



Modelling transitions to a low-carbon emissions PJM electric grid: Data and approach

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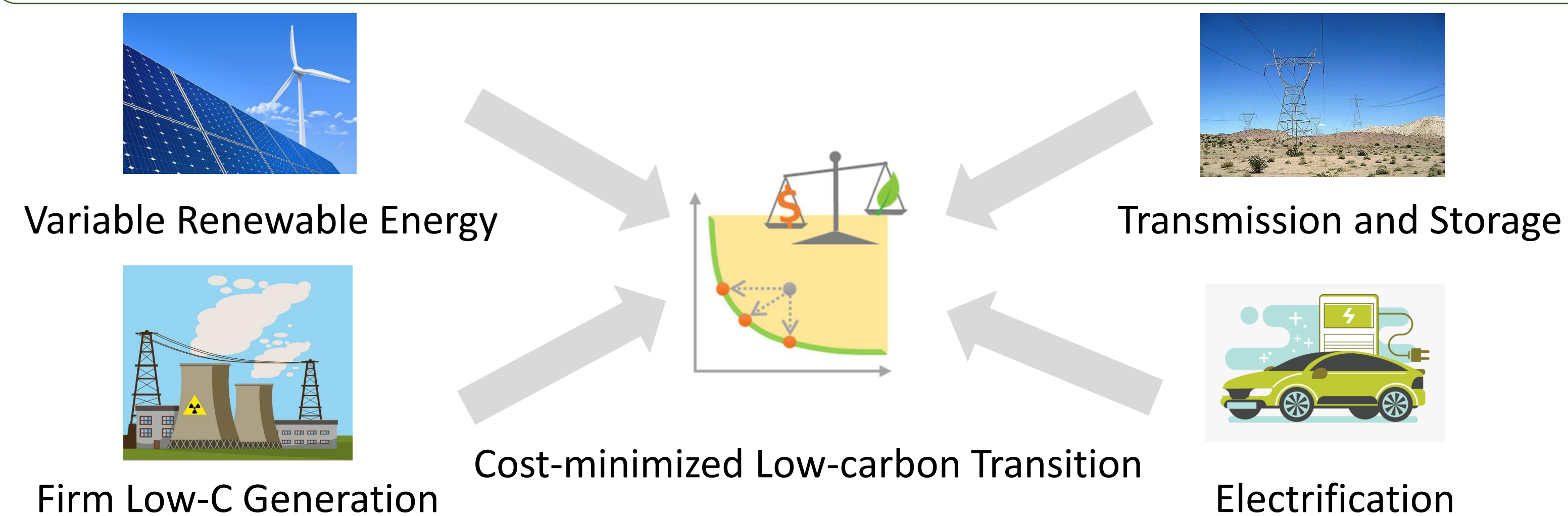
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1 INTRODUCTION/MOTIVATION

PJM had CO₂ emissions 346 million metric tonnes in 2016 (19% of total US power sector emissions, 434 kg/MWh with US average 452kg/MWh.)

A growing number of states served by PJM have passed legislation for 100% carbon-free electricity by 2050 (e.g., NJ, VA, NC, DC).



Research Question: How might the PJM technology mix evolve in the coming decades toward low-carbon goals, and what will the cost be?

