



# Electric Distance Review

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- Clarification of Electrical Distance Proposal
  - Proposed Description
  - Map of Proposed Tiers
- Background on Geographic vs. Electrical Distance
- Update on Electric Distance Calculator
  - Review of approach
  - Progress to date
  - Next steps

Two external resources that are the same geographic distance from the PJM footprint can have different Electric Distances. While the geographic distance is the same, the power supplied by each external resource will flow over different transmission system paths to the PJM footprint. Each path can have different total impedance and as a result, a different Electric Distance.

Generally, external resources that are geographically closer to the PJM footprint will have a smaller Electric Distance than those resources that are geographically farther away from the PJM footprint.

If the Electric Distance is small, the total impedance between the external resource and the PJM footprint is low.

- When the total impedance is low, there are generally a smaller number of parallel paths over which power can flow from the external resource to the PJM footprint.
- Typically results in a smaller number of external facilities that could be impacted by the external resource under normal conditions and when transmission outages (planned or unplanned) occur.

As a result, PJM would be required to model a smaller number of impacted facilities. Electrically close facilities are generally geographically located adjacent to the PJM footprint.

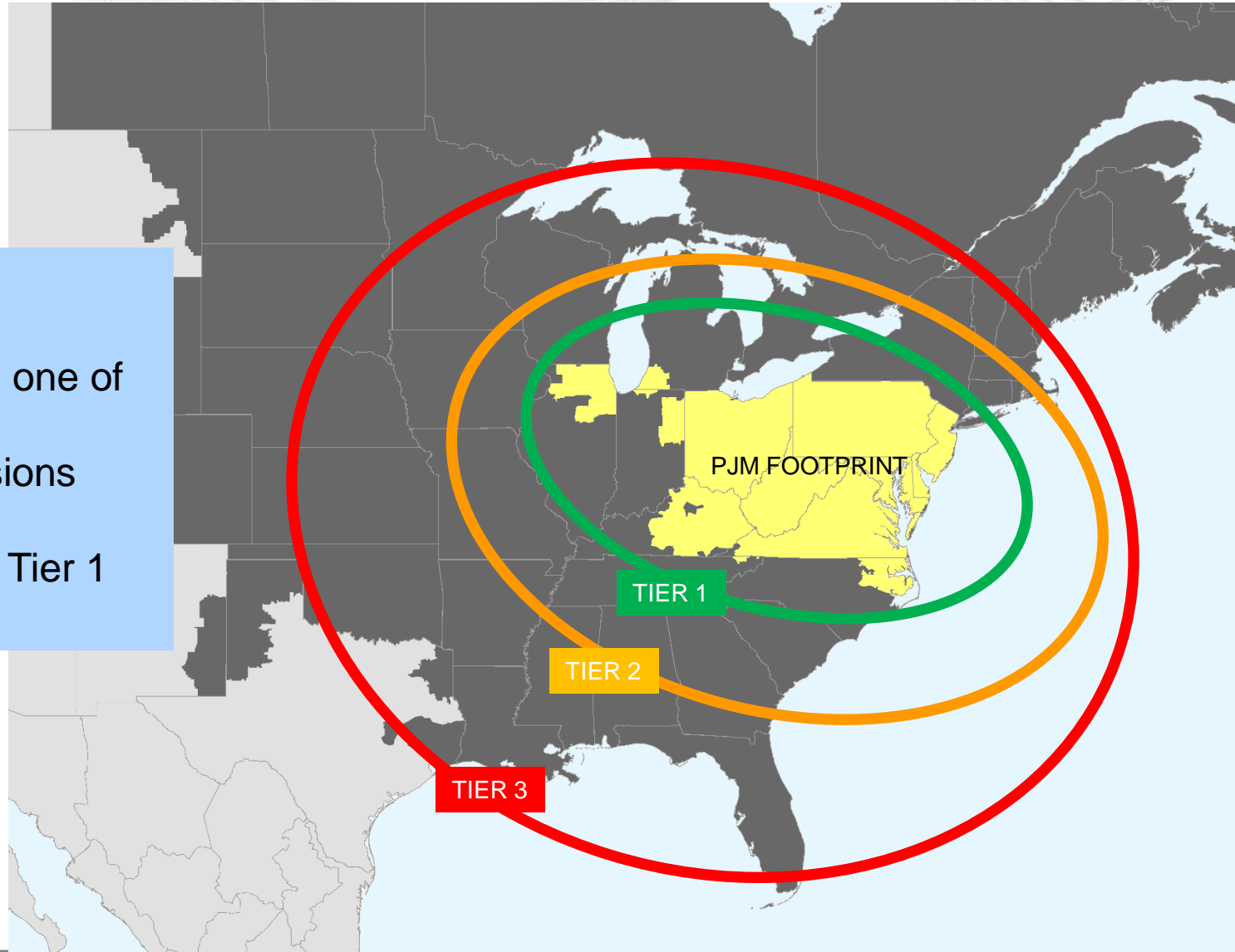
If the Electric Distance is large, the total impedance between the external resource and the PJM footprint is high.

