

Market impacts on grid operations and utility industry

Ascend Analytics

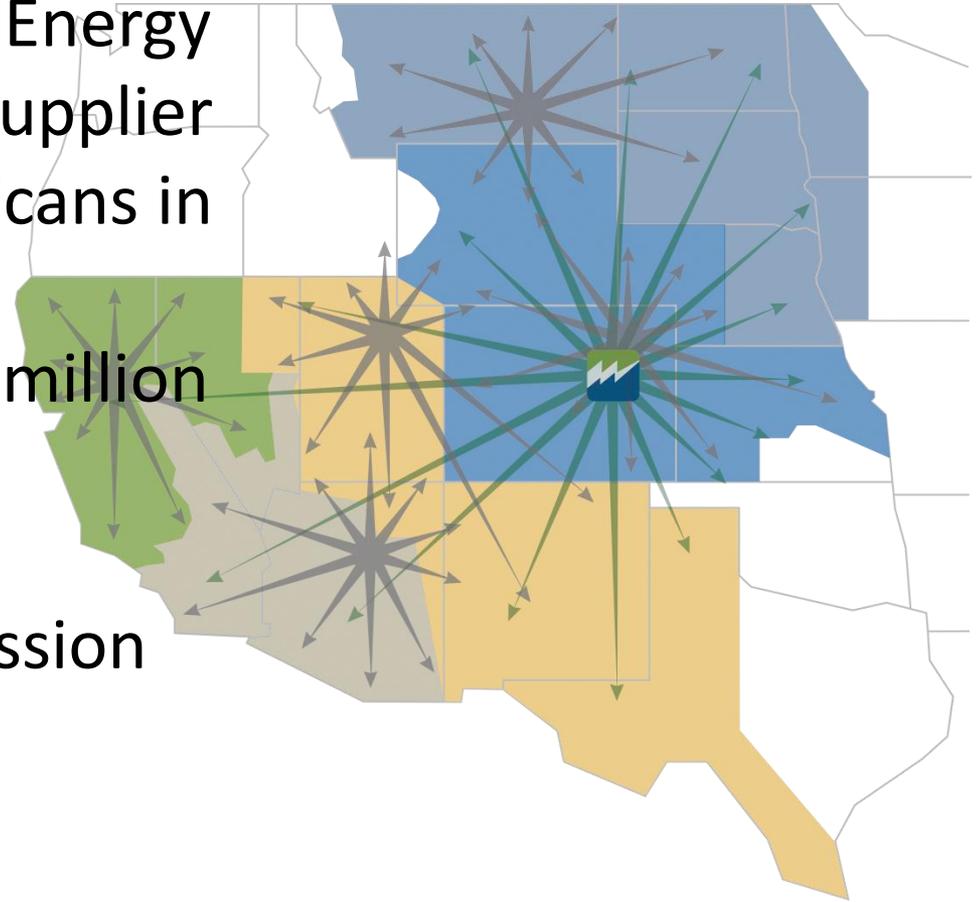
Oct. 12, 2017 | Boulder, CO

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Administrator and CEO



WAPA: Who we are

- Part of Department of Energy
- Wholesale electricity supplier
- Serve 40 million Americans in the West
- 15-state footprint, 1.4 million square miles
- ~700 customers
- Top-10 largest transmission utility in country



WAPA: What we do



Federal Hydropower

Transmission System & Service

Transmission Infrastructure Program

- **Market 10,503 MW of power from 56 dams**
- **Buy and sell power to provide firm electric service**
- **17,000+ miles of transmission lines**
- **Operate 3 balancing areas**
- **15-state operating region**
- **Separate \$3.25 B borrowing authority**
- **Projects must facilitate renewables**
- **Projects must have a terminus in WAPA's footprint**

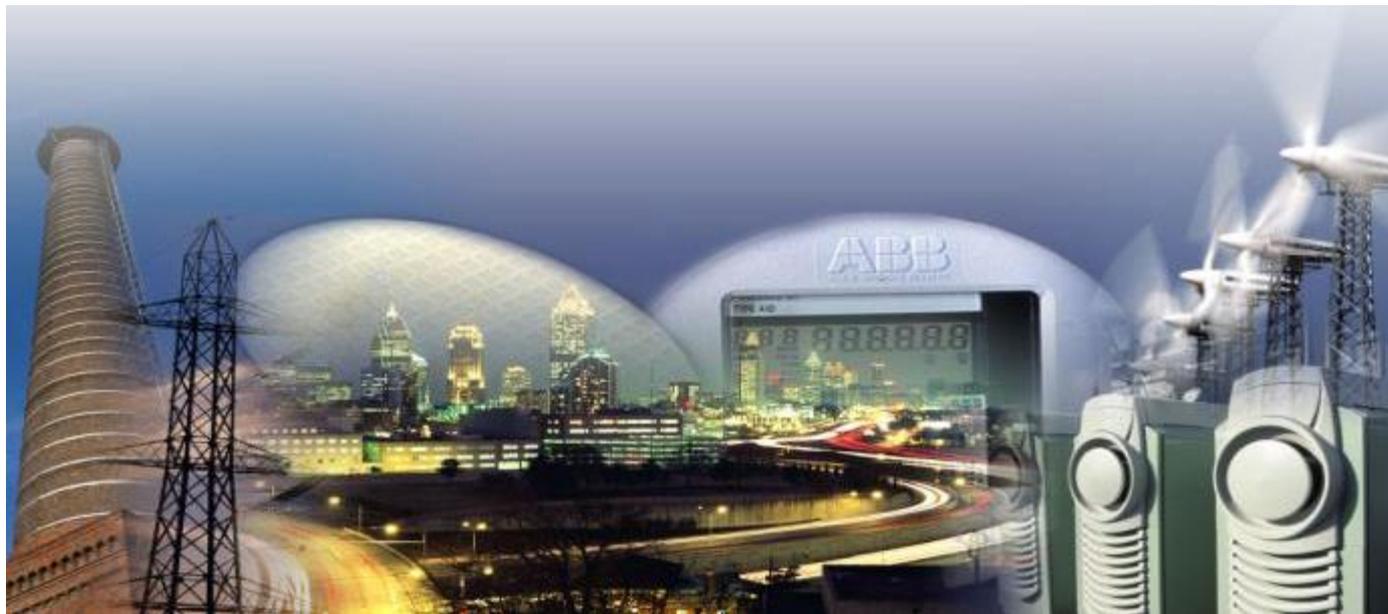
Me and my perspective

- 30 years in electric industry (plus gas, oil and water)
- Eight years at Electric Power Research Institute
- Certified technology nerd
- Published author
- Utility, venture capital, private equity and consulting background
- A DOUG



