

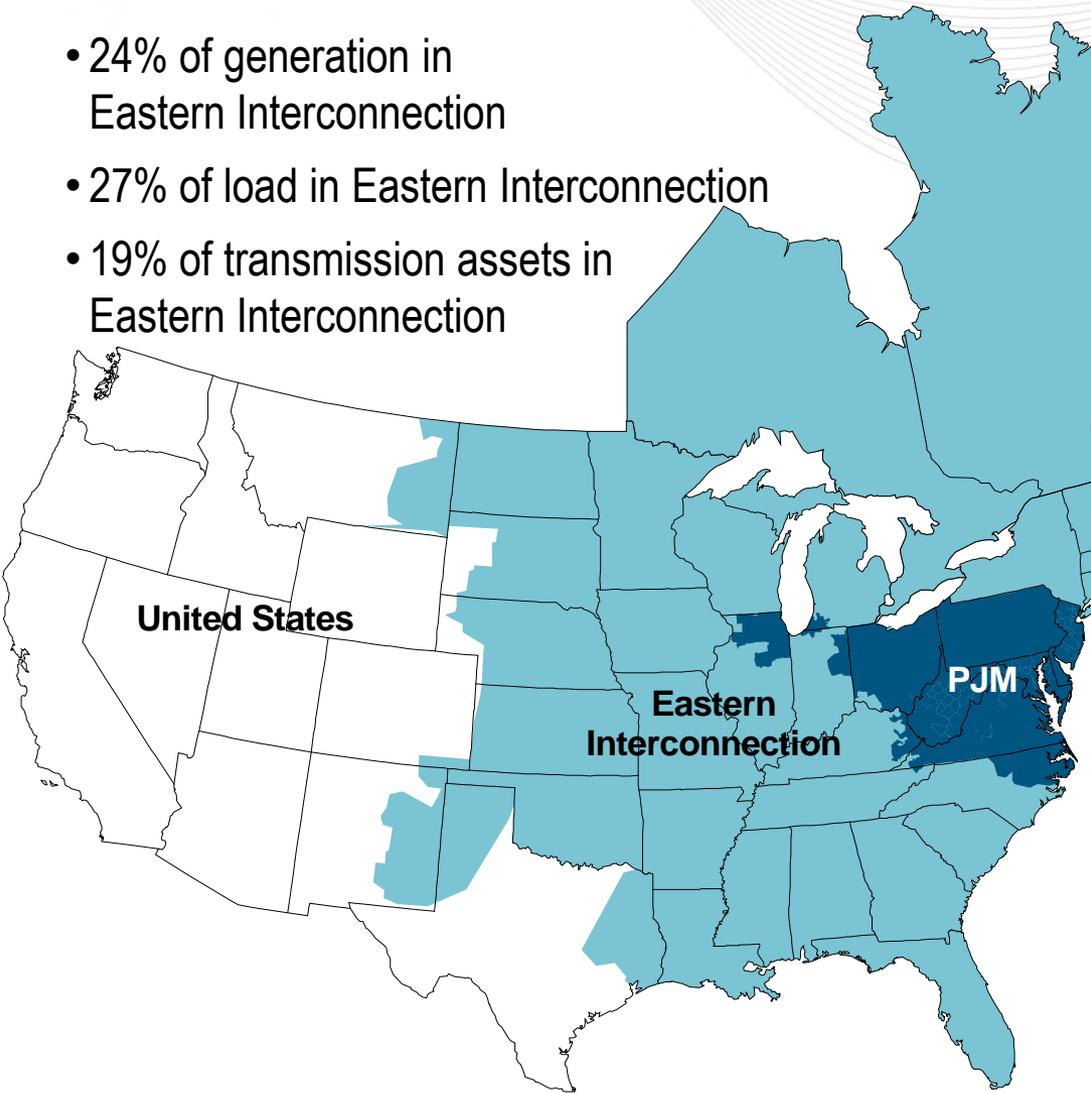
Electric Vehicles and Grid Connectivity: It's about energy storage!

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EV Forum
Washington, D.C.
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PJM as Part of the Eastern Interconnection

- 24% of generation in Eastern Interconnection
- 27% of load in Eastern Interconnection
- 19% of transmission assets in Eastern Interconnection



KEY STATISTICS

PJM member companies	710+
millions of people served	58
peak load in megawatts	158,450
MWs of generating capacity	180,400
miles of transmission lines	61,200
GWh of annual energy generation	794,335
generation sources	1,365
square miles of territory	211,000
area served	13 states + DC
Internal/external tie lines	142

**20% of U.S. GDP
produced in PJM**

As of 7/21/2011

State Renewable Portfolio Standards (RPS) require suppliers to utilize wind and other renewable resources to serve an increasing percentage of total demand.

State RPS Targets:

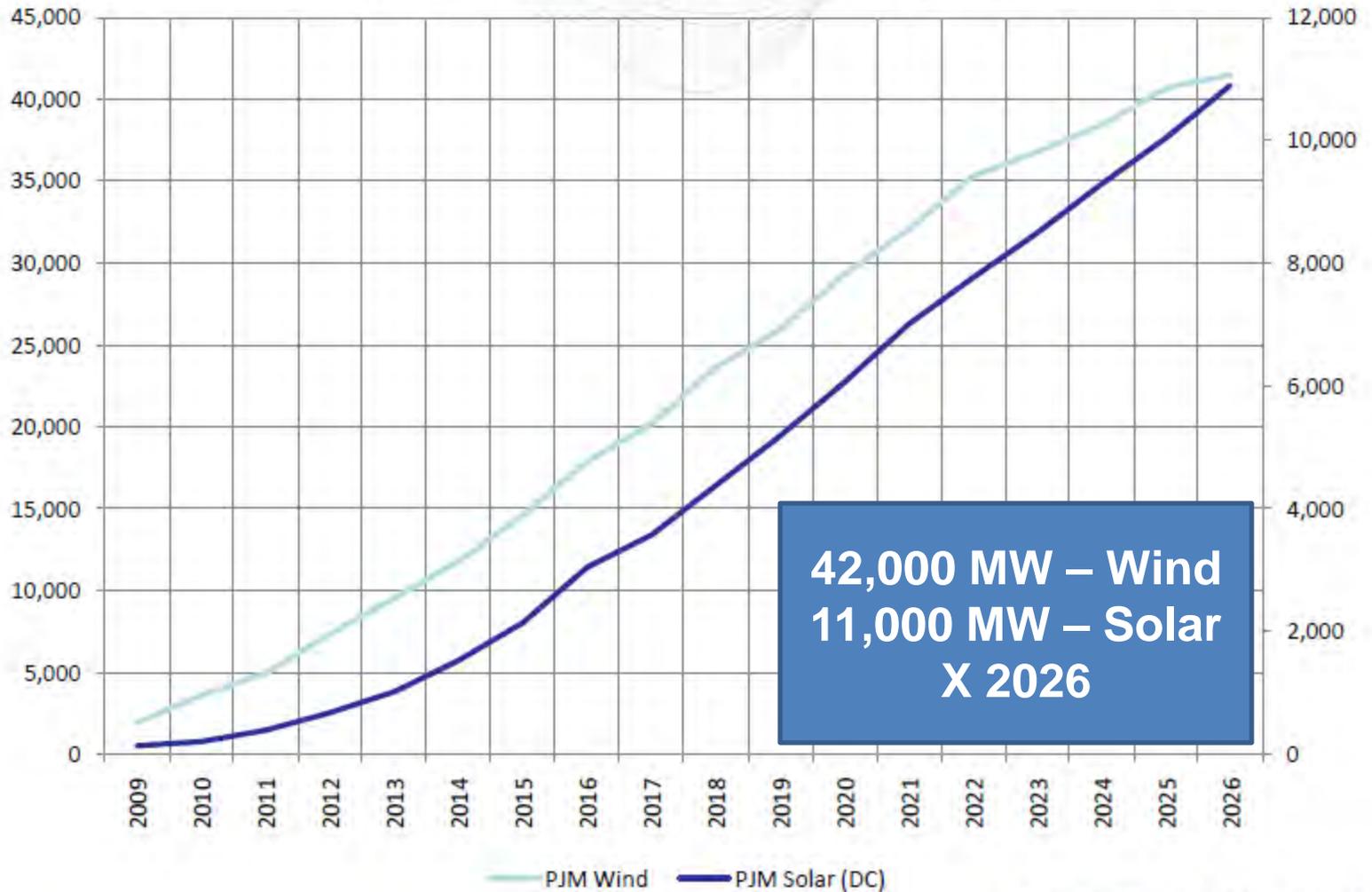


- ☀ NJ: 22.5% by 2021
- ☀ MD: 20% by 2022
- ☀ DE: 25% by 2026
- ☀ DC: 20% by 2020
- ☀ PA: 18%** by 2020
- ☀ IL: 25% by 2025
- ☀ OH: 25%** by 2025
- ☀ NC: 12.5% by 2021 (IOUs)
- MI: 10% + 1,100 MW by 2015
- VA: 15% by 2025
- WV: 25%** by 2025

☀ Minimum solar requirement

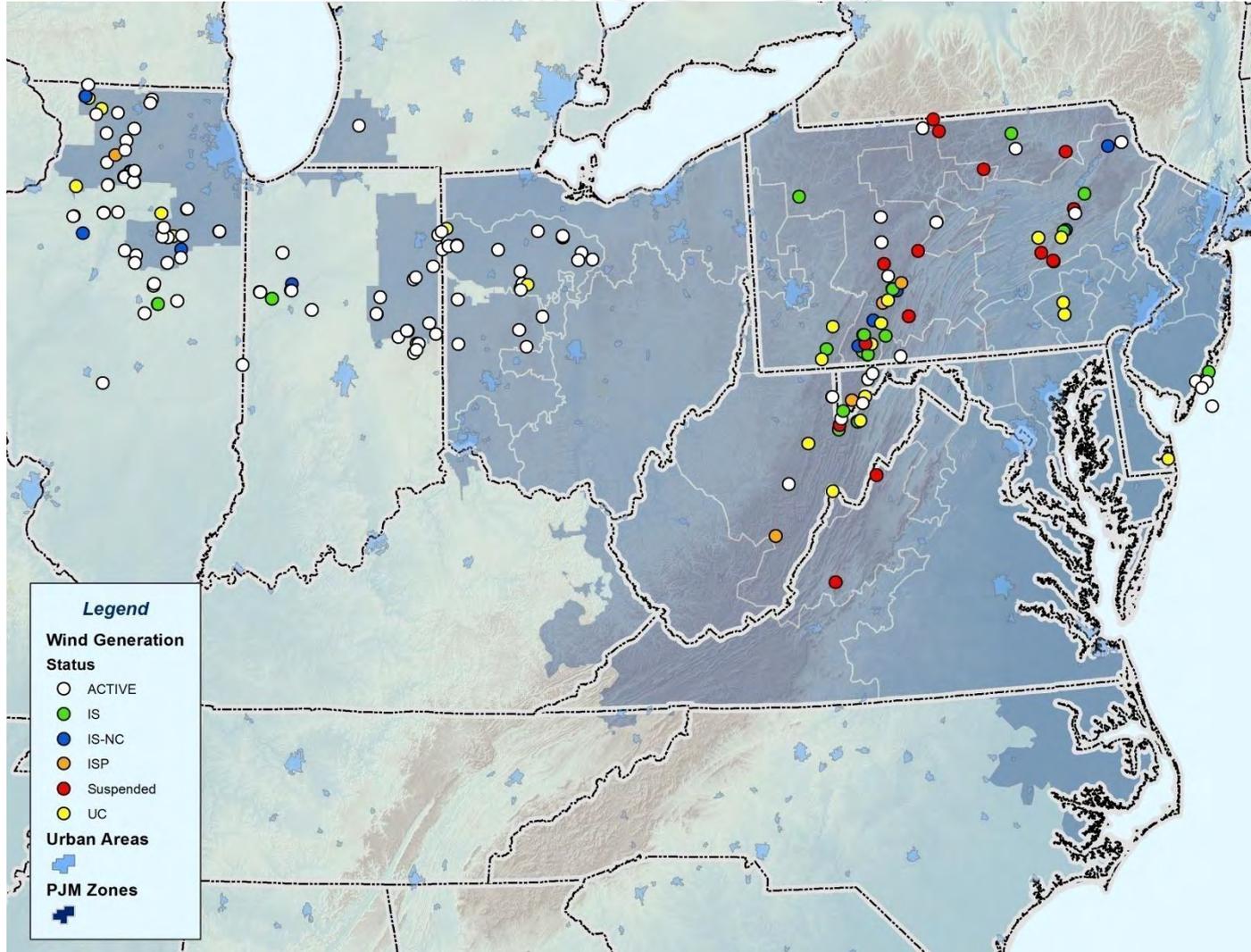
** Includes separate tier of “alternative” energy resources