- When the total impedance is high, there are generally larger number of external parallel paths over which power can flow from the external resource to the PJM footprint
- Typically results in a larger number of facilities that could be impacted by the external resource under normal conditions, and when transmission outages (planned or unplanned) occur

As a result, PJM would be required to model a much larger number of impacted facilities. The majority of electrically distant facilities are generally located farther away from the PJM footprint.

## ECPE Matrix Description

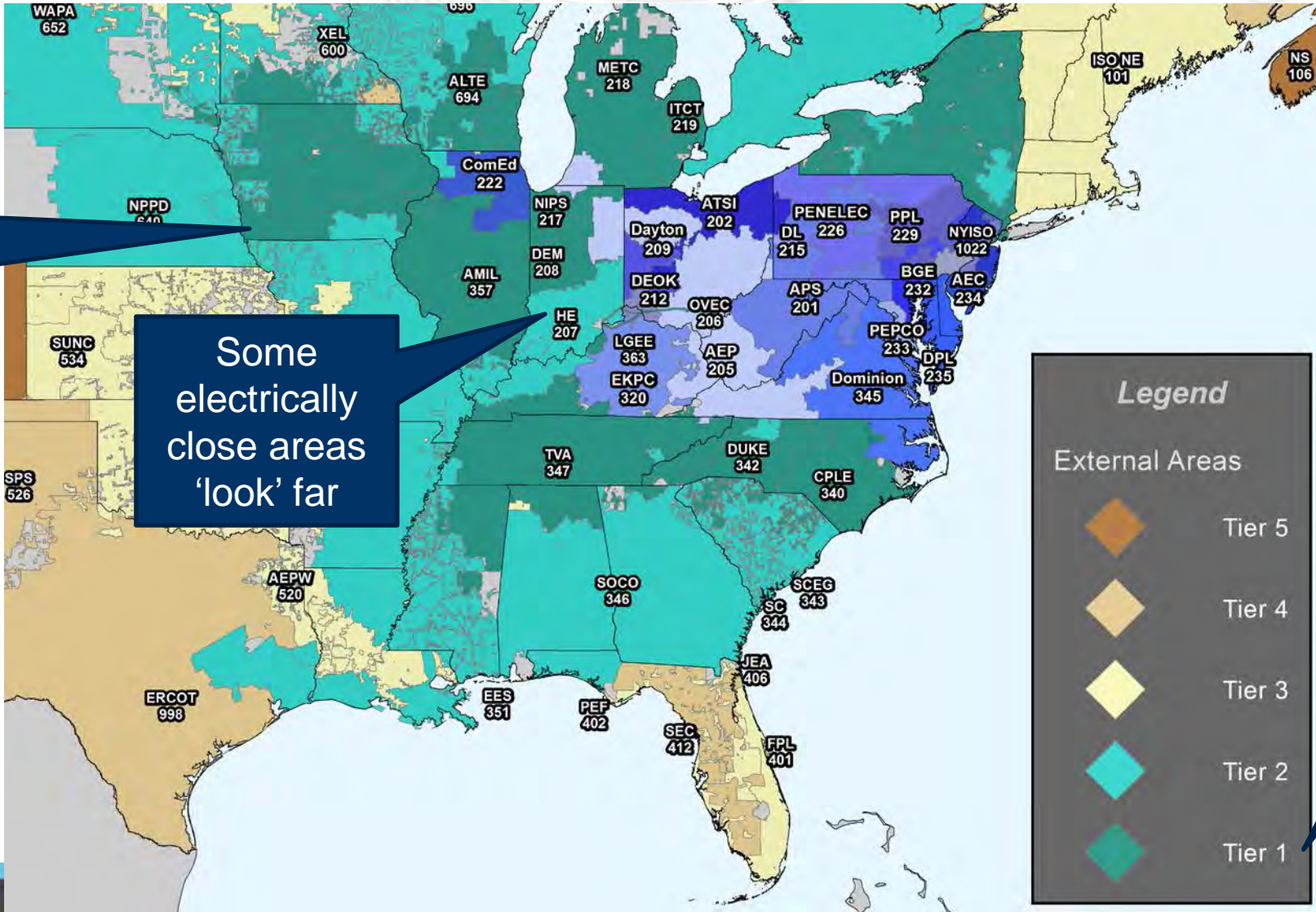
Resources physically located one of the following areas:  
(1) in Tier 1 with some exclusions based on electrical distance  
(2) in Tier 2 AND close to the Tier 1 border