Fundamental change

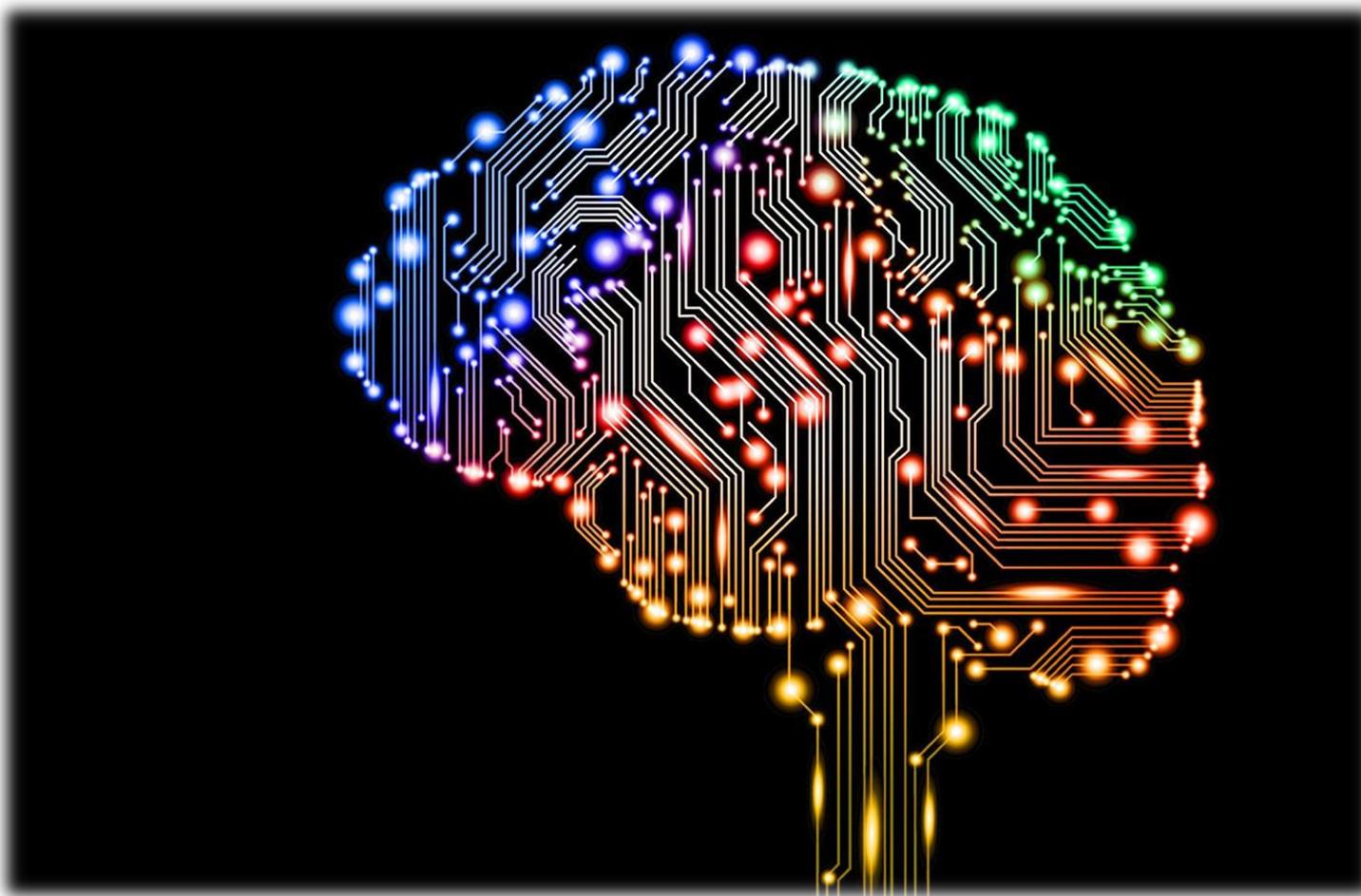
The challenge for the utility of today is not only what is real but what is perceived as real.



