UIUC Capstone

Fundamentals of Energy Markets

The energy sector landscape

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The fundamental objectives of power system operations are the **efficient** and **reliable** supply of electricity.

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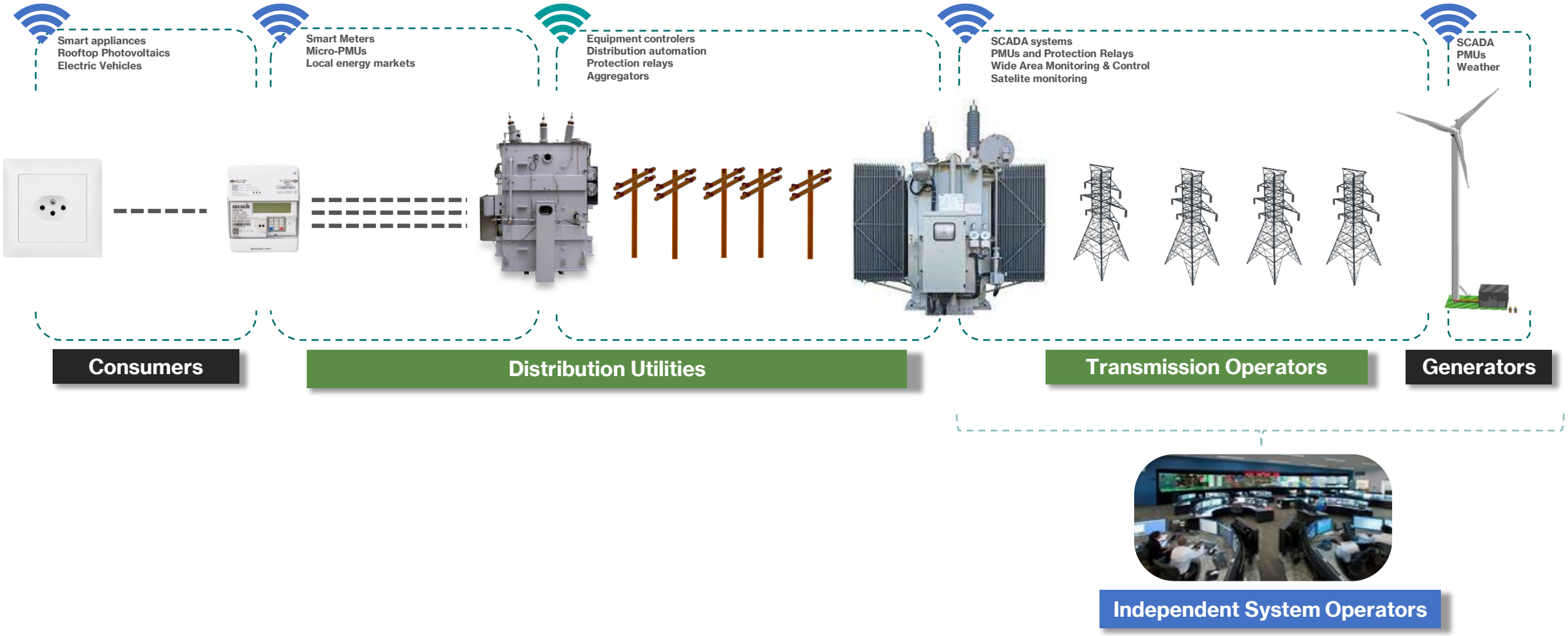
The Electricity Sector
Transmission, Distribution and Generation