# Refined Geographic Tier Diagram (Based on Planning Base Case Areas)

Some electrically far areas 'look' close

Some electrically close areas 'look' far



Tier 1 includes >160,000 MW of generation

# Background on Geographic vs. Electrical Distance



	Trip Distance	Travel Time	# of Major Intersections	Map Complexity / Alternate Routes
Travel to PJM Example	19.2 vs. 19.1 miles	21 minutes vs. 36 minutes	None vs. 4	Rural vs. Urban Road Network
Pseudo-Tie Equivalent	Geographic Distance	Electric Distance	# of Coordinated Flowgates	EMS Model Complexity

Where are you starting?  
US-422 E, Pottstown PA

Where are you going?  
2750 Monroe Blvd, Norristown, PA

Choose Your Route

Route #1 via US-422 E  
21min 19.2mi

Current Traffic: Moderate

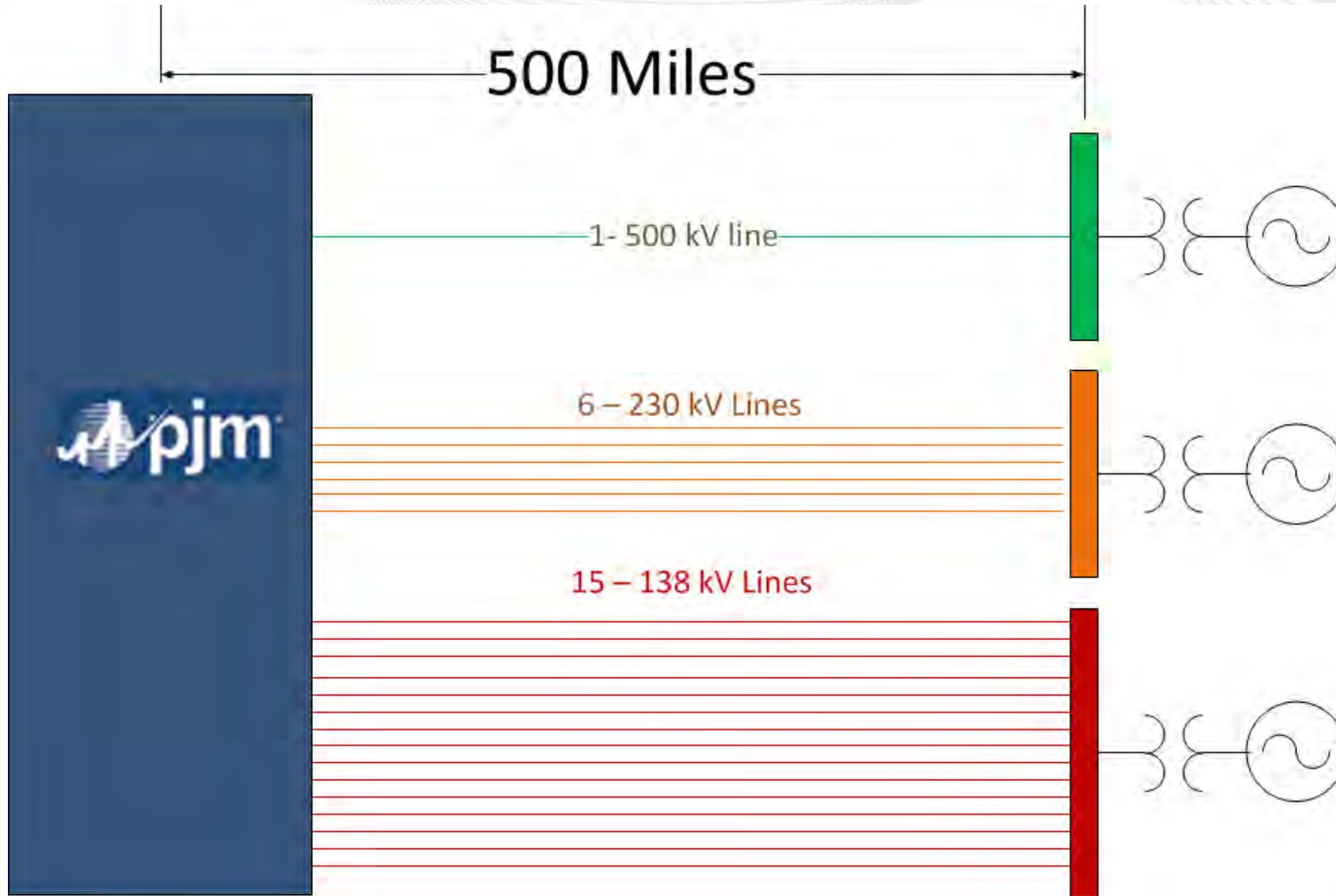
