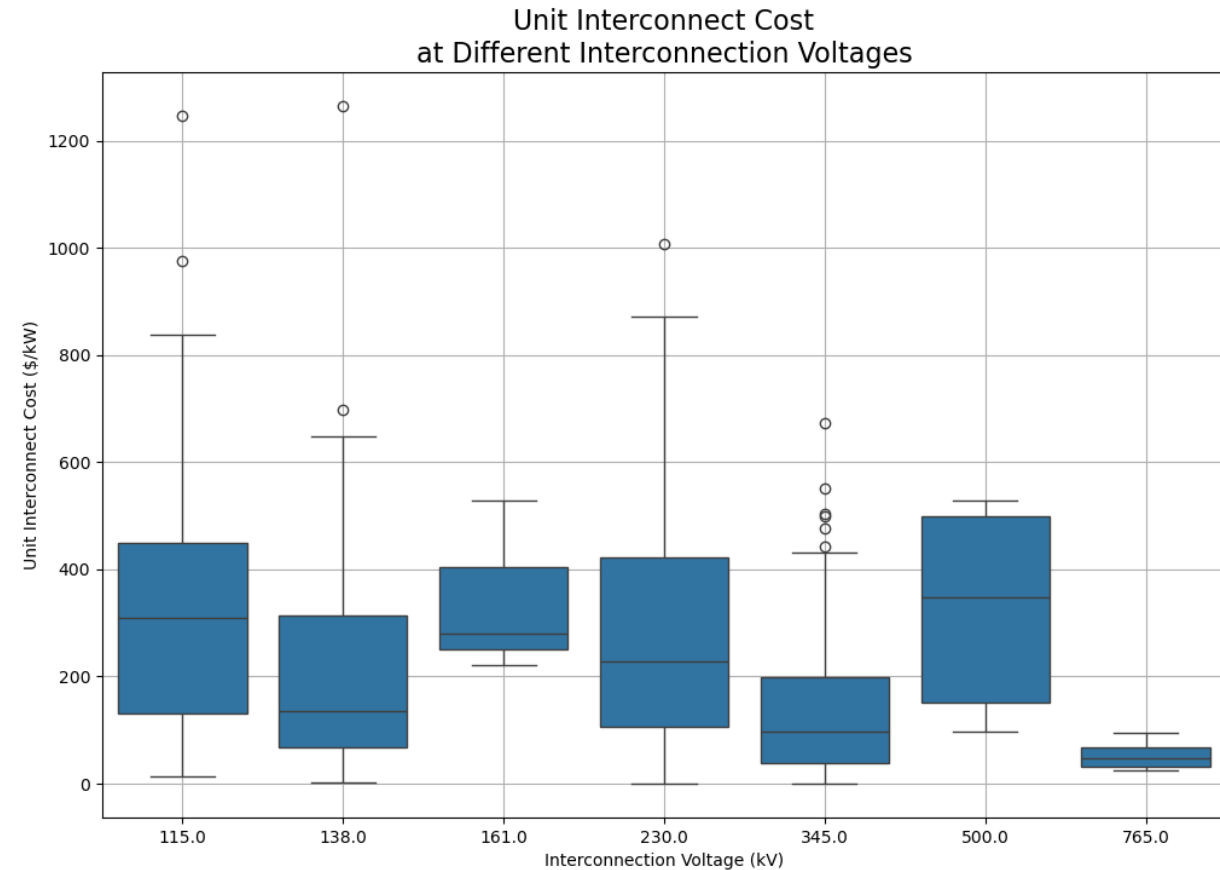
Interconnection Unit Cost vs. Project Size

- Unit Cost of Interconnection (\$/kW) is NOT well correlated to Project Capacity (MW)
- However, projects over 1,000 MW (only 2% of TC-1 projects) generally have low unit cost of interconnection