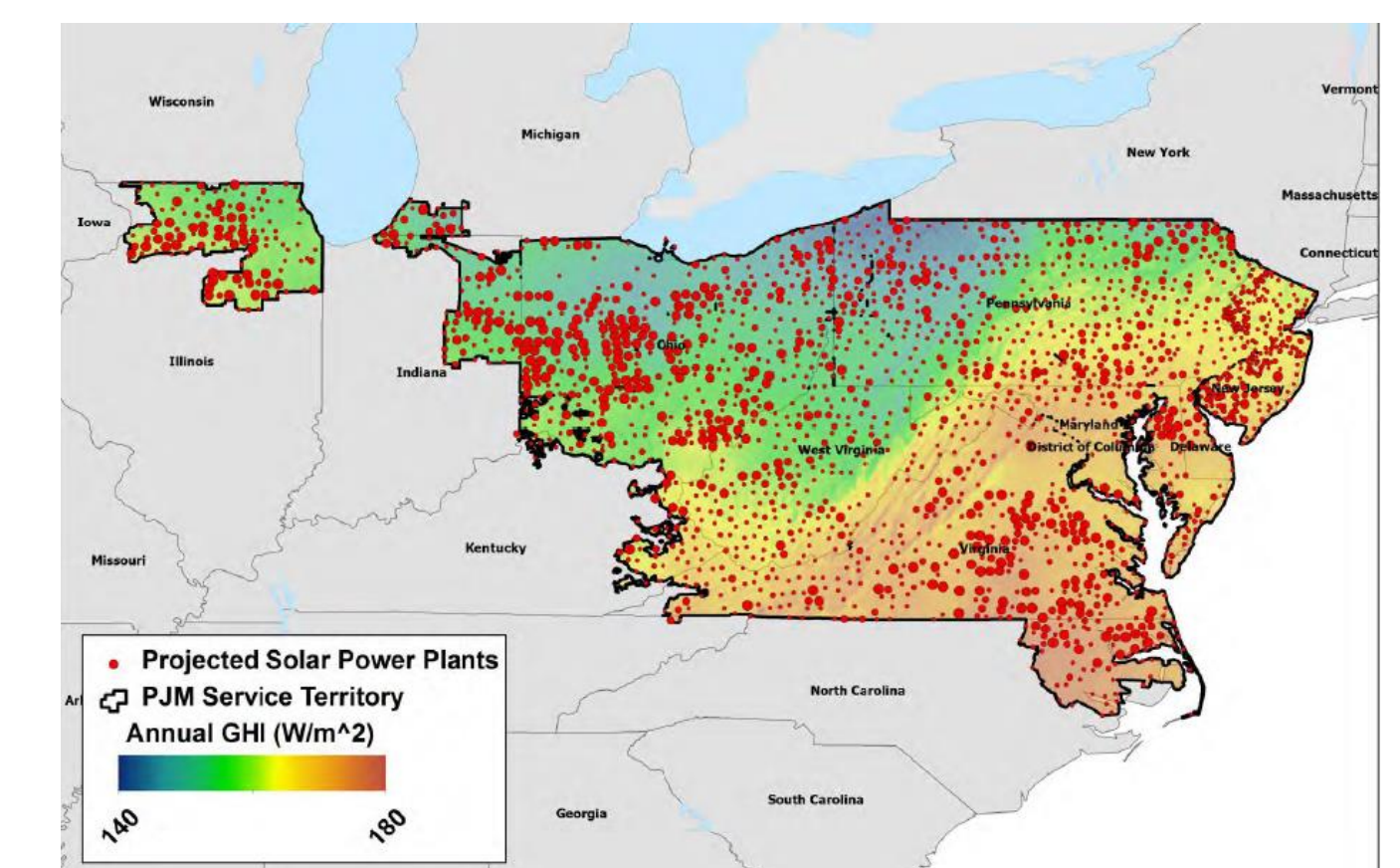
