Electric Industry Infrastructure Requirements for the United States: Challenges Ahead

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Overview

- Evolution and current status of US electricity infrastructure
- National goals for energy efficiency and carbon emission reductions, and how they are affecting planning for new transmission
- Issues associated with integrating significant wind resources
- Opportunities and challenges with smart grid deployment

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Transformation of Electric Transmission & Distribution Grid

- Generation, transmission and distribution were historically built company by company to serve local or single state needs
- Over time, transmission system use underwent transformation
  - Creation of independent or utility-affiliated power generators demanded larger configuration infrastructure to promote robust competitive markets
  - Demands that transmission be built over longer distances for purposes if enhanced reliability, greater supply affordability, and security of supply
- Resource deployment in regional markets required regional planning for new infrastructure
- Current clamor:“federalize” policy regarding infrastructure development and use to meet national objectives (climate and energy security)

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US Electric Utilities : Relevant Factual Features

- Electric utility industry is no longer a declining cost industry
- Transmission & distribution system is aging and in need of upgrade to maintain reliability and to meet anticipated growth in demand
- Generation resource base throughout US is diverse
- Regulatory system is highly balkanized owing to historic role of state regulation
  - 50 separate retail rate regulators
  - State siting and planning role must be factored
- Regional Transmission Organizations (RTOs) have assumed greater responsibility to balance diverse needs of state and local parochial interests with economic participants

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Estimated Costs of Investment of US Electric Infrastructure 2010-2030

- Investment as high as $1.5 trillion
  - Distribution - $582 billion
  - Transmission - $298 billion
  - Automated Meter Infrastructure (AMI) and Energy Efficiency/Demand Response - $85 billion
  - Generation - $505 billion, with no changes in carbon policy
  - Generation capacity cost avoidance partially offset by increased cost of Energy Efficiency investments

Source: Marc Chupka , *et al.* *"Transforming America's Power Industry: The Investment Challenge 2010-2030."* (Brattle Group)

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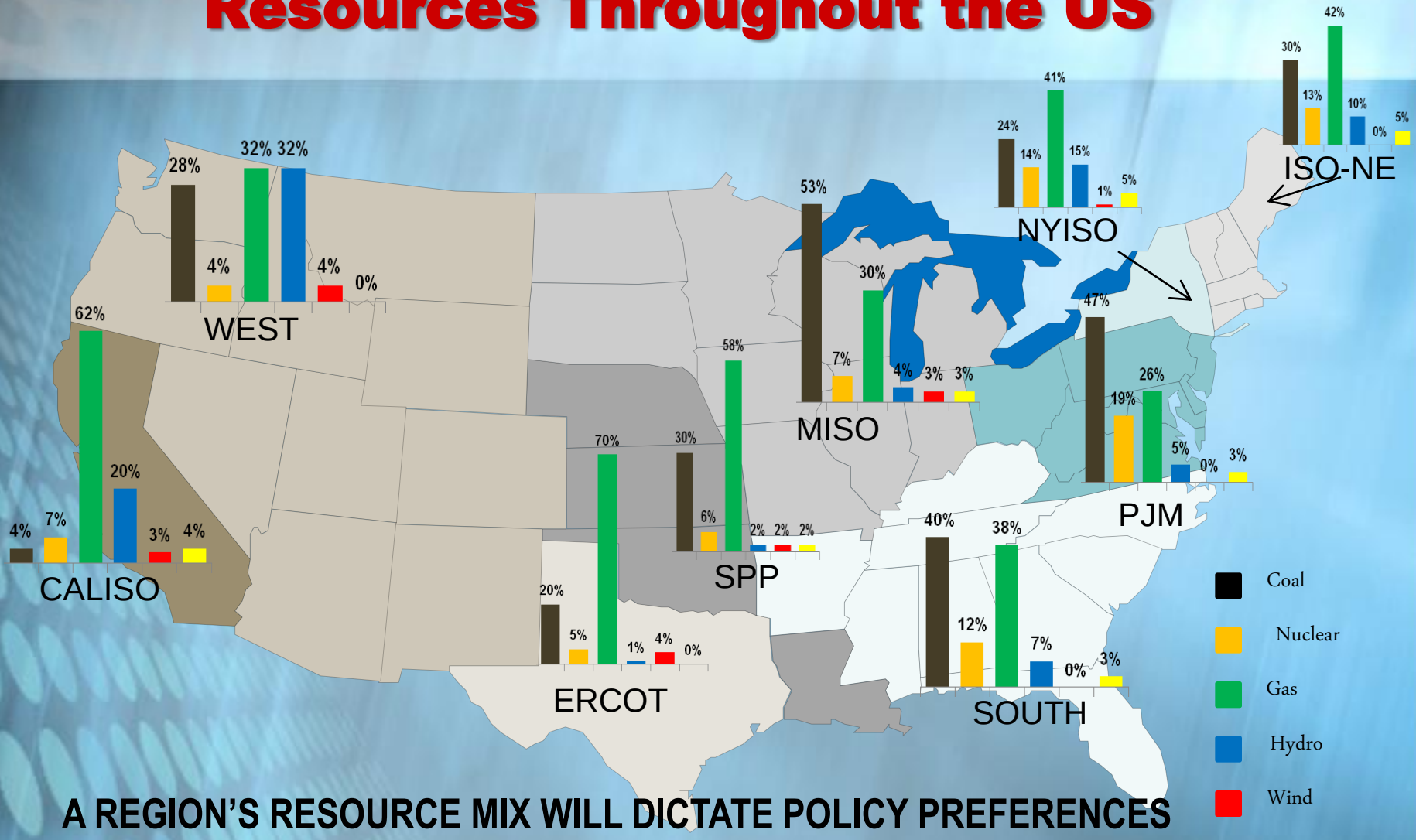
Regionally Diverse Generation Resources Throughout the US