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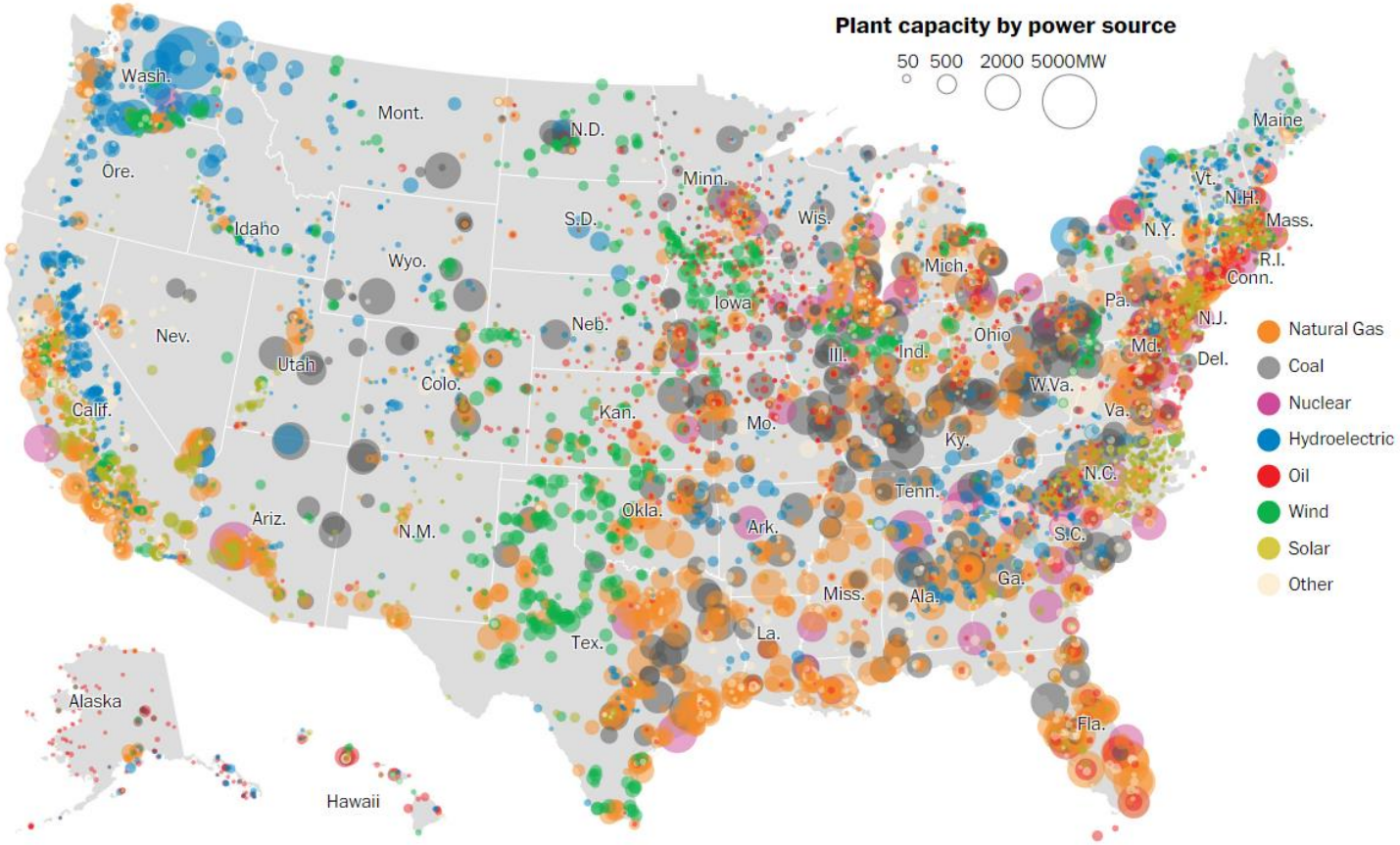