Wind and Solar Requirements in PJM (MW)

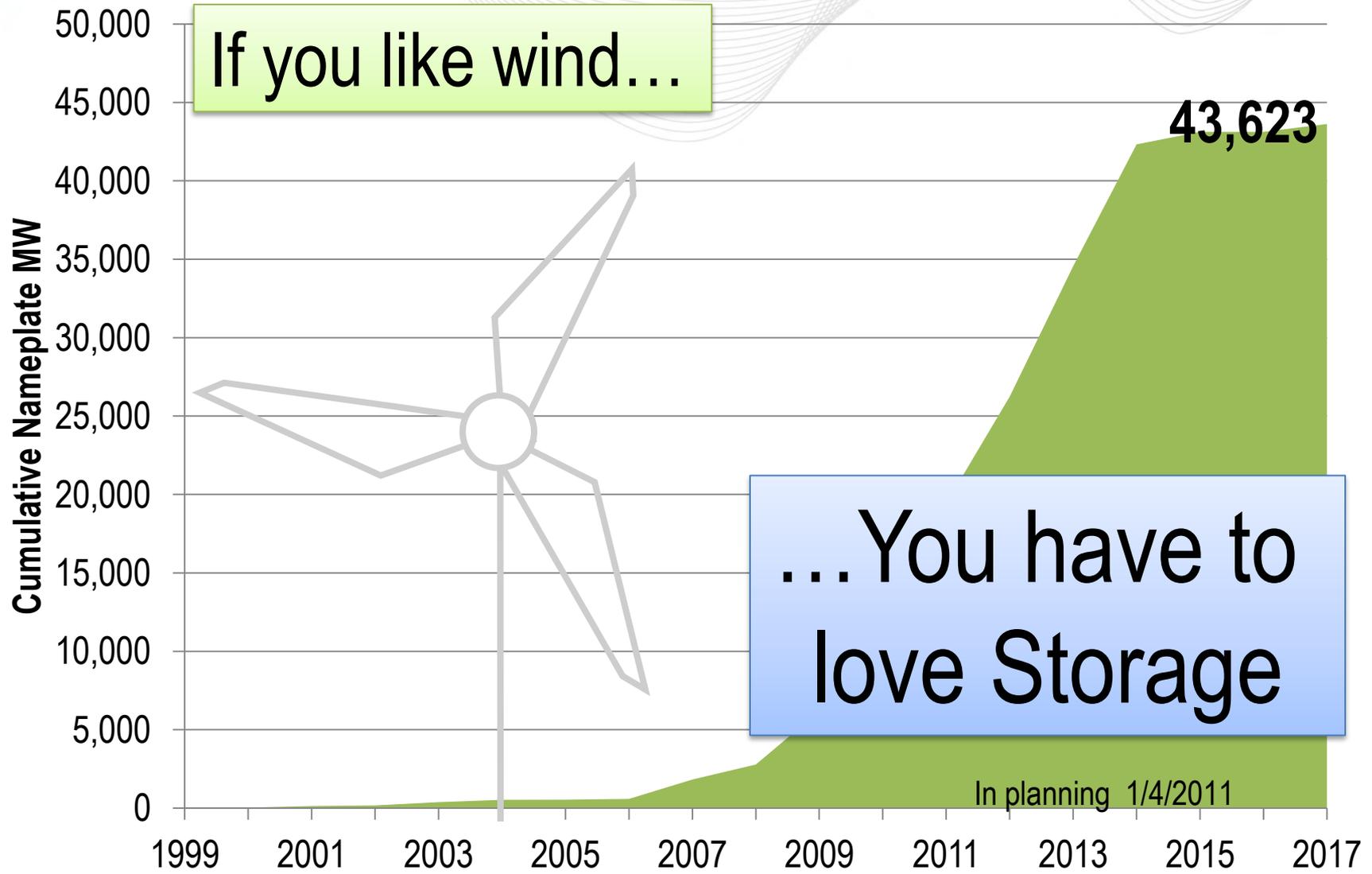


**42,000 MW – Wind
11,000 MW – Solar
X 2026**

Assumes a 30% cap factor for