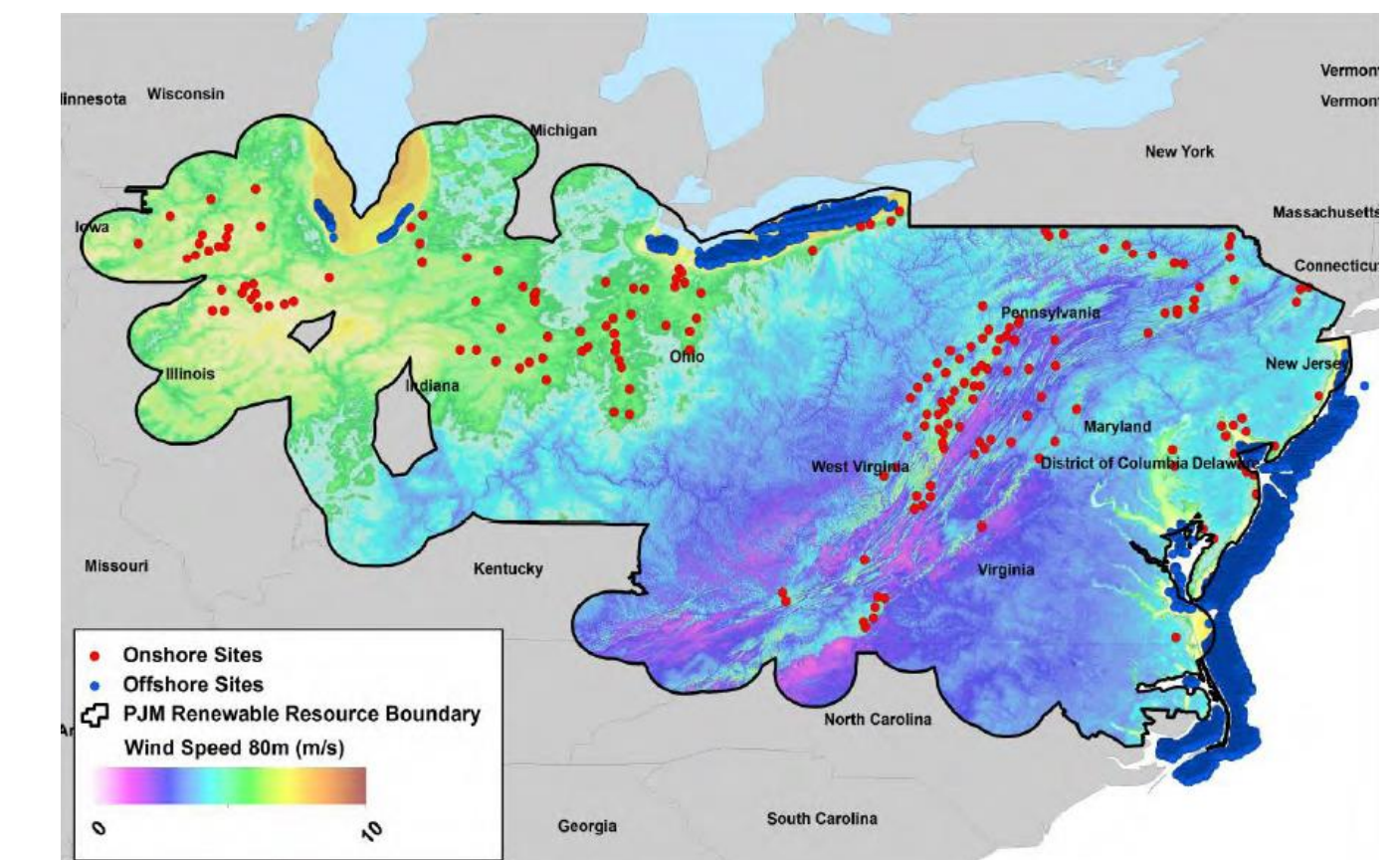
2 DATA