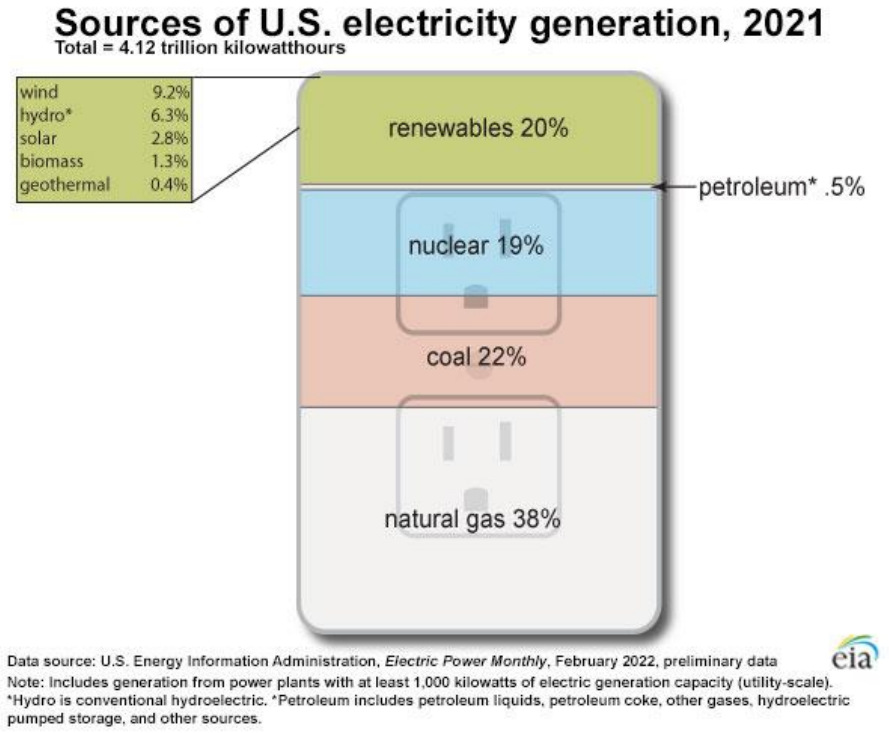
The role of Resources Optimization
Spatial Diversity of the Energy Mix