A REGION'S RESOURCE MIX WILL DICTATE POLICY PREFERENCES

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Today's Policy Drivers: Heightened Federal Policy Objectives

- Renewable Portfolio Standards – multiple state mandates in place, possibly superseded by single federal mandate
  - 28 states and DC w/3 percent non-hydro renewables today, escalating to 10 percent by 2020
  - American Clean Energy & Security Act of 2009 (enacted by U.S. House): 6 percent by 2012 to 20 percent by 2020, with 25 percent attributable to energy efficiency
- Carbon emission reduction goals
  - Vision of transmission to integrate greater amounts of renewables to reduce carbon emissions
  - Smart Grid to also achieve carbon emission reductions
- Federal stimulus spending under the American Recovery and Reinvestment Act -- $11 billion in transmission upgrades and Smart Grid investments

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Transmission Issues Stemming From Wind Integration

- Transmission planning made more complex owing to magnitude and/or uncertainty of RPS mandate (state and federal) –magnitude of mandate changes grid configuration
- Operational issues -- mismatch between wind and load profiles will need to be addressed. Commercial storage one answer.
- Additional transmission needed to integrate wind resources casting doubt on traditional cost allocation methodologies

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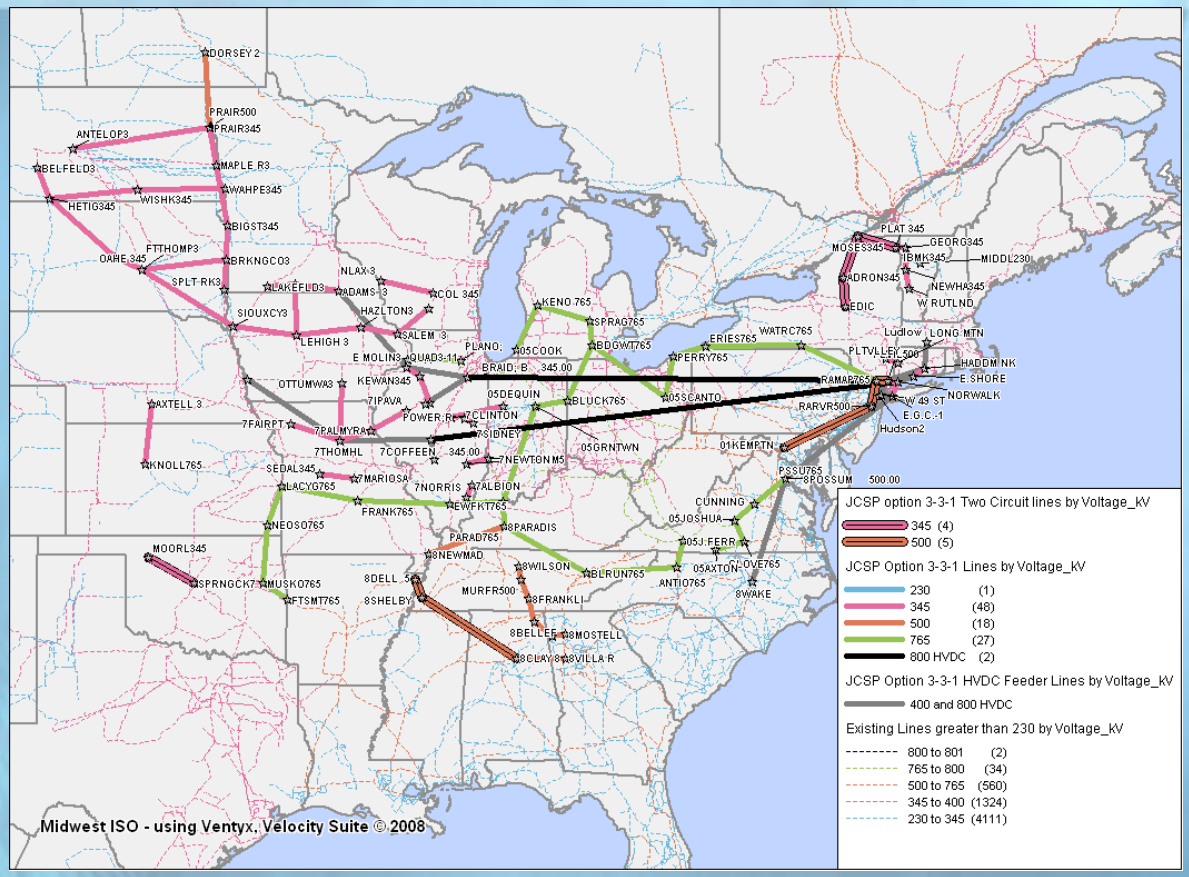
MISO Study w/ Reference Case Overlay (Status Quo): Some Backbone Required



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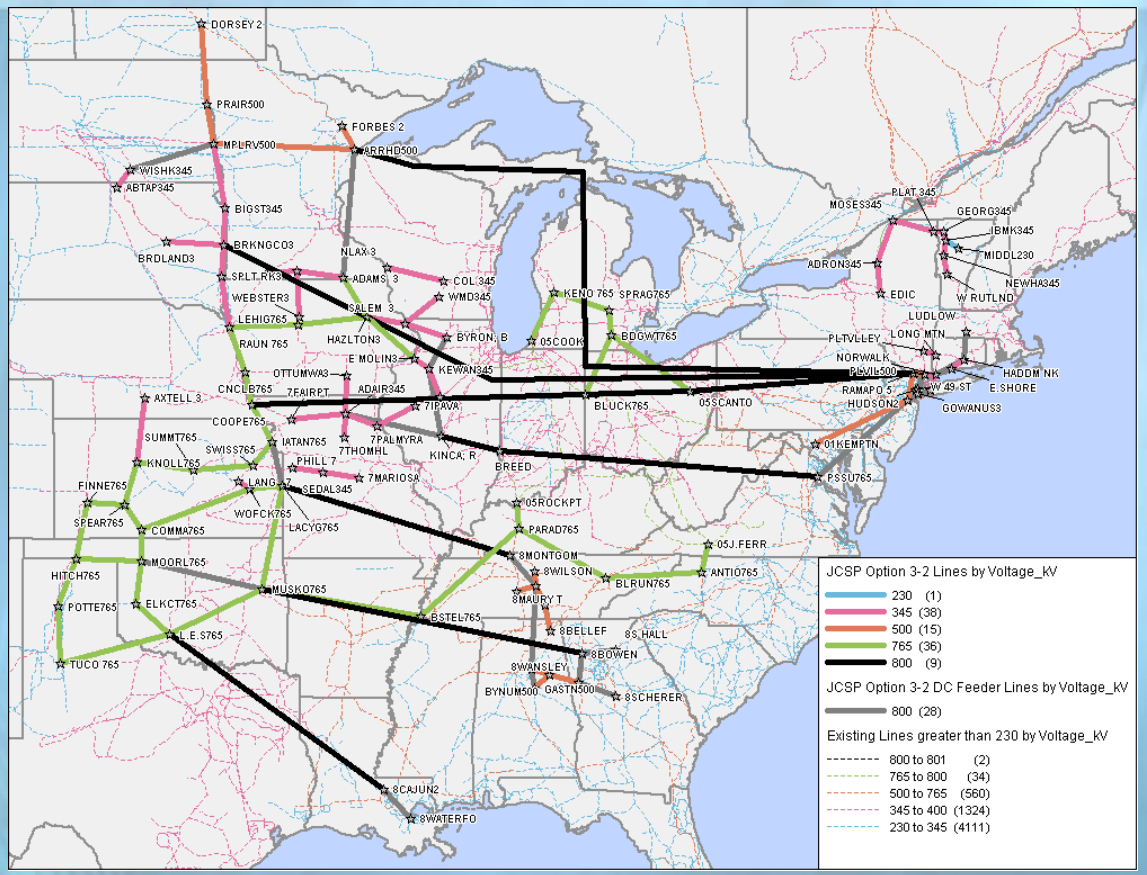
MISO Study w/ Twenty (20) Percent Wind Overlay: Substantial Backbone Required