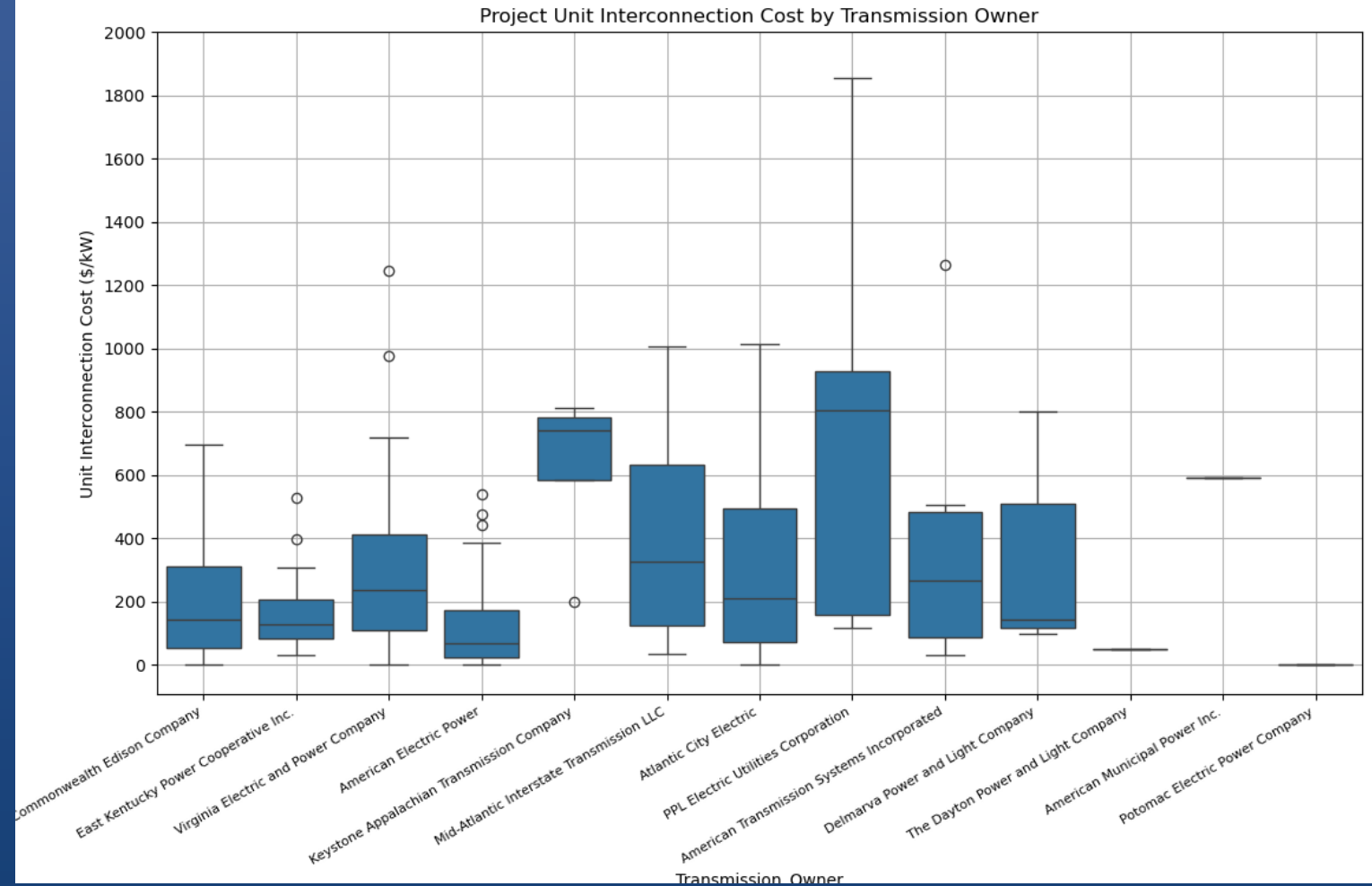
Distribution of Project Unit Interconnection Cost and Interconnection Voltages

