Science and policy solutions for a low-carbon grid

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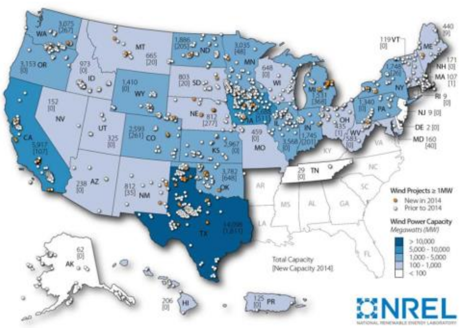
Overview

- Transmission planning and cost allocation
- Energy, capacity, and ancillary services markets
- State commission and utility planning reform

Lack of transmission causes lack of wind resource diversity



Transmission planning

- FERC Order 1000 provides a framework for planning and cost allocation
  - Has not yet been used to drive major change, particularly inter-
  - Requires policy to "be considered," which will include CPP
  - Could be strengthened
- Transmission and generation planning optimization
  - Goal of transmission planning should be all-in cost optimization
  - Renewable output patterns should be factored into transmission
  - Transmission can be used to drive generation: if you build it they will
  - Generation planning decided by market, with some state regulator role
  - Market should provide right incentives; developers increasingly congestion cost, curtailment risk, capacity value, time of production as utilities and other buyers have gotten more sophisticated in signing
- Role for atmospheric scientists in collecting more data at higher hub heights, particularly in regions that have not traditionally seen large wind deployment

MISO planning approach

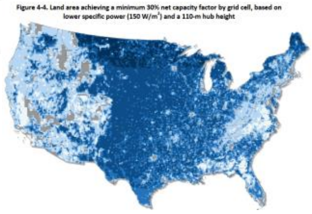
MISO results, using VCE renewable output data

VCE study results show that a cost effective way to achieve high levels of CO_2 reduction is to build wind in resource-rich areas and transmission to deliver it to the rest of MISO

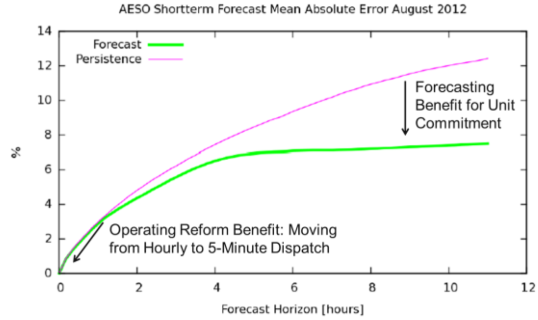
Need more wind resource data at higher hub heights

Figure 4-1. Land area achieving a minimum 30% net capacity factor by grid cell, based on 2008 technology

Figure 4-4. Land area achieving a minimum 30% net capacity factor by grid cell, based on lower specific power (150 W/m²) and a 110-m hub height



Benefits of forecasting and grid operating reforms



Adapted from Mark Ahlstrom, NextEra; and Alberta Electric System Operator

Capacity market and resource adequacy planning failures

- Some like PJM fail to account for fleet-wide capacity value of renewables, requiring resource pairing to receive capacity credit
- Most assume conventional generation outages are random and uncorrelated, despite many real-world common mode failures
- Increasing penetration of renewables and gas requires more sophisticated approach to accounting for capacity in planning
- Many regions use rules of thumb that are less accurate than Effective Load Carrying Capacity methods
- ELCC varies significantly from year to year, no straightforward way to determine typical value

State and utility generation planning failures

- Utility Integrated Resource Planning (IRP) processes are capacity-focused as that was large share of costs traditionally (coal, hydro, nuclear); utility earns return on capex and fuel costs are passed through
- With large wholesale markets, increased use of gas, and increased focus on carbon, energy is more important than capacity
- Renewable resources are typically unattractive from a capacity perspective, as their primary value is in low cost energy and fuel price stability
- Fuel price stability of renewables, and volatility of other energy sources, is typically ignored; a few states require probabilistic planning, others at best require fuel price sensitivities
- Fuel price risk will become more pronounced under carbon policy as carbon price is typically set by difference between coal and gas price

Summary: Solutions for a low-carbon grid

- Workable policies to plan, pay for, and permit transmission are essential. Transmission:
  - Provides access to lower cost renewables
  - Enables greater geographic diversity in renewable output within region, particularly if output patterns accounted for in transmission planning
  - Reduces net load variability and uncertainty among grid operating areas
- Energy, capacity, and ancillary services market rules must work for all resources
  - Most energy markets now include renewables in dispatch; probabilistic unit commitment not widely used
  - Capacity markets should reflect system-wide contributions to needs
  - Markets critical for obtaining ancillary services at lowest possible cost
  - Lowest-hanging fruit: areas without markets need them
- Commission and utility planning process reform
  - Typically dominated by capacity considerations now; poorly suited for energy-driven issues like carbon, fuel price risk