



Winds of Change

The Electric Infrastructure Challenge

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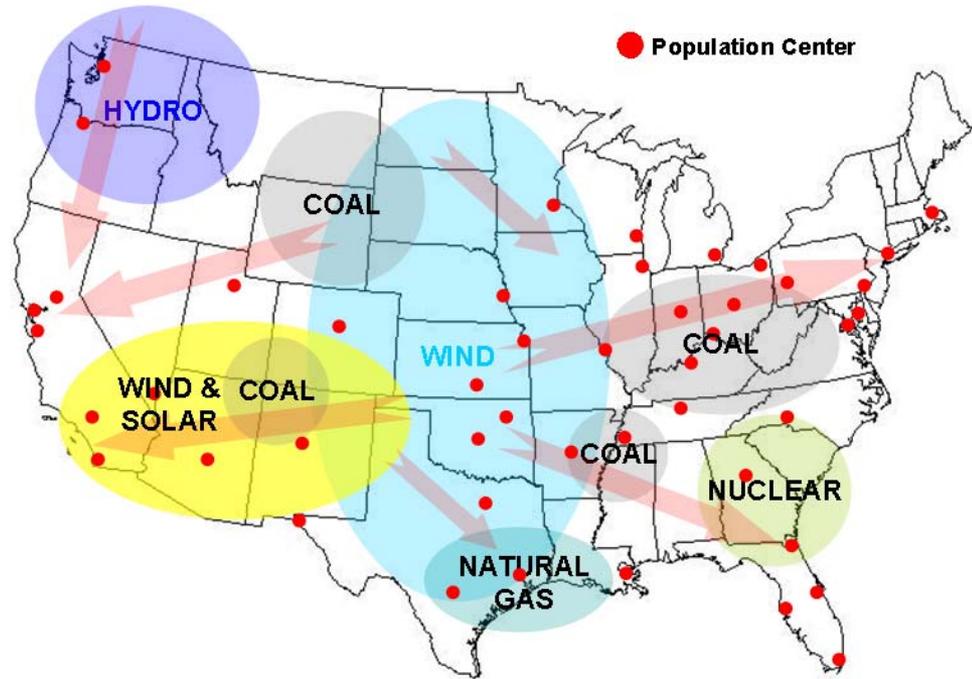
Role of Electric Transmission

- Transmission serves as:
 - Physical connection point for generators
 - Transportation system for delivery of energy to load
 - The platform for energy markets
- Constraints on the transmission system can:
 - Limit the development of new generation and particularly renewable development
 - Limit competition among generators and choices for serving load
 - Create price volatility in energy markets
 - Decrease system reliability