Geographically spread primary energy sources



Source: Washington Post - 2017



Source: EIA - 2021

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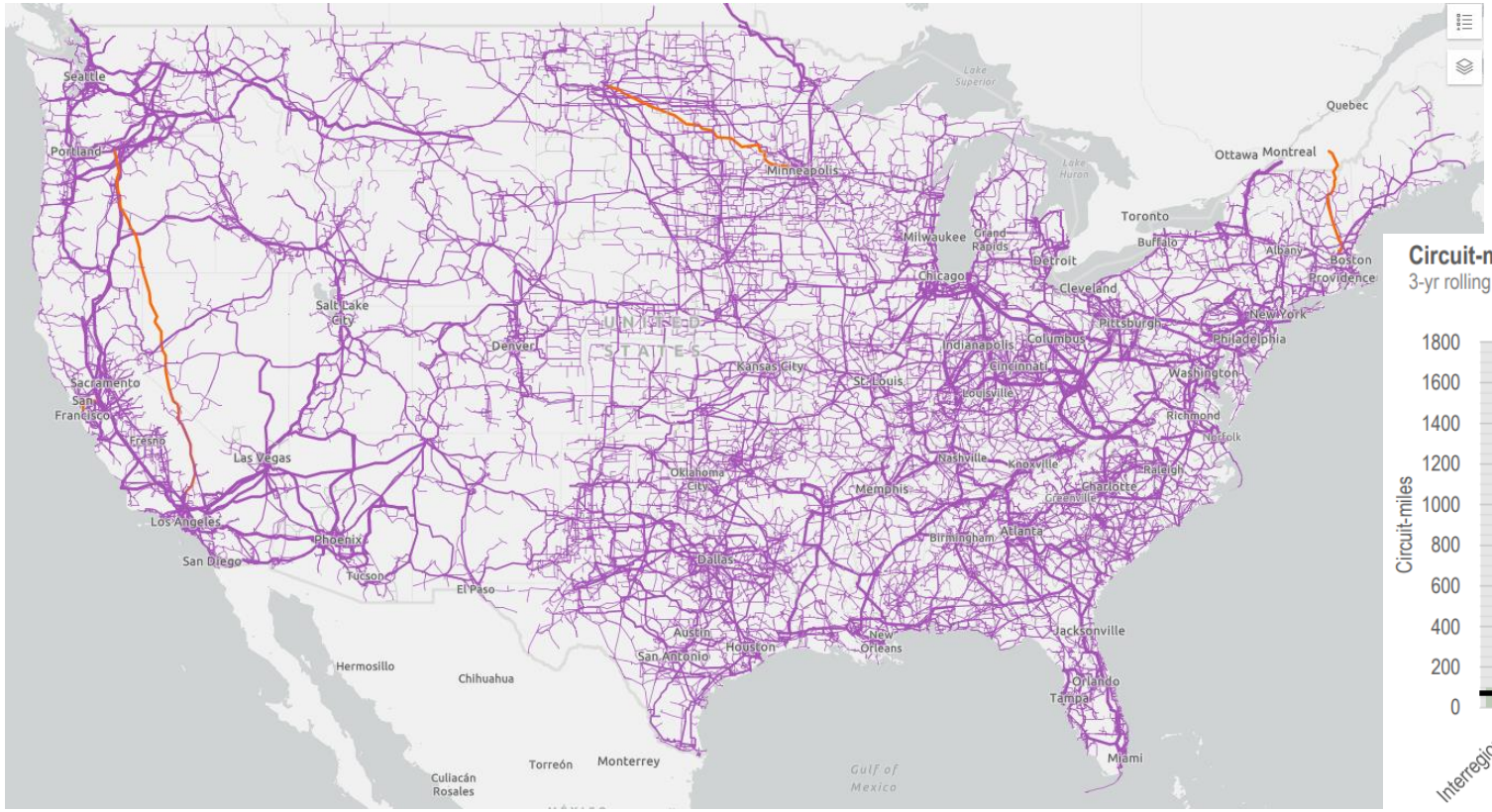
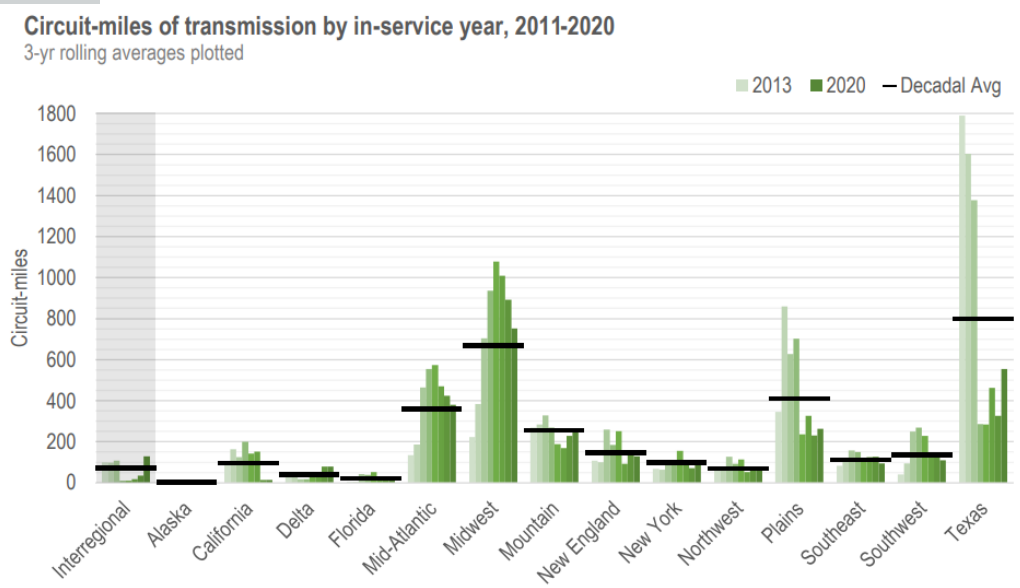
The role of Resources Optimization