Assumes a 12% cap factor for

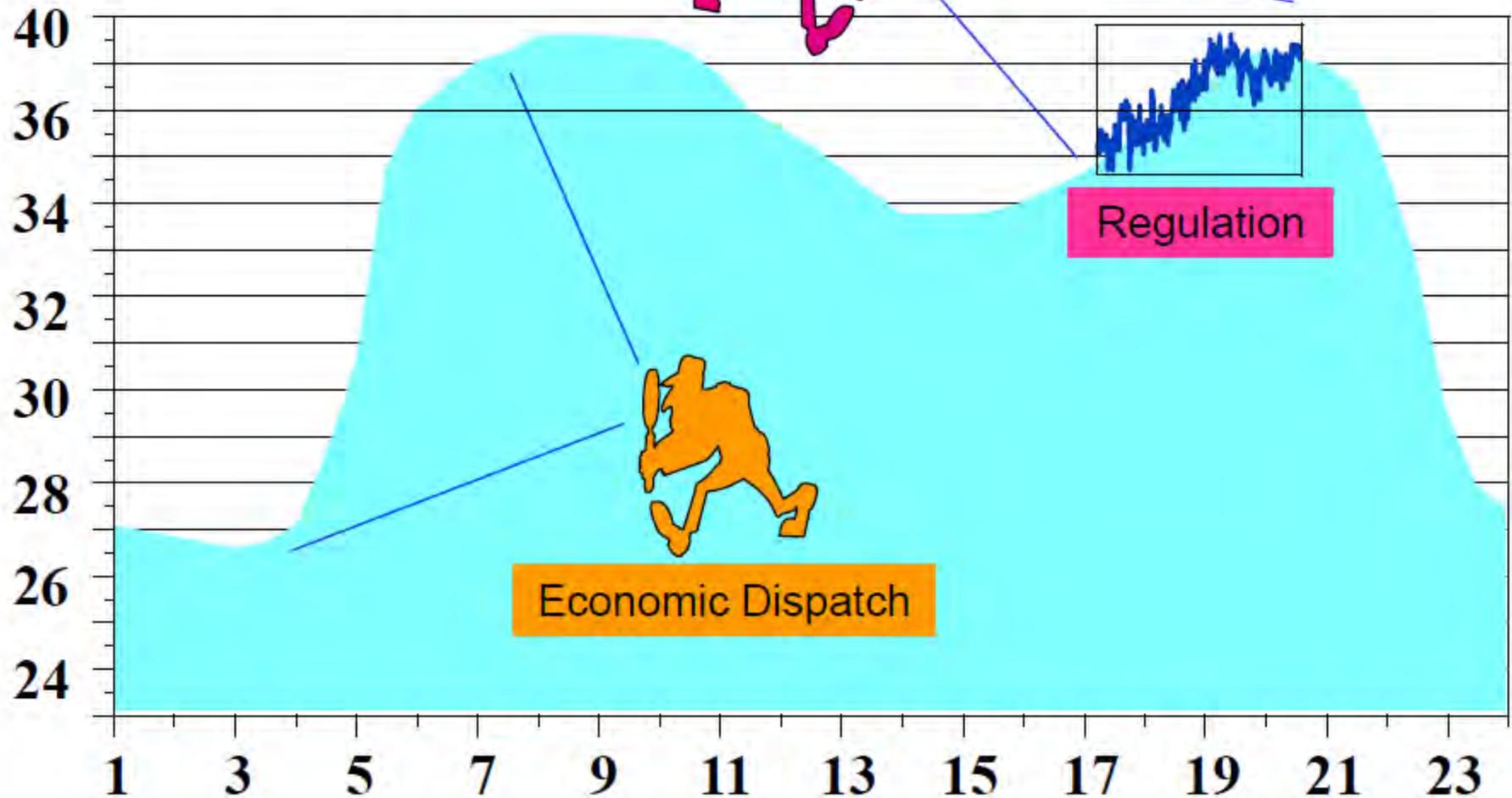


As of December 2010



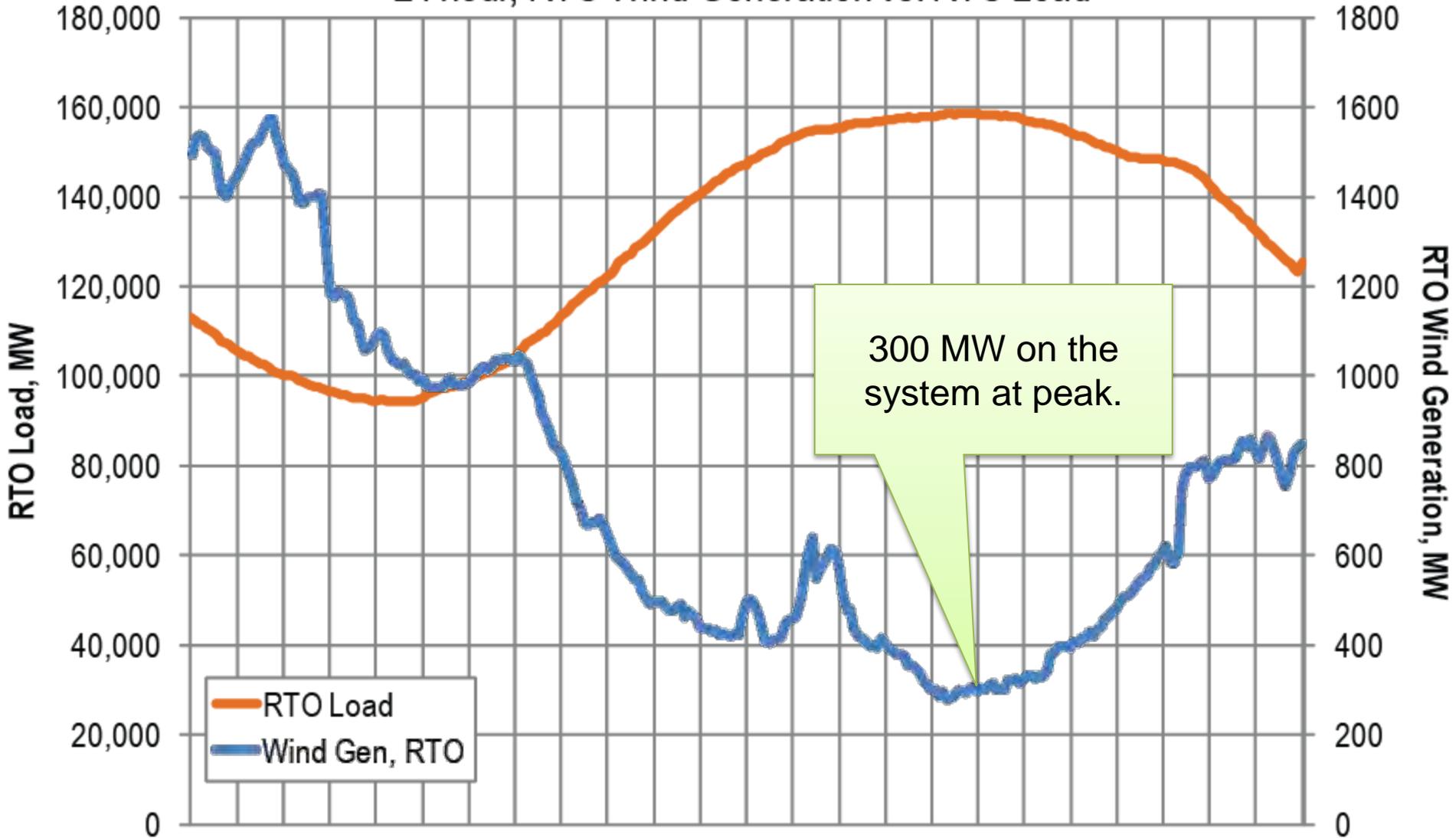
Regulation vs Economic Dispatch

Load (MW x 1000)