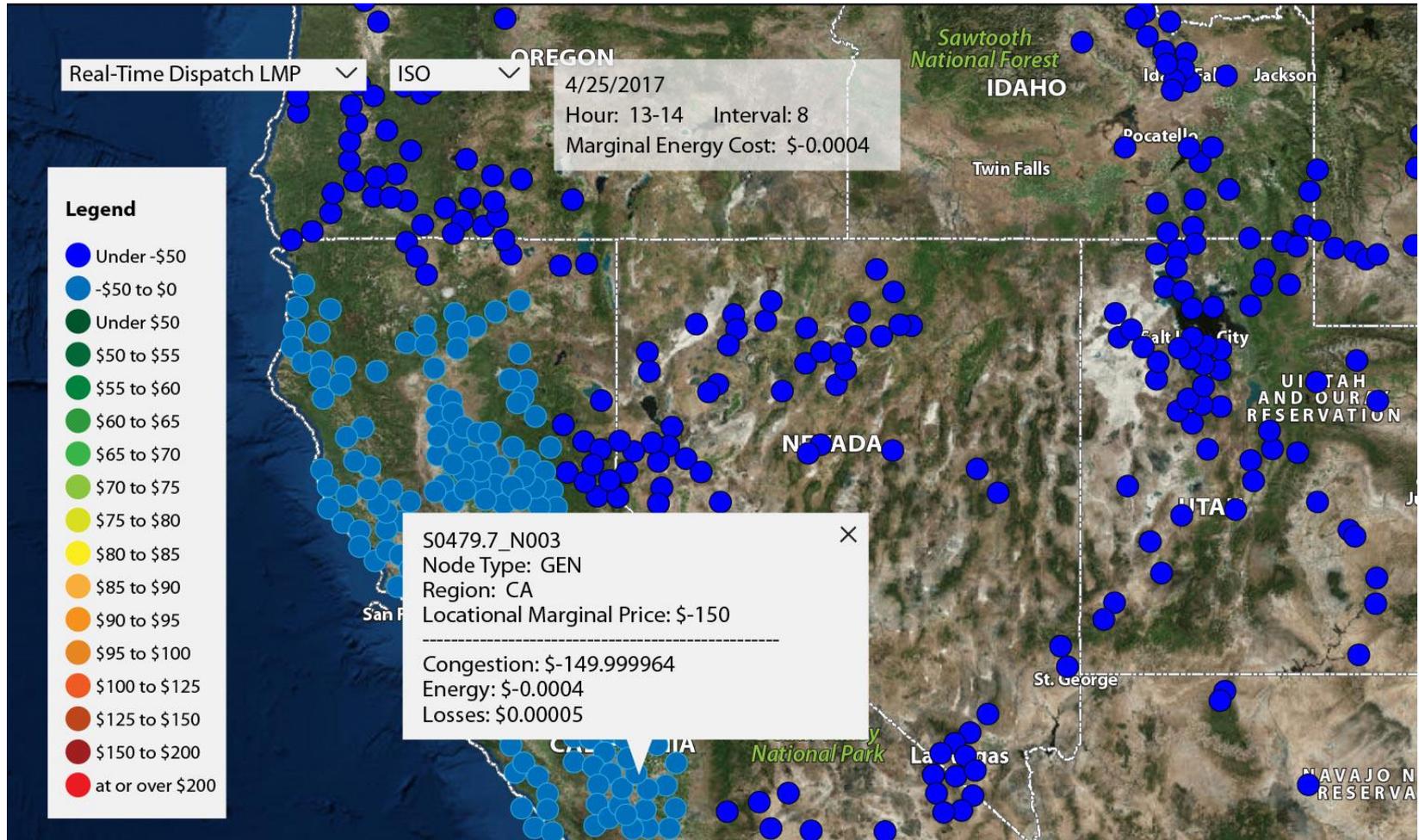
Change is upon us



Operational challenges

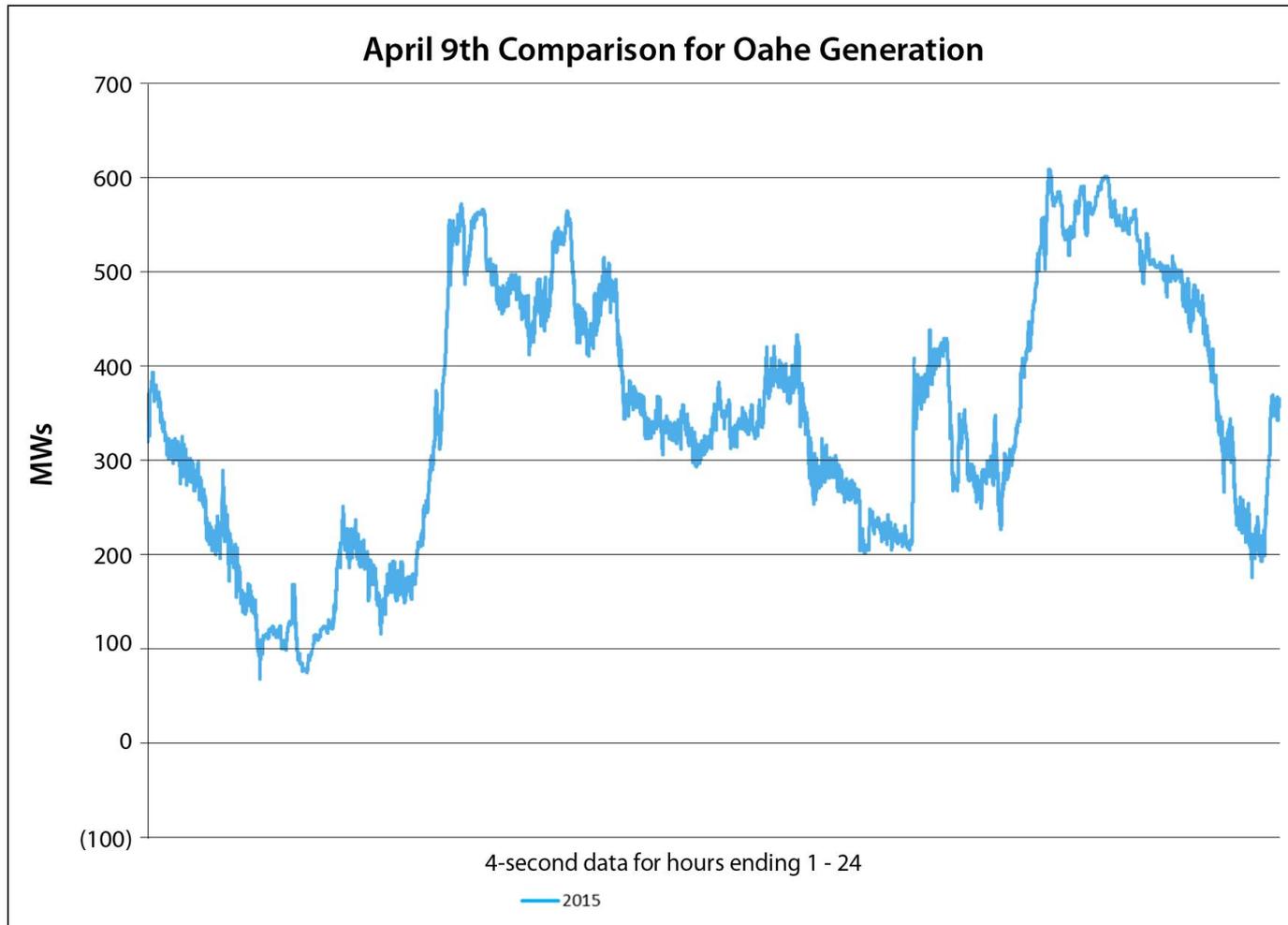


Market impact on pricing

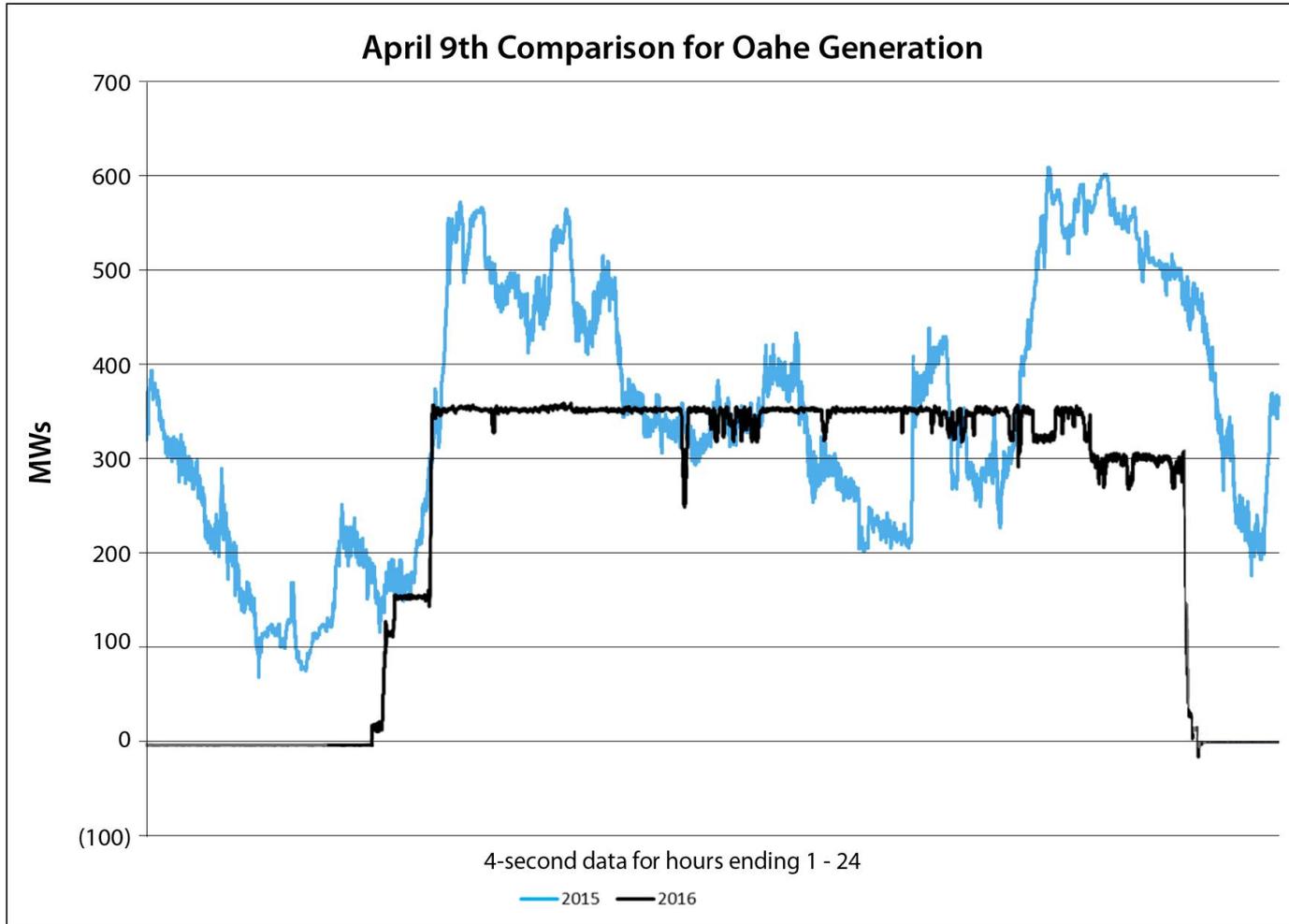