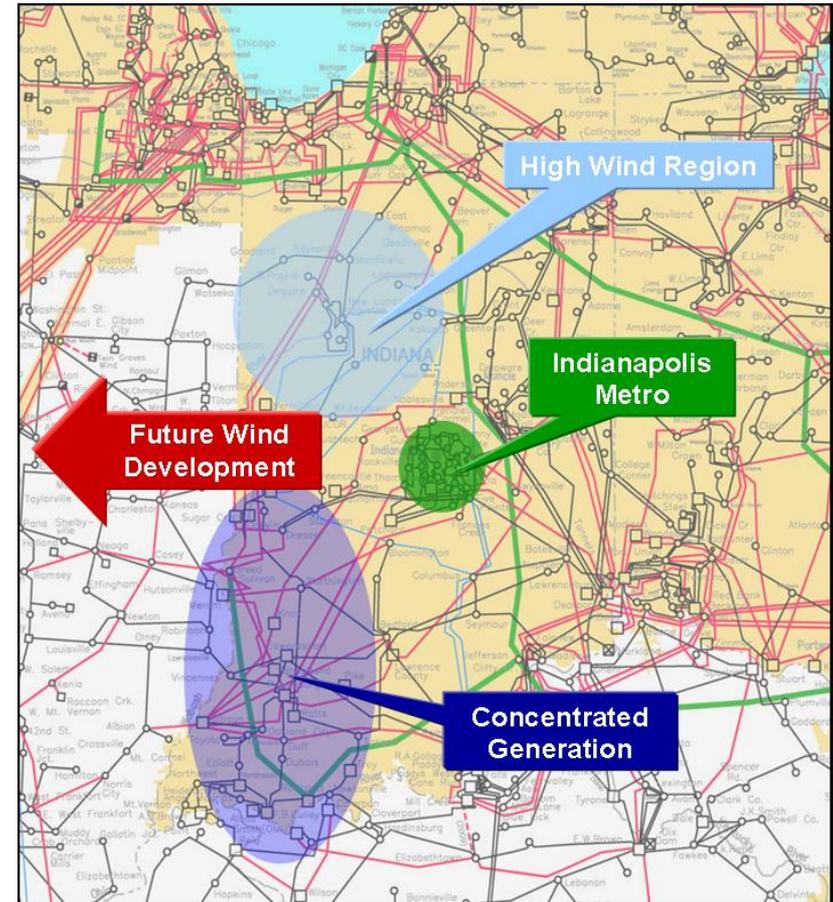
National Landscape

- Aging transmission infrastructure in need of renewal
- Policy changes causing dramatic shifts in the generation profile
- Optimal use of renewable and fossil fuels is constrained due to insufficient transmission infrastructure
- Traditional uses of the transmission grid have changed
- Conventional planning processes are rapidly becoming obsolete



Indiana Example: Changing System Demands

- Site selection of new generation is resource-dependent
 - IGCC/CCS
 - Wind
 - Nuclear
- Location of new resources will impact power flow patterns on the transmission system
- Transmission planning must consider:
 - Resource integration
 - Reliability impact
 - Market impact
 - Demand-side variations
 - Changing and uncertain conditions



A Primer on “The Grid”

Theory vs. Reality

– The Balance of Power.....

- Amount of power generated in an electric system *equals* the amount of power consumed



- **In Theory....** *the electric transmission grid would consist of an interconnected network of high-voltage transmission lines that span North America, tying together and moving large amounts of power from the source of generation to the consumers of power.*
- **In Reality....** *Our present system is ill-equipped to integrate large scale wind resources. Wind resources are often located in areas of the country where there is little or no transmission infrastructure.*



The Challenge: “Impact of Wind Interconnection on Transmission Performance”

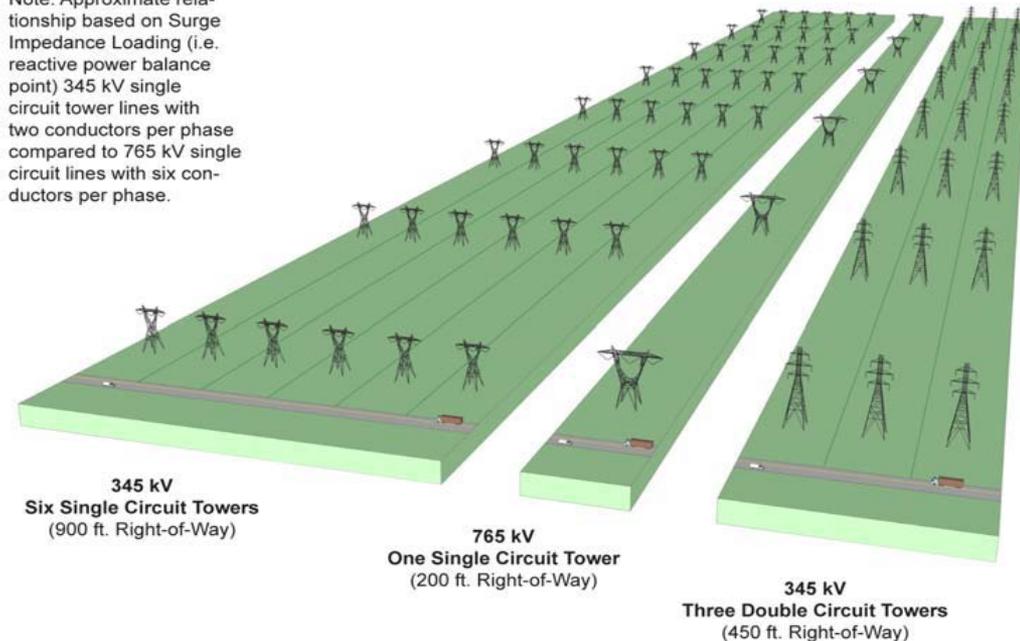
- Transmission planning is generation-neutral and systems must be adaptable to an uncertain future
- Expand extra-high voltage (EHV) transmission to:
 - Reach new resources
 - Ensure long-term reliability and flexibility
 - Enhance market efficiency
- Renew existing facilities to:
 - Maximize utilization of existing lines
 - Refurbish facilities in poor physical condition



Meeting the Challenge: Building Transmission “Smarter”

- Use higher voltage and higher capacity lines to make best use of new rights-of-way
- Use higher voltage lines and more efficient equipment to reduce energy losses
- Apply “Smart Grid” technologies to the transmission system

Note: Approximate relationship based on Surge Impedance Loading (i.e. reactive power balance point) 345 kV single circuit tower lines with two conductors per phase compared to 765 kV single circuit lines with six conductors per phase.