Where are you starting?  
Overbrook, PA

Where are you going?  
2750 Monroe Blvd, Norristown, PA

Choose Your Route

Route #1 via City Ave to I-76 W  
36min 19.1mi

Current Traffic: Heavy





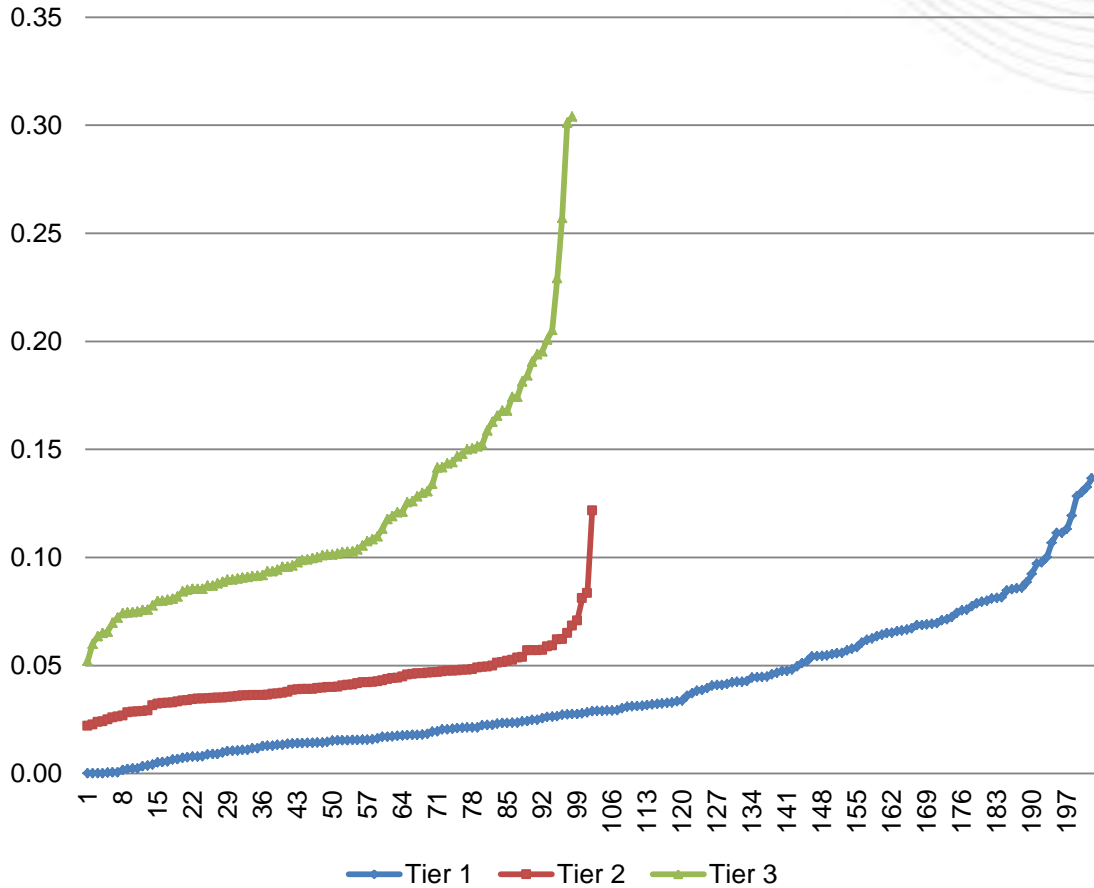
# Example Engineering Parameters

Base Typical Impedance Information					Electric vs. Geographic Distance		
	Aerial Transmission Cable Size/Type	X/mile	Normal MVA Rating	Emergency MVA Rating	Total % Impedance for a Single 500 Mile Line	Mileage @ 12% Impedance	Equivalent # of Parallel Lines
<b>500 KV</b>	2-2493 MCM ACAR	0.024	3850	4430	12	497	1
<b>230 KV</b>	2-1590 MCM ACSR	0.106	1418	1706	53	113	4
<b>230 KV</b>	1590 MCM ACSR	0.145	709	853	72	83	6
<b>138 KV</b>	1590 MCM ACSR	0.425	272	323	213	28	15
<b>69 KV</b>	1590 MCM ACSR	1.426	213	256	713	8	60