Source: CAISO market price map

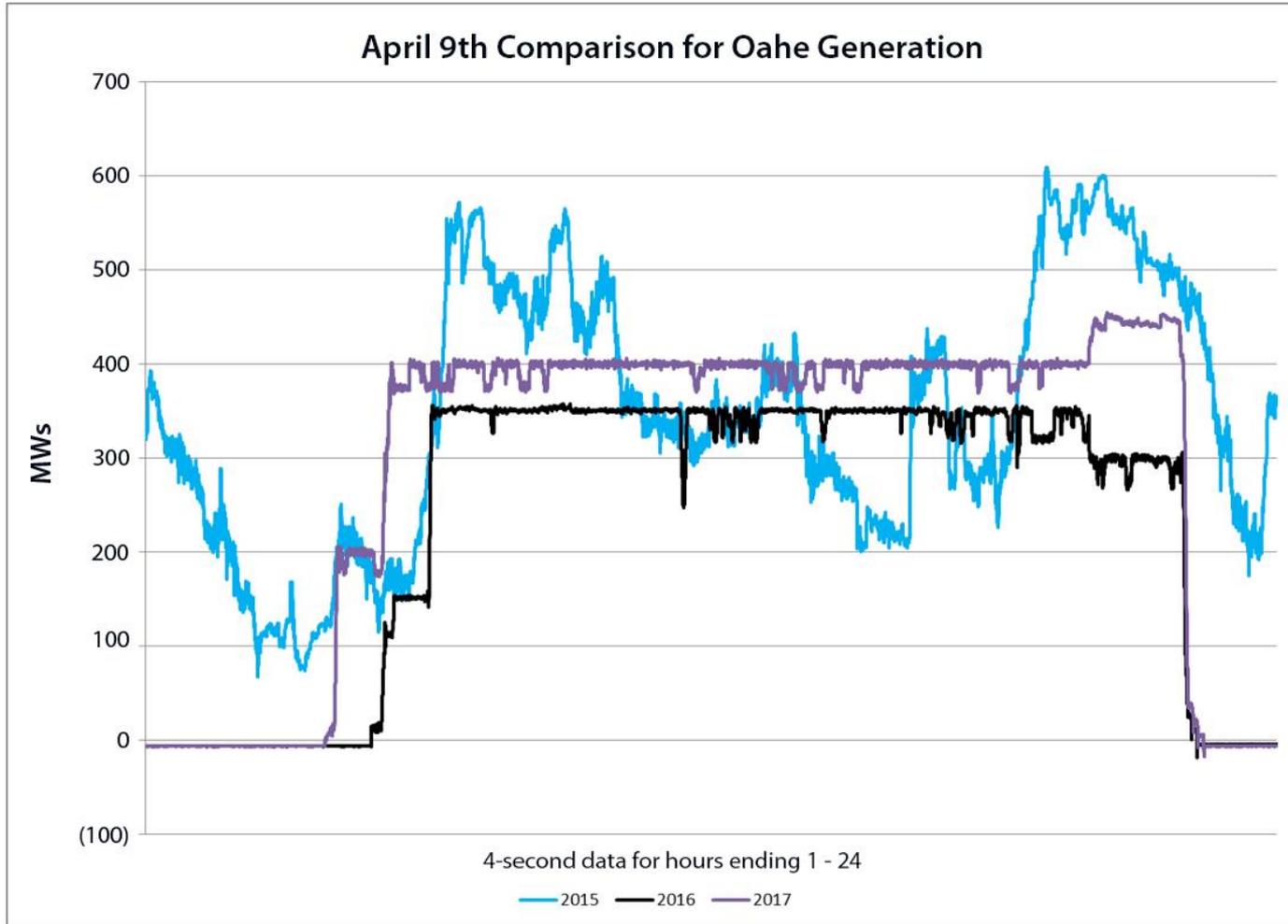
Oahe generation - 2015



Oahe generation - 2016



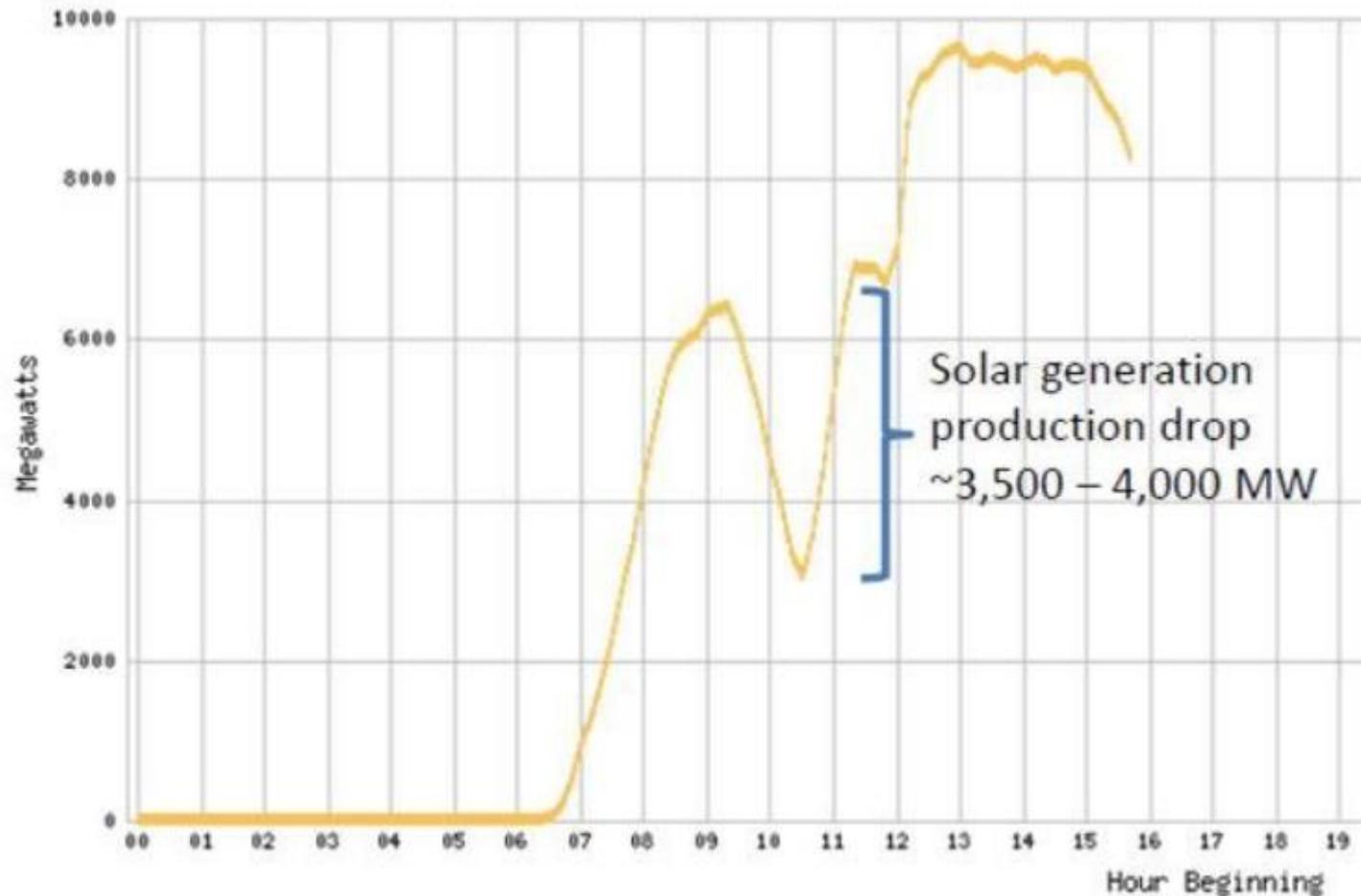