Availability of Transmission System to Interconnect Demand and Supply

Interconnections ensure supply and demand needs across wide areas



Source: EIA - 2021



Source: DOE – 2023 "National Transmission Needs Study"

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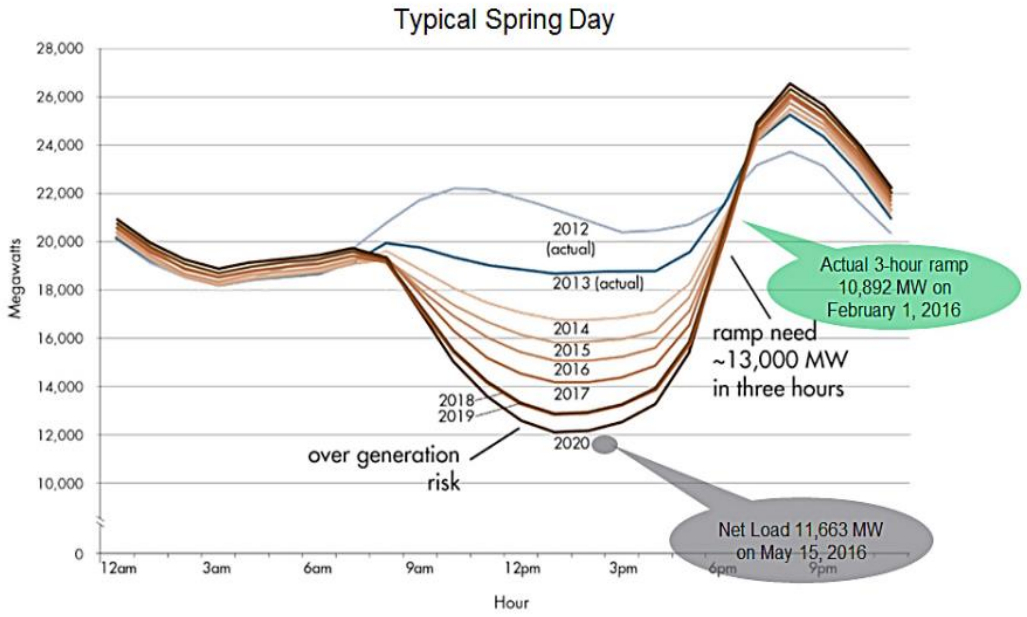
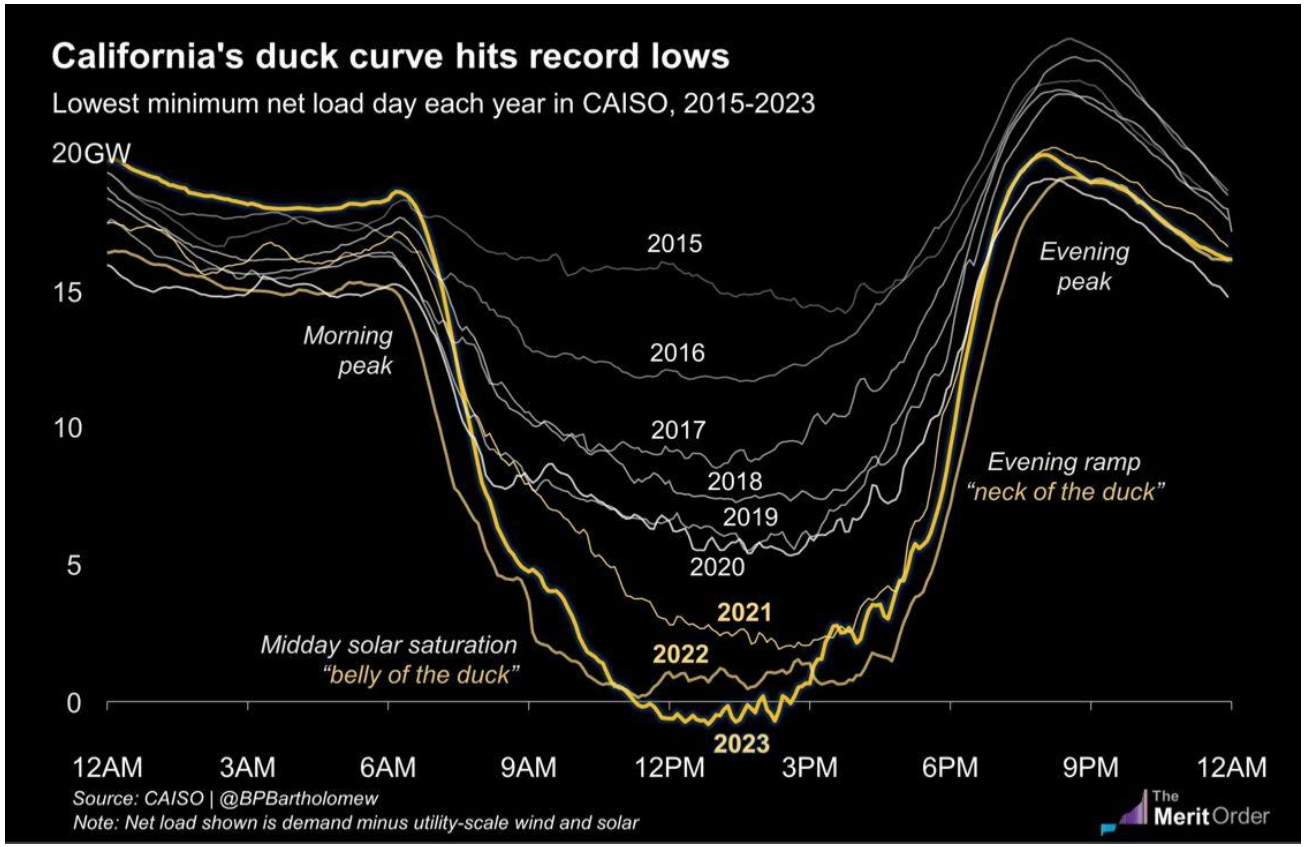
The role of Resources Optimization
Temporal Dependencies and Adaptability