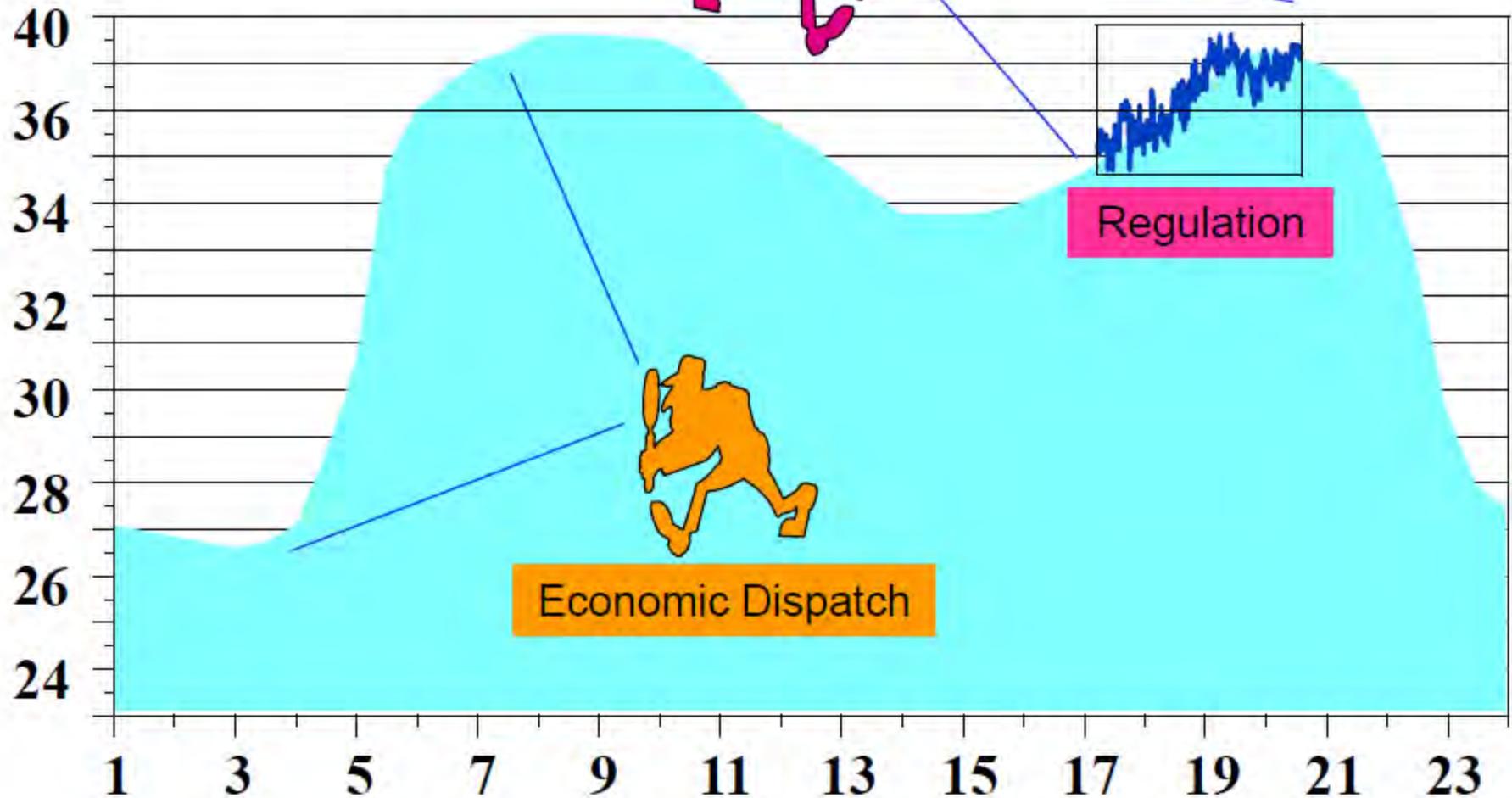
Hour of Day

24 hour, RTO Wind Generation vs. RTO Load



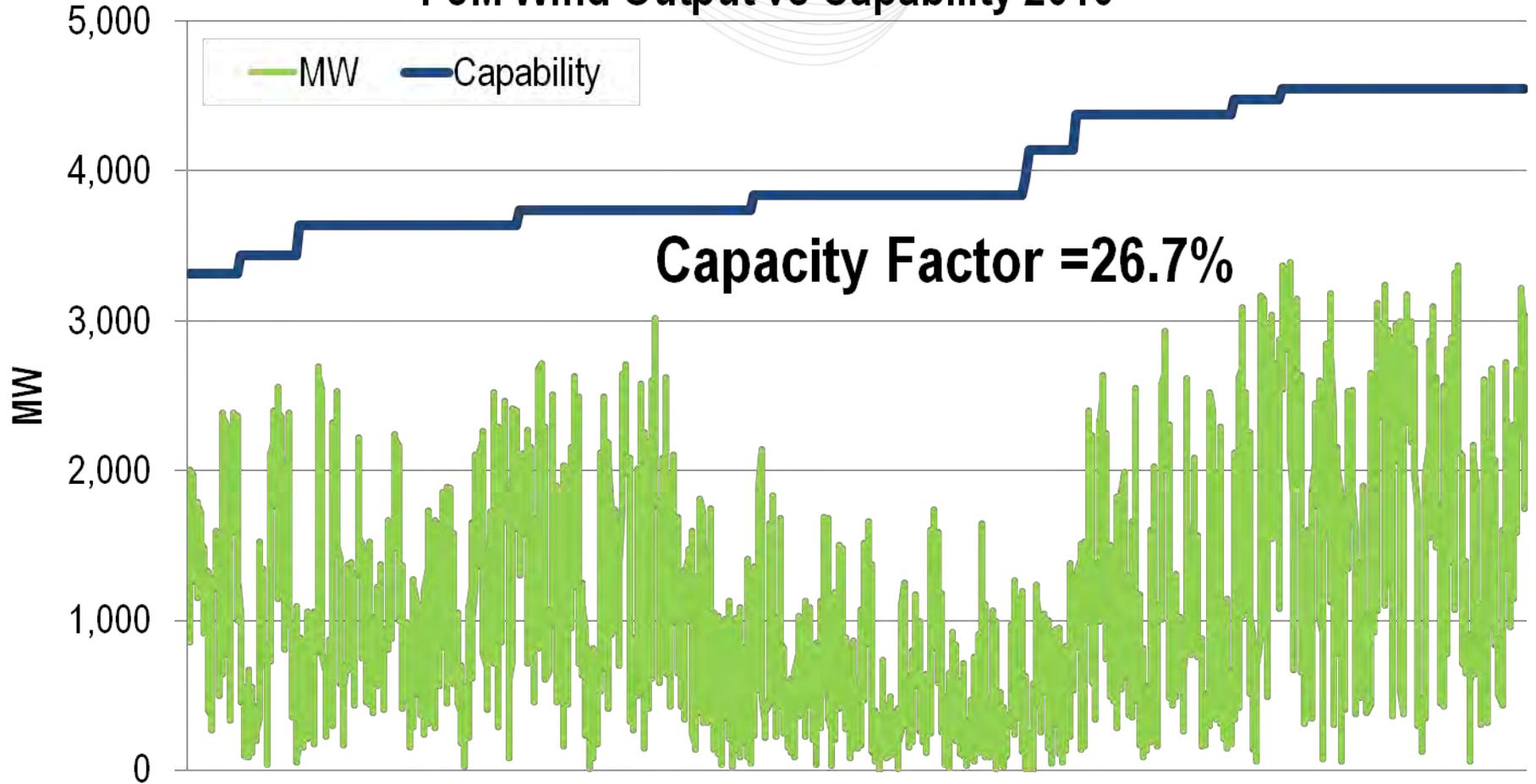
Regulation vs Economic Dispatch

Load (MW x 1000)