Oahe generation - 2017



Eclipse operations

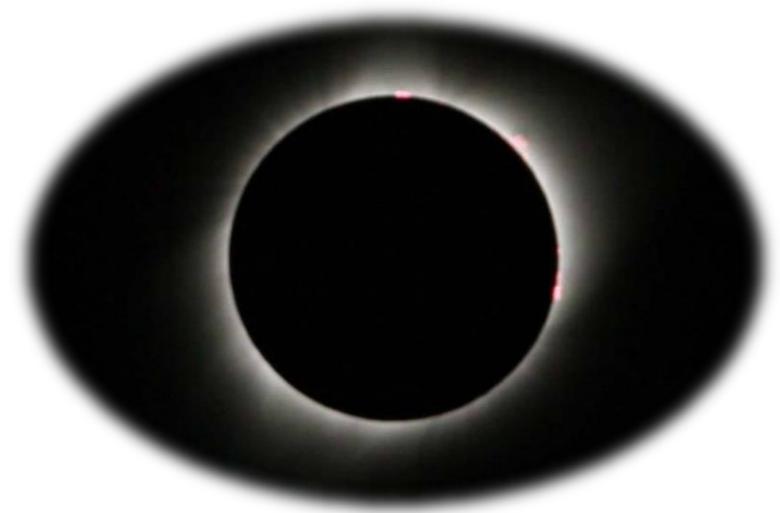


Eclipse operations

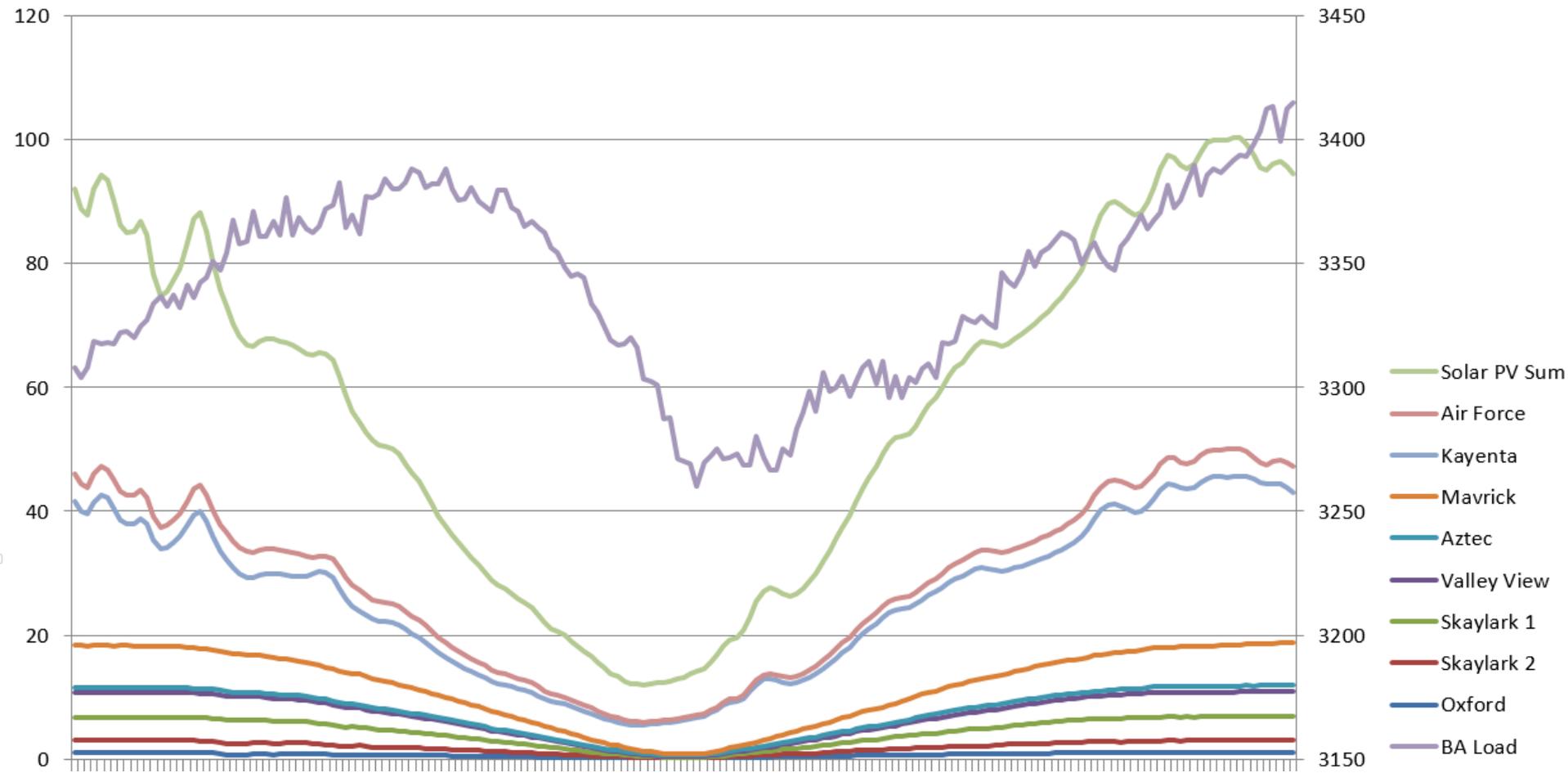


Eclipse operations

- Replacement energy came from the following:
 - Interties (~3,200 MW)
 - Hydro (~800 MW)
 - Thermal (~1,600 MW)
 - EIM transfers (~350 MW)
- No manual intervention during the eclipse