Long-term, medium-term, short-term and very-short-term power balance



Source: CAISO Original "Duck Curve" - 2013



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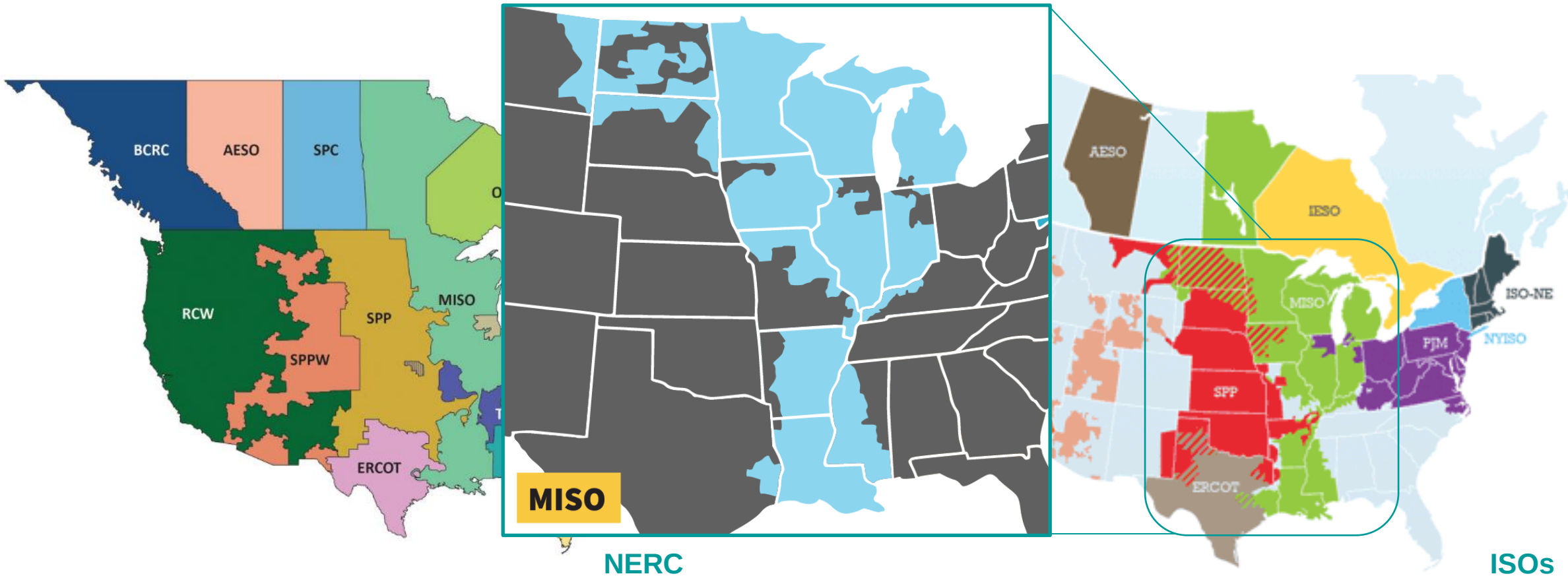
Decision Making at the High Level of Power Systems
Reliability Coordinators and Independent System Operators