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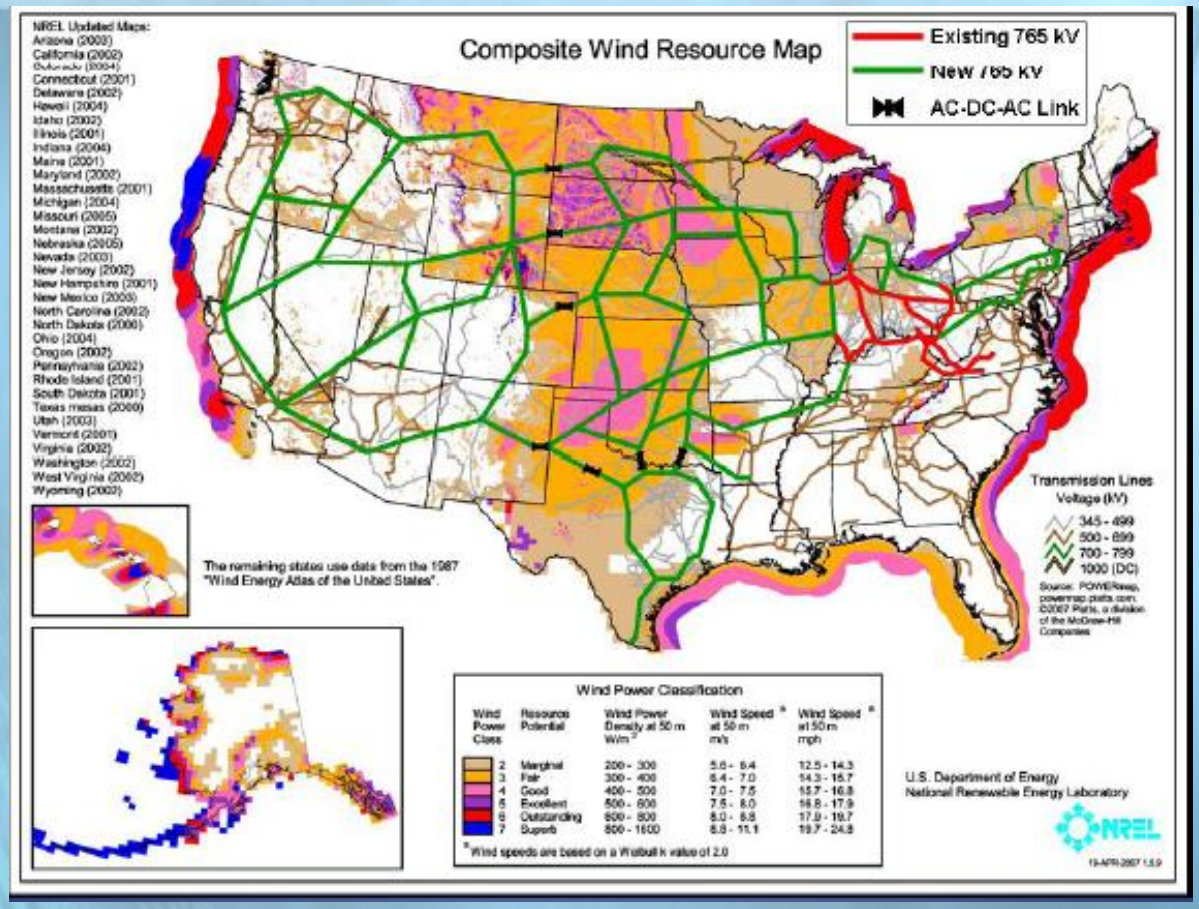
American Wind Energy Association/ American Electric Power "Green Superhighway Map"