Eclipse operations – The Surprise



Reliability: PJM's perspective

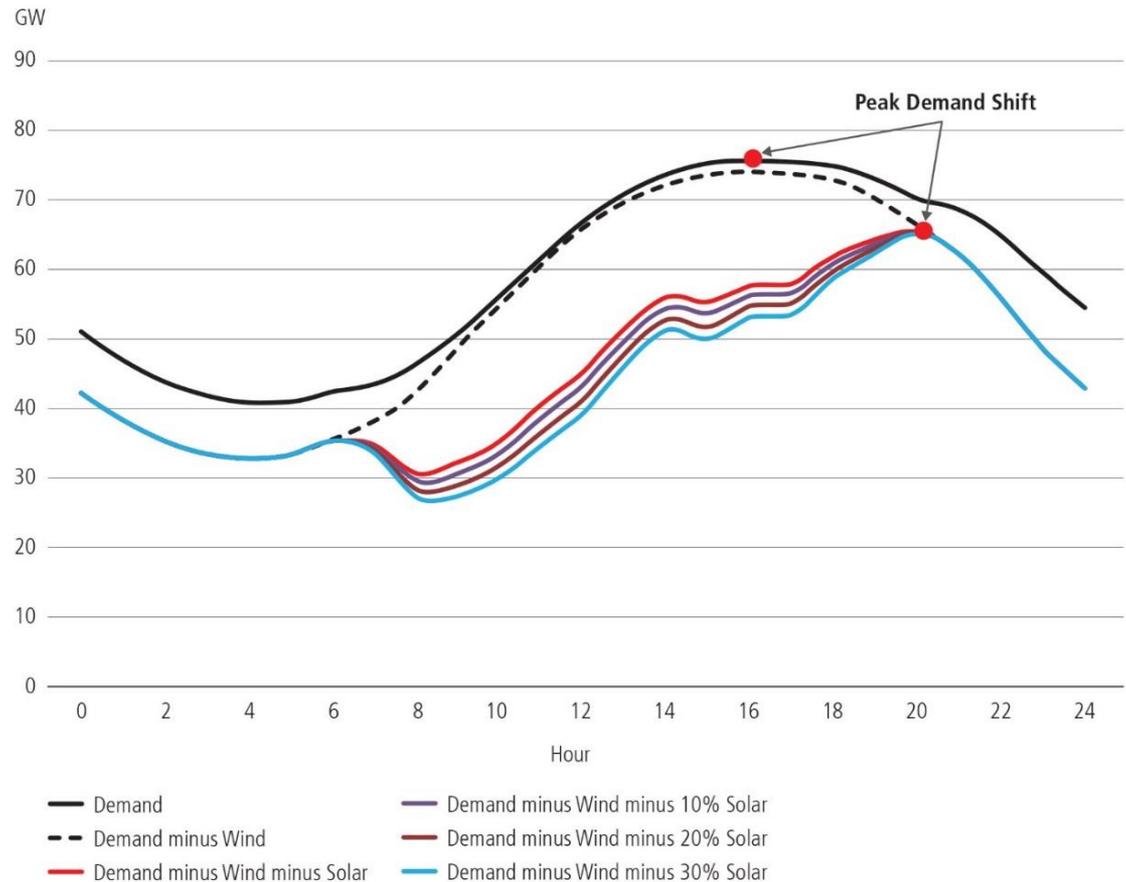
- PJM: determine how different resources can provide ERS
- More work is needed to fully define, value, procure, and compensate ERS

Source: DOE Energy Policy, Office of Electricity

Resource Type	Essential Reliability Services (Frequency, Voltage, Ramp Capability)					Fuel Assurance		Flexibility			Other		
	Frequency Response (Inertia & Primary)	Voltage Control	Ramp			Not Fuel Limited (> 72 hours at Eco. Max Output)	On-site fuel inventory	Cycle	Short Min. Run Time (< 2 hrs./ Multiple Starts Per Day)	Startup / Notification Time < 30 Minutes	Black Start Capable	No Environmental Restrictions (That Would Limit Run Hours)	Equivalent Availability Factor
			Regulation	Contingency Reserve	Load Following								
Hydro	●	●	●	●	●	○	◐	●	●	●	●	◐	●
Natural Gas - Combustion Turbine	●	●	◐	●	◐	●	○	●	●	●	●	◐	◐
Oil - Steam	●	●	●	●	●	●	●	●	○	○	○	○	◐
Coal - Steam	●	●	●	●	●	●	●	◐	○	○	○	◐	◐
Natural Gas - Steam	●	●	●	●	●	●	○	●	○	○	●	◐	◐
Oil/ Diesel - Combustion Turbine	●	●	○	●	○	○	●	●	●	●	●	○	◐
Nuclear	◐	●	○	○	◐	●	●	○	○	○	○	◐	●
Battery/ Storage	◐	◐	●	●	○	○	○	●	●	●	◐	●	●
Demand Response	○	○	◐	◐	◐	◐	◐	●	●	◐	○	●	●
Solar	◐	◐	○	○	◐	○	○	●	●	●	○	●	●
Wind	◐	◐	○	○	◐	○	○	●	●	●	○	◐	●