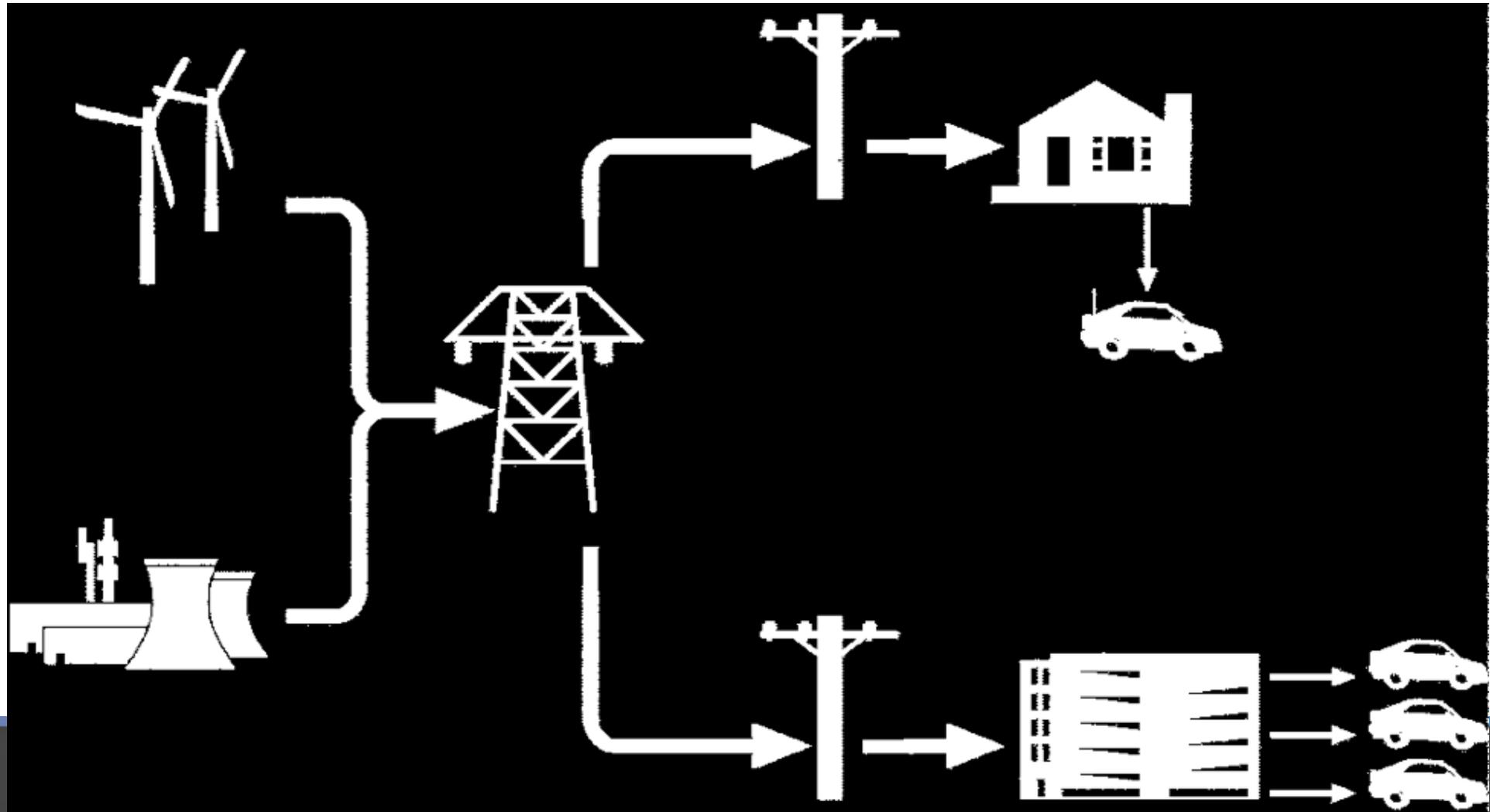


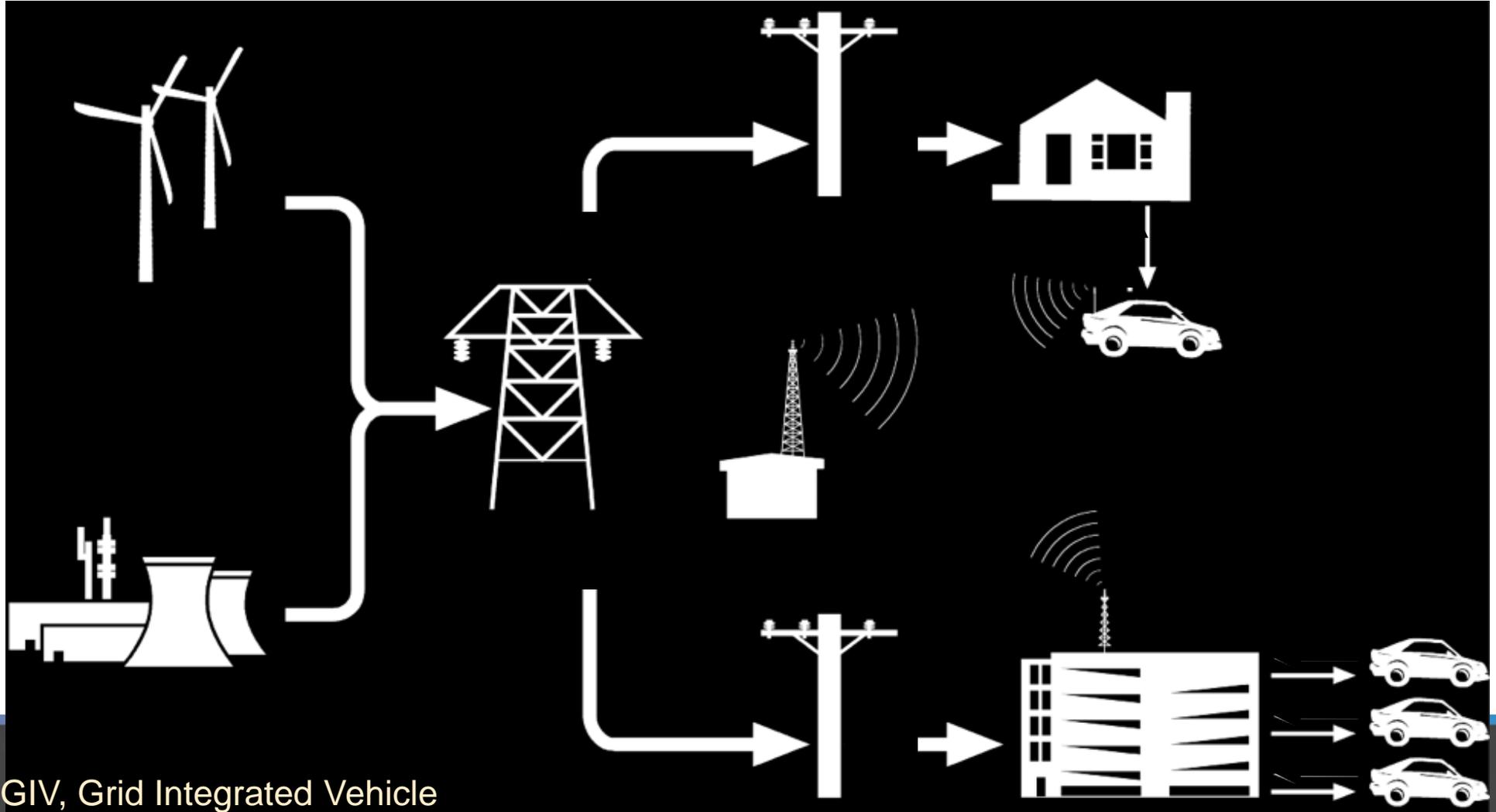
Hour of Day

PJM Wind Output vs Capability 2010

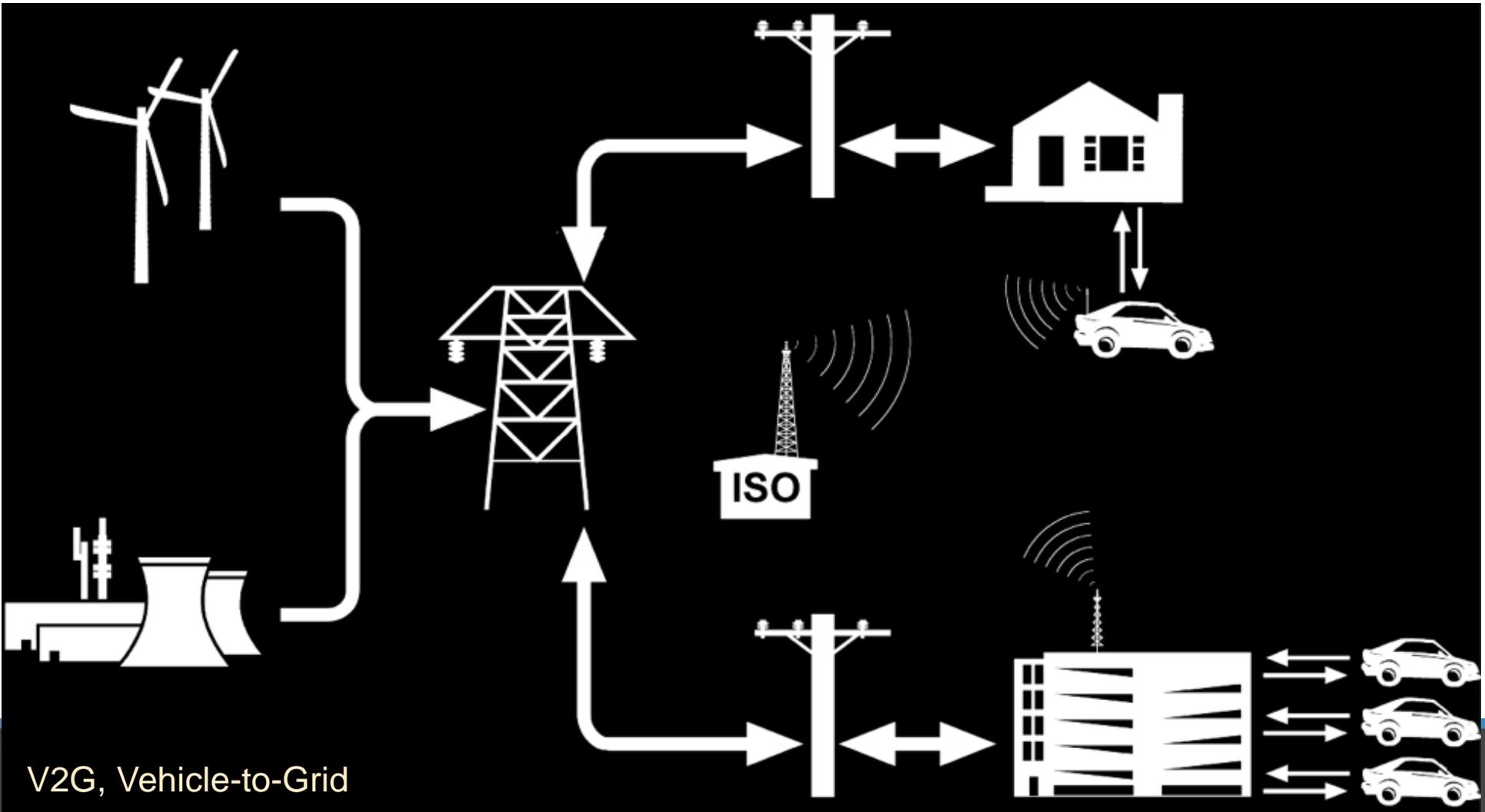








GIV, Grid Integrated Vehicle



- **Mid-Atlantic Grid Interactive Car Consortium (MAGICC)**
- **Over three years experience**
- **7 cars capable, 5 currently aggregated**
- **Using Power Line Carrier to push AGC signal to the vehicle via the SAE J1772 pilot wire.**