	2017	2018
Peak demand (MW)	142,387	147,042
Installed capacity (MW)	183,882	185,952
Load weighted LMP (\$/MWh)	\$31	\$38
Congestion cost (million \$)	\$698	\$1310

➤ PJM statistics in 2017 and 2018

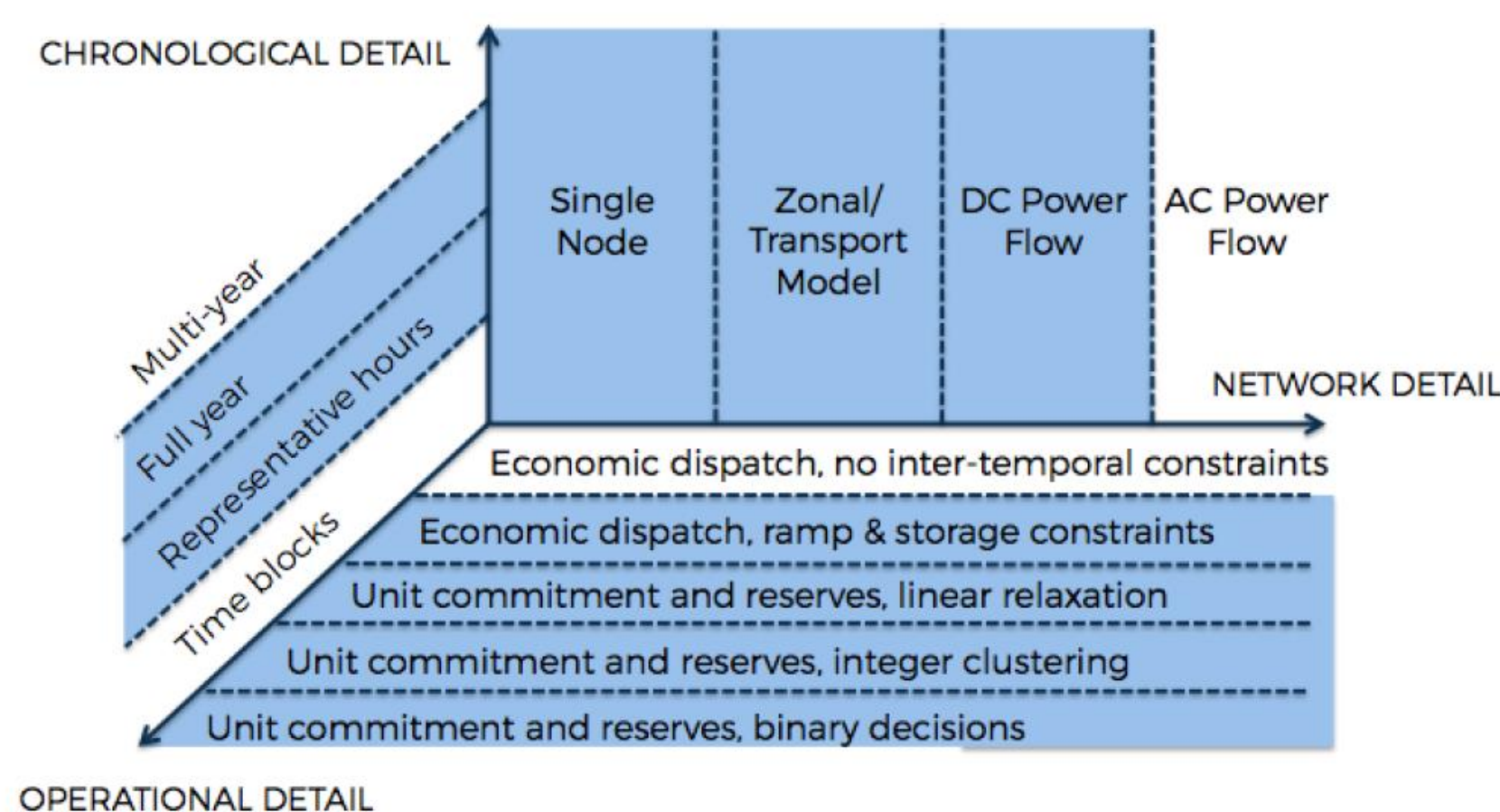
Zone	Net Gen
ComEd	35,585
AEP	31,999
PECO	26,325
...	...
DAY	-13,047
Pepco	-17,828
ATSI	-27,308

➤ Net Gen minus net load in different zones in PJM



➤ Wind/Solar resources in PJM

3 METHODS



GenX is an electricity capacity expansion model that can represent both conventional and novel generation technologies, with different possible resolutions of spatial, operational, and temporal details.

➤ Capacity Expansion Modelling

Objective function

Minimization of electricity system cost

Decision Variables

Capacity addition/unit commitment for different technologies and zones;
 Energy storage and transmission within and between different zones;
 Operating reserves for electricity system;
 Interconnection between power sector and other sectors (e.g. heat, transportation, H₂).

Constraints

Demand balance, renewable portfolio standards, CO₂ emission limits, transmission/distribution expansion etc.

4 PRELIMINARY RESULTS AND FUTURE WORK

- Transforming PJM's current energy system (40% nuclear + VRE) to 100% low-carbon energy by 2050 is a prospectively challenging task;
- Transmission, together with storage, is key to accommodate increased VRE (A 2014 study suggested that PJM can accommodate 30% VRE generation with current system, more renewable penetration needs to be studied.)
- Potential roles for firm low-carbon resources, distributed energy resources, and storage will be assessed/quantified.

5 REFERENCES

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2. Monitoring Analytics, 2019. PJM State of the Market, 2019;
3. PJM, 2014. PJM Renewable Integration Study Report, 2014.