A VISION OF THE FUTURE?

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No Consensus on Cost of the "Green Superhighway"

- Initial AEP Estimate $60 – 100 Billion (nationwide)
- Joint Coordinated System Plan -- $80 Billion (Eastern Interconnect)
- Eastern Wind Integration and Transmission Study – $93 Billion (Eastern Interconnect)
- Christensen Associates -- $220 Billion (nationwide)

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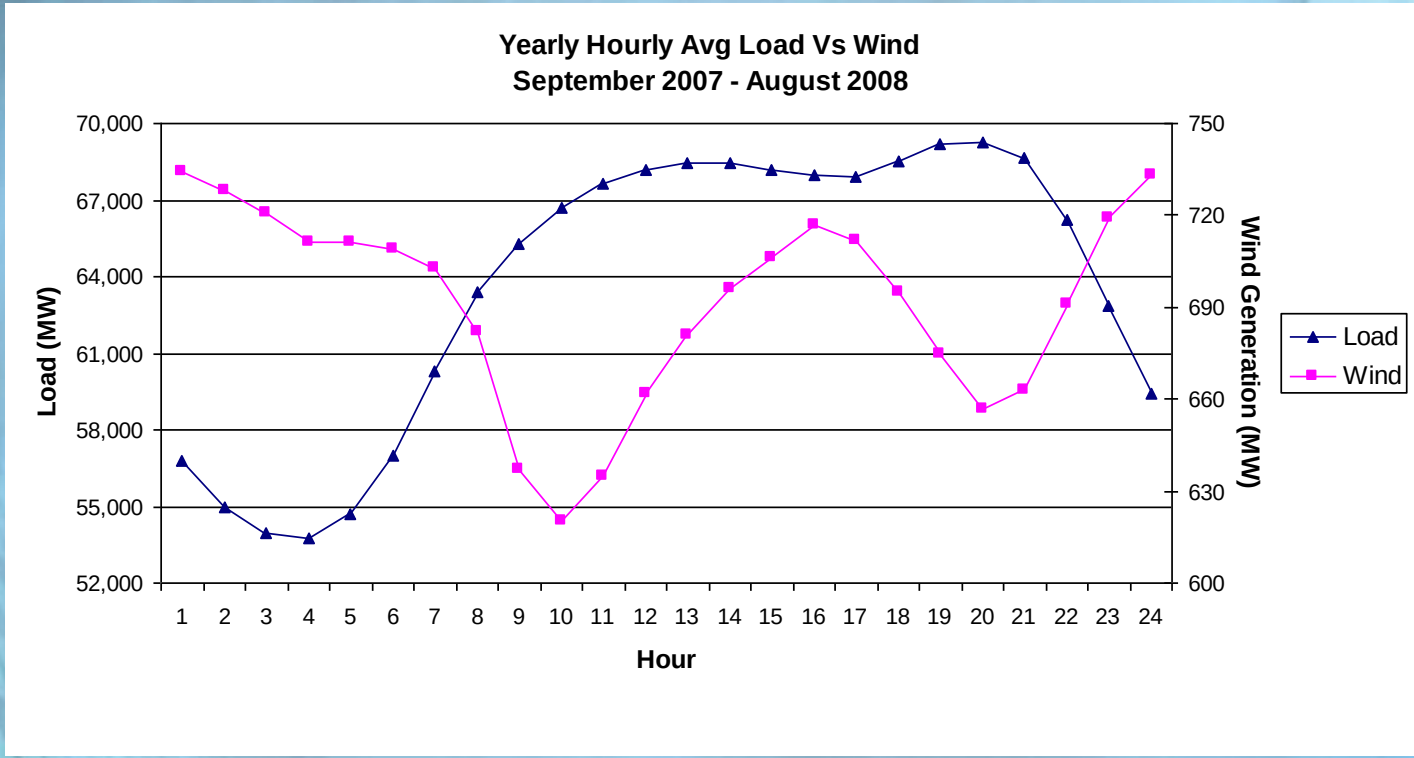
Wind and Load Profile Mismatch on Midwest Independent System Operator System