Decision making the <u>efficient</u> and <u>reliable</u> supply of electricity



Source: NERC 2024

NERC
Reliability Coordinators

Source: ISO/RTO Council 2024 / FERC 2024

ISOs

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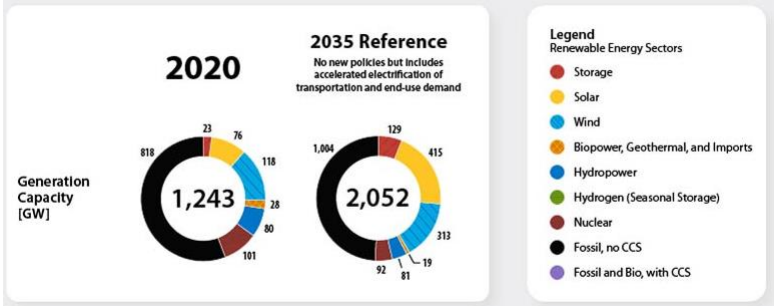
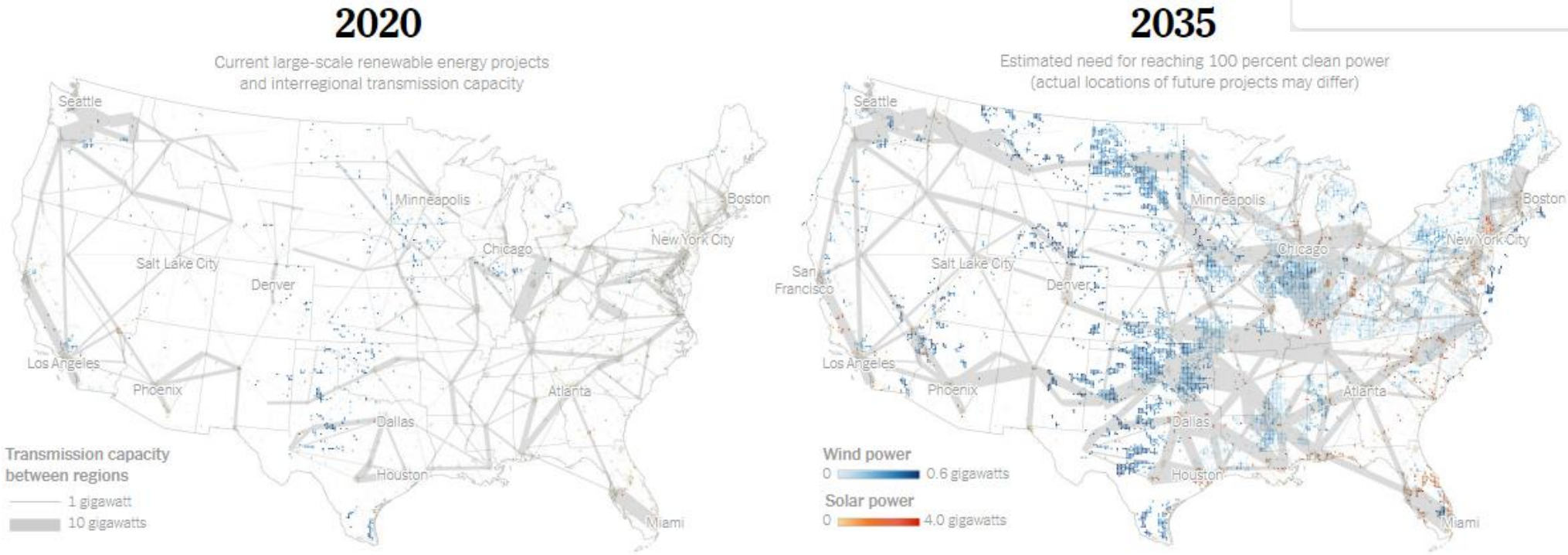
Evolution of Infrastructure and Energy Mix for the Energy Transition

Increasing interconnections to accommodate more renewables

The evolution towards of a 100 % Clean Electricity Sector requires massive changes on the entire infrastructure and the way we manage the grid





Source: National Renewable Energy Laboratory (2022) "Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035"

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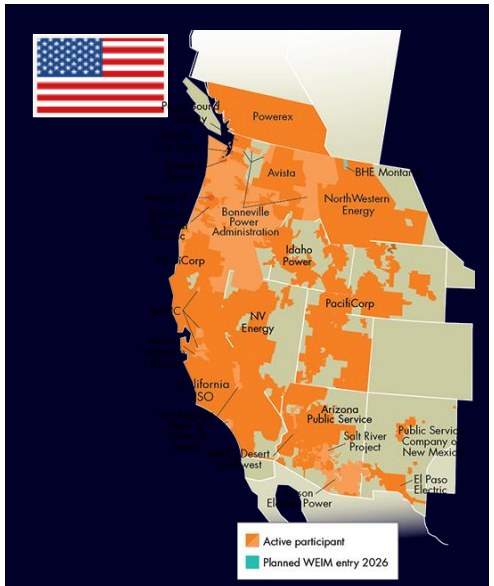
Siemens Energy Market Management

Optimization Engine that enabled the growth of CAISO EIM and future EDAM



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gross benefit since Nov 2014, just from the **EIM Real-Time Market.** Currently extending to the **Day-Ahead MP (EDAM).**

CAISO Provides Open Transparent Market, Greens the Grid and Power lives of 30 million consumers

- Solutions and Technology to the base product at CAISO
- Established methods to inform the Customers and involve their judgment in selecting the features to update the base product.