- The lowest median unit interconnection costs appear at 765kV and 345kV



Distribution of Project Unit Interconnection Cost by Transmission Owner

- Median unit costs are \$300 /kW or less except for:
 - Keystone Appalachian Transmission Company
 - Mid-Atlantic Interstate Transmission Inc.
 - PPL Electric Utilities
 - American Municipal Power



Projects with Lowest Interconnection Cost

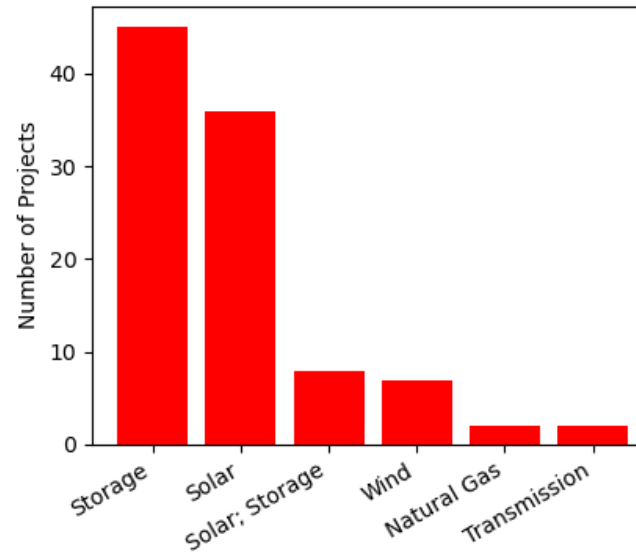
Projects with Low Cost of Interconnection

- Generally, only 30% of projects which apply for interconnection proceed all the way through and sign an interconnection agreement.
- Reasons may include:
 - Project financing or problematic project economics
 - Lack of or loss of developer funding
 - Project delay or difficulty getting permits
 - High Interconnection costs
- It's assumed that projects with low cost of interconnection are more likely to proceed than projects with high costs of interconnection.
- Assuming true, what are the characteristics of the subset of projects in bottom 35 percentile of unit interconnection cost? ~ 100 projects

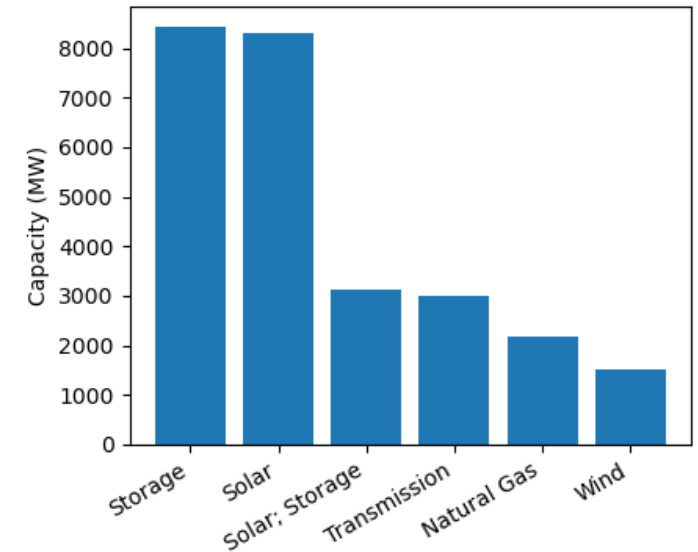
Project Characterization Lowest 100 Unit Interconnect Cost

- Storage, Solar and Solar + Storage still represent the majority of projects by count and MW capacity.
- American Electric Power, ComEd and Virginia all have the most MW capacity; but ranking has changed. AEP now first, followed by ComEd
- A good percentage projects with AEP as the Transmission Owner are among the lowest 100 projects.
- Indiana, Illinois, Virginia still have the most projects; but ranking has changed. (was Illinois, Virginia, then Indiana)