- Additional on-line capacity needed to follow wind output and load
- Quick-start capacity needed to maintain adequate ramp

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Allocation of Added Transmission Costs to Integrate Wind Resources

- **Issue:** Should costs be allocated on basis of cost causation (traditional basis), or some other method, such as who benefits?
- **Problem**:
  - Load in high wind zones do not need capacity and do not want to pay for transmission to load
  - Wind resources do not want to pay costs for transmission upgrades to move power to population centers
  - Influx of substantial wind creates reliability issues, but intermediately situated customers do not want to bear the costs of sending wind energy further east
- **One proposal**: because all customers benefit from reduced carbon emissions from wind renewables, costs should be spread interconnection-wide, or across as many regions as possible (advocated by certain utilities and wind trade assoc.)
- **Question:** whether Federal Energy Regulatory Commission has legal authority to allocate costs in this fashion
- **Issue** is subject of legislative proposals pending in US Congress

The "Smart Grid" : Will it Enable the "Killer Application"?

- **What is it?** Integration of advanced communications and information technology into the electric grid (from generation to consumer) for enhanced grid operations, customer services, reliability, and environmental benefits
- **Optimizes asset utilization** to minimize line losses and increase efficiencies
- **Operates resiliently** to restore system outages, natural or manmade
- **Home Area Network (HAN)** potential, giving residential customers new applications to realize significant energy efficiencies, and to accelerate deployment **of Plug-In Hybrid Electric Vehicles (PHEV)**
- **"Smart Meter/Automated Meter Infrastructure"(AMI)** in 70 pilot programs in 33 states

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Estimated Environmental /Energy Efficiency Benefits of Smart Grid Deployment

- Smart Grid can **reduce GHG emissions** from electric generation **by up to 12% by 2030** (equivalent to removing 65M cars from the road) -- Pacific Northwest National Lab, 2009.
- Dynamic pricing and smart home technologies can **reduce peak demand by up to 44%**, limiting new power plant builds and the emissions they would generate -- FERC, 2009.
- Simply providing consumers with their energy information can lead to a **5-15% reduction in their energy use**, and lead to billions of dollars in energy bill savings -- Google, 2009.

Source: Presentation by Nick Sinai, Energy and Environment Director, Federal Communications Commission, before Utilities Telecom Council, April 2010

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Smart Grid/AMI Challenges

- **Technology obsolescence** – What will the economic viability of the "smart meter" be? Will it be replaced by an internet-based virtual customer interface provided by a third party?
- **Cost versus benefits** – Is there a less expensive way to achieve the same outcomes? Will benefits justify the up front capital investment?
- **Dynamic Pricing** -- Regulator and Consumer acceptance needed
- **Customer acceptance and durability** – how many will adopt and how long will they stay with it?
- **Cybersecurity threats** – multiple vendors and smart meters create multiple entry points for hackers; will need to be resolved through standards development and legislation
- **Customer Privacy** – who owns the data generated from customer use, and who gets it? Legislation will be necessary.

Questions?

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