Vehicle to Grid -- Coalition Server

University of Delaware

Coalition Status

ISO	Power Capacity Up (kW)	Power Capacity Down (kW)	Power Requested (kW)	Power Provided (kW)	Energy Charge (kWh)	Energy Empty (kWh)	Number of Cars
PJM	49.37	49.37	-14.80	-15.81	104.30	35.70	4
CAL-ISO	0.00	0.00	0.00	0.00	0.00	0.00	0
Simulated-ISO	0.00	0.00	0.00	0.00	0.00	0.00	0

Hide Charts

CAL-ISO

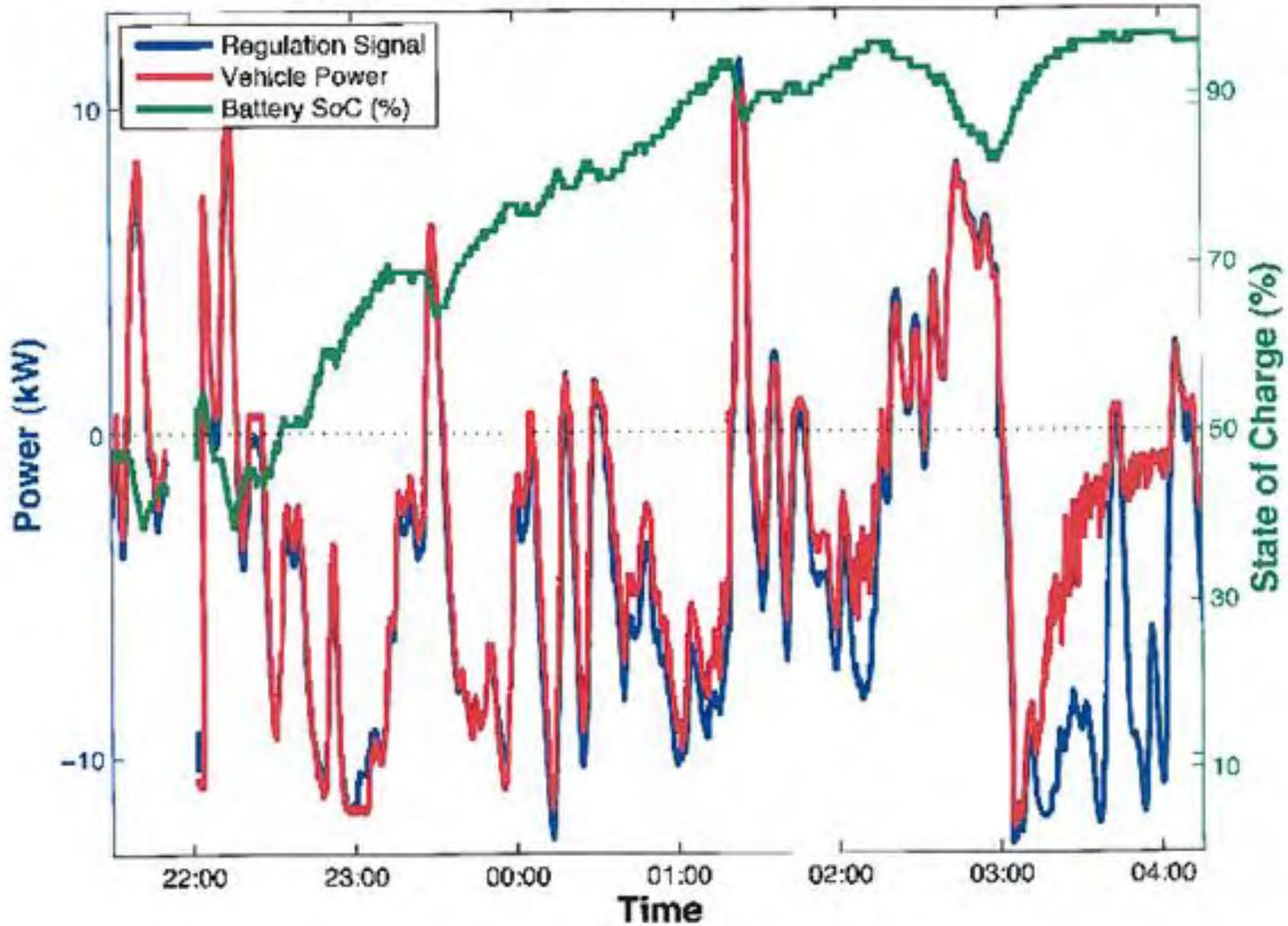
Simulated-ISO

PJM

Individual Vehicle Status

Car Name	Power Capacity Up (kW)	Power Capacity Down (kW)	Power Requested (kW)	Power Provided (kW)	Energy Charge (kWh)	Energy Empty (kWh)	Miles	Volts (V)	Amps (A)	Monthly Credit (\$)
UD-296	0.00	0.00	0.00	0.00	29.05	5.95	91.30	211	22.5	33.17
UD-170	11.23	11.23	-3.36	-3.95	12.60	22.40	39.60	234	16.9	76.31
DEState5205	10.70	10.70	-3.21	-2.05	33.25	1.75	104.50	214	9.6	21.73
DEState0000	17.36	17.36	-5.21	-5.70	31.50	3.50	99.00	248	23	24.59
UD-210	10.08	10.08	-3.02	-4.09	26.95	8.05	84.70	210	19.5	23.38

Regulation Supply (incidental charging)





Available for full-time Summer job.



Bottom Line: Your electric vehicle is a valuable asset to the electric system, when it isn't driving