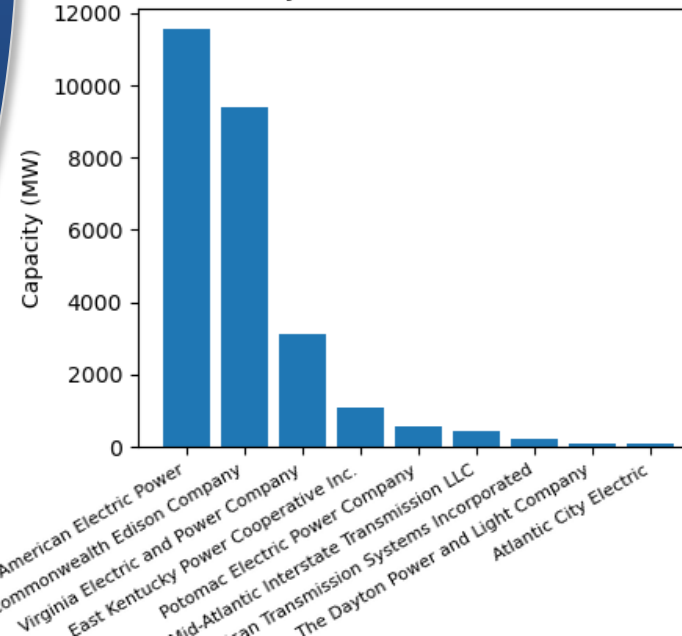
Number of Projects
by Resource Type



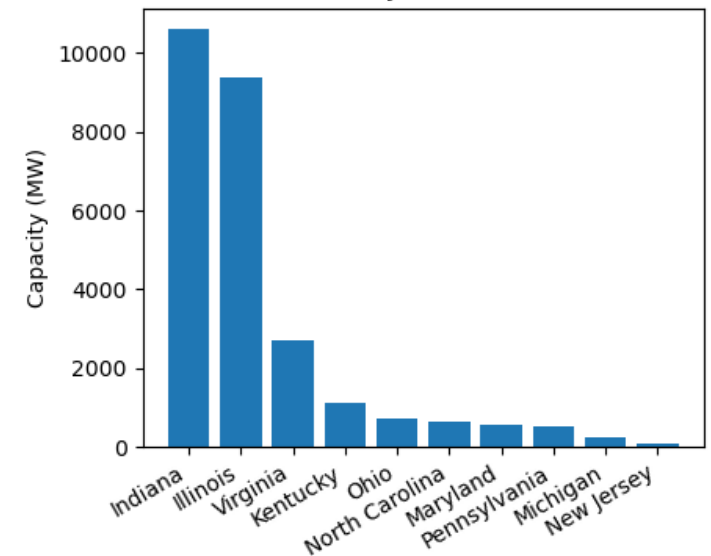
Capacity of Projects in MW's
by Resource Type



Capacity of Projects in MW's
by Transmission Owner



Capacity of Projects in MW's
by State



Conclusions

- PJM's Transition Cycle 1 cluster of projects is comprised mostly of solar, energy storage and solar+ energy storage projects
- Projects are primarily located in Virginia, Illinois and Indiana,
- A high proportion of projects interconnect with ComEd, Virginia Electric Power Company and AEP
- Unit Interconnection cost for projects have a median unit cost of \$170/kW and 30% of projects have units costs of \$90/kW or less.
- A very high percentage of AEP's projects are among the 100 projects having the lowest unit cost of interconnection.

Appendix

- Data Source: https://www.pjm.com/pub/planning/project-queues/Cluster-Reports/TC1/TC1_PH1_Executive_Summary.htm
- Interconnection Process Reform: <https://www.pjm.com/-/media/committees-groups/committees/mrc/2022/20220427/20220427-item-02a-interconnection-process-reform-presentation.ashx>

Acknowledgements

- PJM makes data publicly available on their interconnection process.
- This type of transparency is important for developers to understand the market.