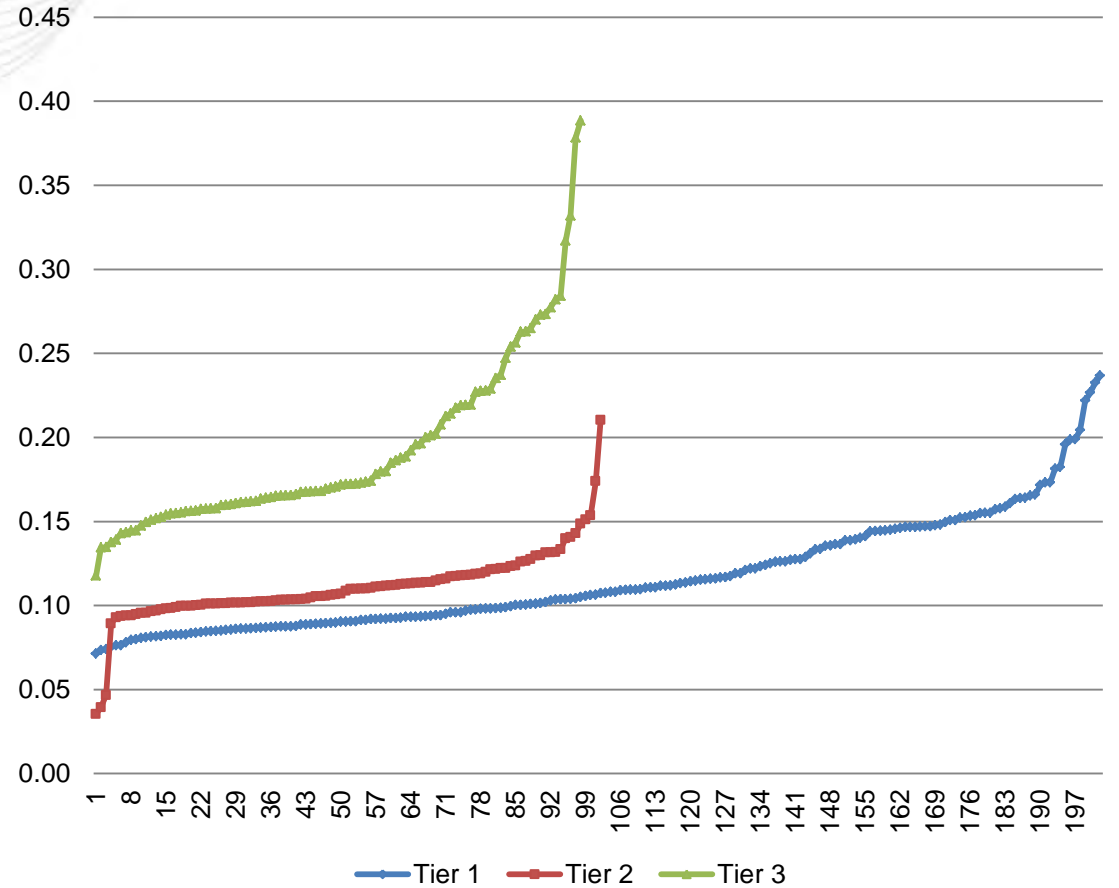
# Update on Electric Distance Calculation Methodology

- Geographic based proxy approaches have inconsistent results
  - Network topology and complexity is not the same
- PJM is developing a tool to assess all external generators
  - Uses a full Eastern Interconnection model
  - Generates an equivalent impedance from each generator to the PJM footprint for available paths (a.k.a. - Thévenin equivalent impedance)
  - Provides a simple, consistent, engineering based comparison metric

Distance to the **Nearest** Tie-line Bus



**Average** Distance to All Boundary Buses



- Initial subset of results show good alignment with previous detailed model assessments
- PJM will apply the new approach to existing generator locations to establish:
  1. A map of electrically close generation to PJM
  2. A recommended threshold to update the EPCE matrix definition for “Operational Modeling Requirements”