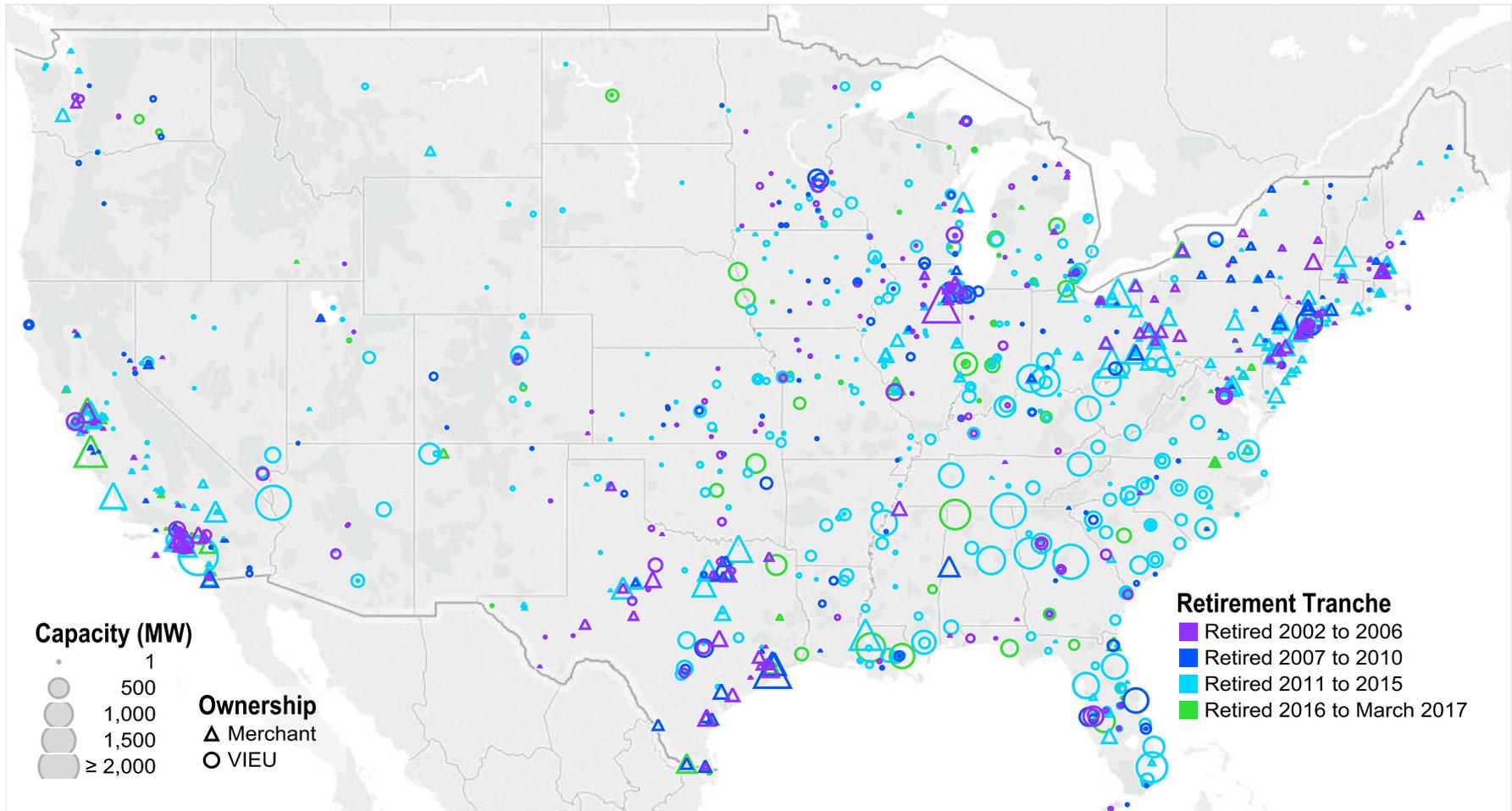
Reliability: Changing “net load” shapes

- RTOs/ISOs are integrating growing levels of VRE, which shift the time of peak load
- They also introduce more hourly and intra-hourly variability



Source: DOE Energy Policy, Office of Electricity

Retirement tranches by size, ownership



Source: DOE Energy Policy, Office of Electricity

Economic challenge

How can we manage in a
Twitter–centric world?

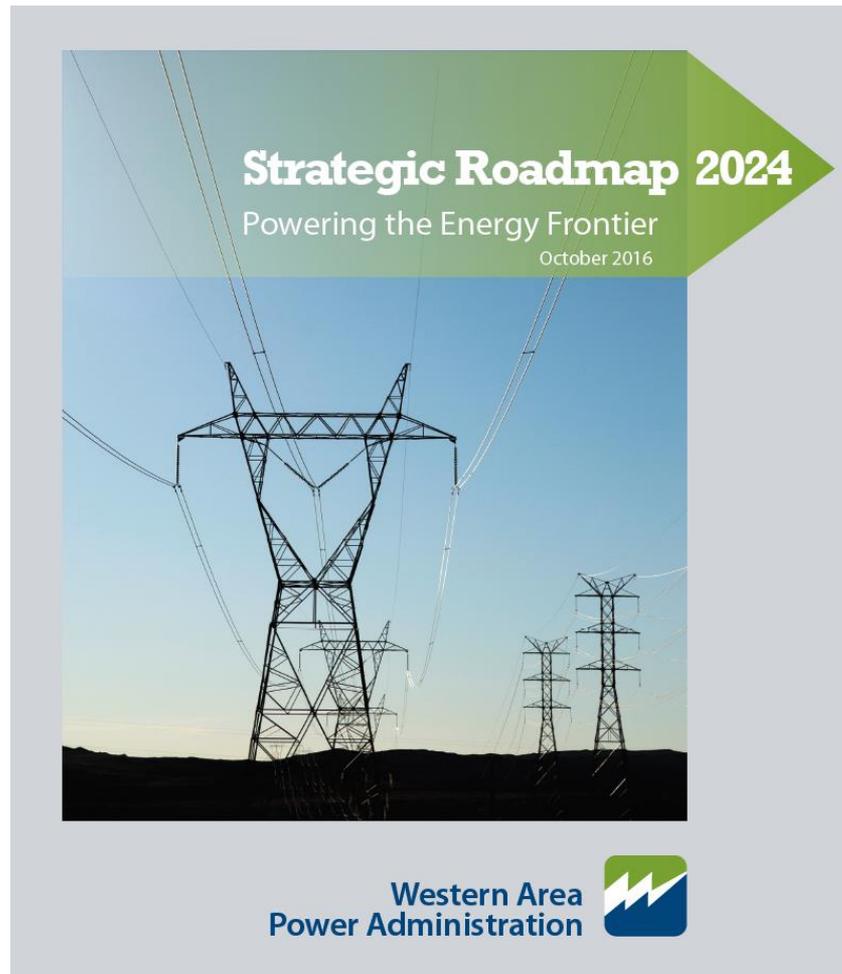


And over in Germany...

- Energiewende aims to eliminate coal and nuclear as a social policy
- Wholesale prices down steadily while consumers bear the impact: 40 cents per Kwh
- Blown up the utility business
- 800-900 DSOs
- 4 TSOs (owned by foreign entities)
- 1.8 million generators
- Relies heavily on assets of other countries



What are we doing about it?



Shift in strategic thinking

- Broader perspective
- Data-driven decisions
- Industry impacts to customers



Radical thoughts ...

- kWh is dead
- All-you-can-eat electricity
- Time-of-purchase rates NOT time-of-use rates
- Utility is the network provider
- Markets replace IRPs



Key takeaways

*Change is everywhere.
Focus on value and business excellence.
Continue delivering on mission.*



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