Using Meteorology to Optimize Deployment of Renewable Energy

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Sustainable FERC Project
Policies for a Clean Electric Grid

NRDC

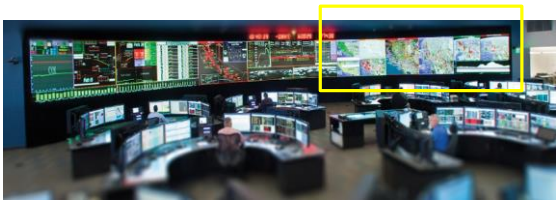
Summary

- **Meteorological drivers of load and generation** must be considered in planning, siting, and operating renewable energy generation and transmission.
  - Optimizes the **resource adequacy balance** -- reduces variable energy integration issues.
  - Fewer **fossil reserves**.
  - Produces more **just and reasonable rates**.

Key Legal Standard

- **The Federal Power Act** - electricity rates, and practices affecting rates, must be **just and reasonable.**
- **Failure to consider** and implement cost-effective and efficient grid planning solutions could result in **unjust and unreasonable rates**.

Weather Matters to the Grid



California ISO Control Center
Folsom, California

Especially for Integrating Renewable Energy

Geospatial maps show real-time weather conditions and forecasts, generator status, wind, solar, hydro performance and forecasts, wildfires, etc.

Planning for a Low Carbon Future

- Weather and climate affect both **load** and **generation**.
- Reliability Need: Generation should follow load closely at **all timescales** in an **interconnected region**.
- Affordability Need: Meet reliability and public policy needs at the **lowest possible cost** - just and reasonable rates.

Approaches

- Focus solely on **high capacity resource areas** and **large new transmission buildout**. But risks include:
  - Mismatch of load with generation
  - Unnecessary curtailment
  - Higher costs for infrastructure buildout
  - Dependence on fossil thermal generation reserves
  - Slower path to goals.
- Current examples of this approach.

Approaches

- **Optimize the resource value in relation to load,** based on meteorological considerations.
  - Promotes resource diversity
  - Targets transmission to optimal resource mix
  - Minimizes need for fossil generation reserves

What does this mean?

Imagine . . . a 100% hydropower standard.

Assume:

- Tax incentives to maximize energy production
- Low-cost power drives long-term power production agreements
- Current grid planning practices.

River System A

- High annual stream flow + new transmission
- But . . . in some years the spring runoff correlates with lower peak loads, and sometimes the drought years correlate with peaks.
- Result: Periodic massive oversupply and undersupply
- Costly solutions: More hydro in a different area, and/or more fossil for reserves.

River System B

- Better correlation than System A, but every 5 years or so it experiences drought conditions – fossil reserves to the rescue.
- Two years after construction there is an early and rapid melt of snowpack leading to oversupply. Massive curtailment and prices plunge.

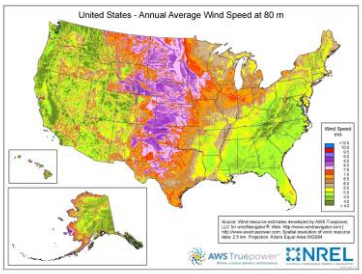
River System C

- Only average flow conditions, but it peaks in the summer and winter.
- No transmission because it wasn't identified as a high capacity resource.
- Early consideration of this resource could have avoided the unnecessary costs and integration problems with A and B.

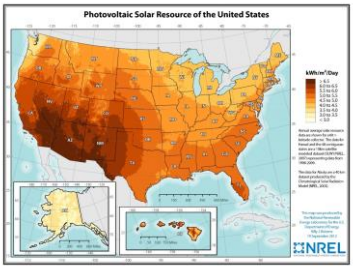
Bottom Line

- All capacity is NOT created equal.
- Some high capacity sites may have periods of extremely low or extremely high capacity factors at different time scales; forecasting may be challenging.
- Loads and generation may not be correlated.
- Goal – best **match of load and generation** and **reduce overall variability** across time scales.

Wind and Solar Resources Not Evenly Distributed Across the Country



Photovoltaic Solar Resource



Solutions

- **Expand FERC Order 1000 to interregional and cross-regional planning**
  - One set of rules for planning and cost allocation to streamline and accelerate the planning process
  - Identifies optimal, cost-effective transmission solutions
  - Improves alignment of resources with load patterns across regions.

Solutions

- Develop **new system models** to incorporate meteorology into generation and transmission planning (and markets).
  - Look beyond the highest capacity areas
  - In combination with broader planning, will help to match load shapes and generation across time zones and regions.
- No grid region does this now.

Solutions

- Create **transmission cost allocation metric** to reveal value of resource optimization.
  - Currently very few benefit metrics for assessing benefits of transmission projects.
    - For example, "*avoided production cost*" usually is the sole metric for economic projects.
  - A weather-specific metric would **monetize** the value of different transmission solutions based on load/resource correlations and related factors.

Systems-Based Thinking

"Like a prairie, savannah or rain forest, the new and renewable energy industry must also evolve to form a complete, stable and complex ecosystem… the global shift to clean energy is all about systems.

Michael Liebreich, Founder, Bloomberg New Energy Finance