Siemens Spectrum Power™ Energy Market Management

- Full suite of applications providing a Bid to Bill Solution over time varying time horizons ranging from a few minutes to a few days.
- Co-optimization of Energy and Ancillary Services with MILP based SCUC Engine providing Least Cost Market Clearing & Marginal Pricing Calculation.
- Core of all market application process thus providing consistency of results.
- Detailed resource model that accounts for Variable Energy (e.g., Wind, Solar), Combined Cycle Plant, Energy Storage and Hybrid Energy Resources, and more.
- Full Network Model AC solution, Loss Modeling and Contingency Analysis for network constraints

Accelerating transition for zero carbon grid

904,219 tons of CO2 reduced since 2015

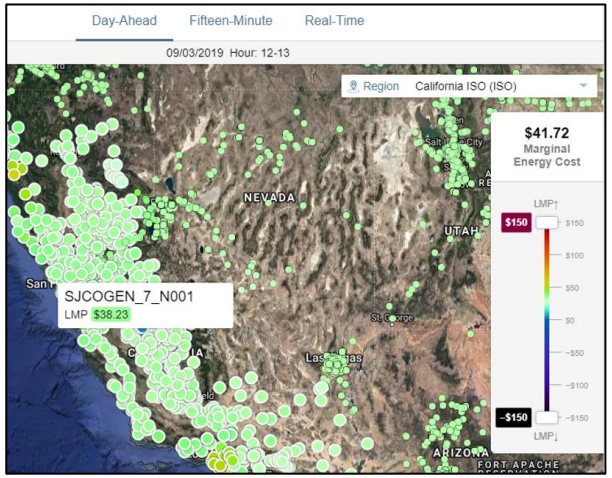
50% Reduction in Flexible Reserve (2023 Q3)

California ISO

Customer: California Independent System Operator

Period: Since 2009 - Ongoing

Highlights: SCUC/SCED Engine for Day Ahead and Real Time Markets



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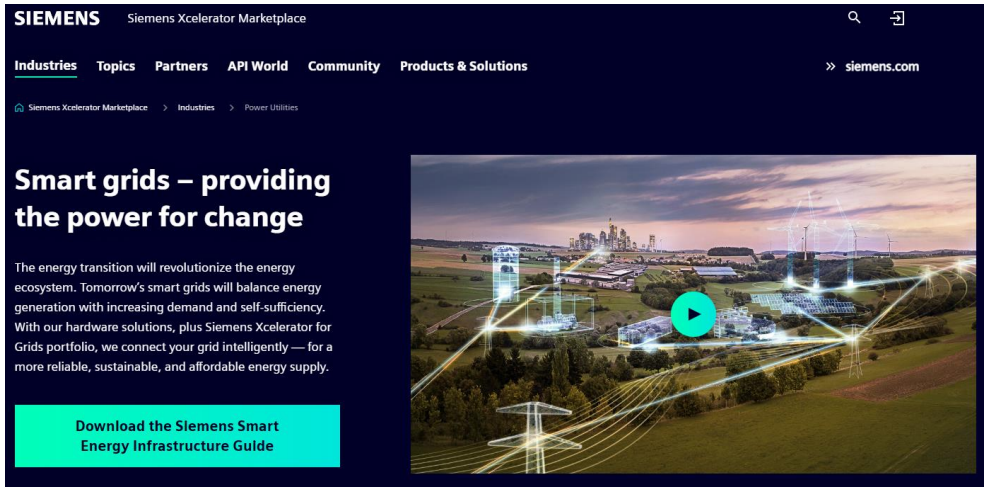
Cool Places to Look:

https://www.eia.gov/



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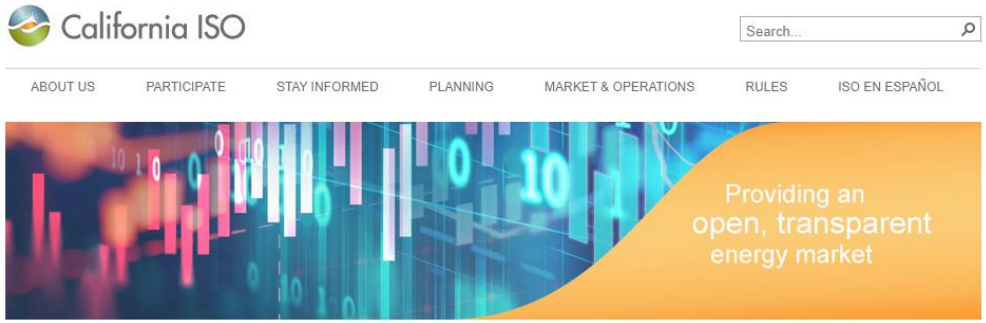

https://www.caiso.com/Pages/default.aspx

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Thank You

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