Voltage selection significantly affects performance, cost and the environment.



Changing the Way we *Plan*....

- Long term planning horizon 20-30 years
- Focus must be within and between planning regions with a common platform particularly for EHV planning
- Transmission planning needs to “anticipate” rather than “react” to problems
- Broader system benefits need to be considered and accounted for:
 - Reliability benefits beyond the short term least cost solution (that moves a problem from today to tomorrow)
 - Economic benefits
 - Operational flexibility and loss savings
- Once need is determined, EHV projects should be encouraged to come into service as soon as possible, rather than targeting a specified date

Creating a foundation for efficient and cost effective transmission solutions....



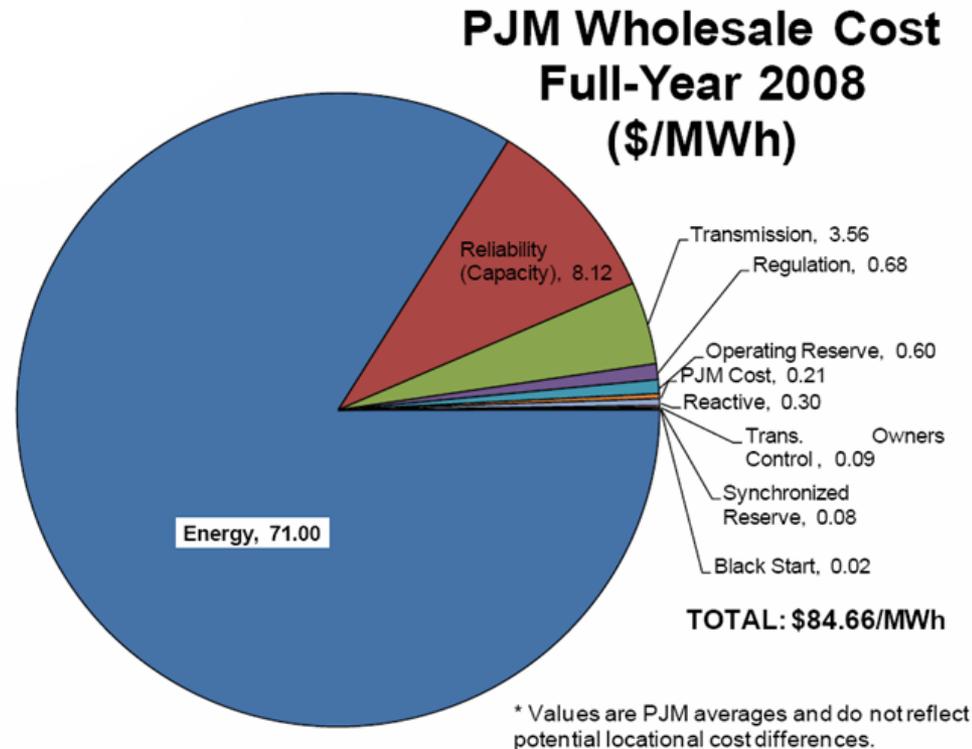
Transmission Cost Responsibility

- RTOs determine cost-allocation methodologies, which differ from region to region
- Wide variety of methodologies, from “beneficiary pays” to “postage stamp”
 - Determining “who benefits” is complex, can change over time, and is often met with objection and debate
- Methodologies for large backbone projects are ill-designed to accommodate projects that must be built to meet our energy goals
 - Large projects benefiting large regions should be shared broadly among all customers



Transmission Cost Responsibility

- Transmission represents a very small part of the customer bill
 - Substantial investments in transmission have a small impact
- Transmission expansion facilitates lower delivered energy costs due to:
 - Increased competition and less constrained markets
 - Reduced energy losses
- Studies often show transmission can pay for itself



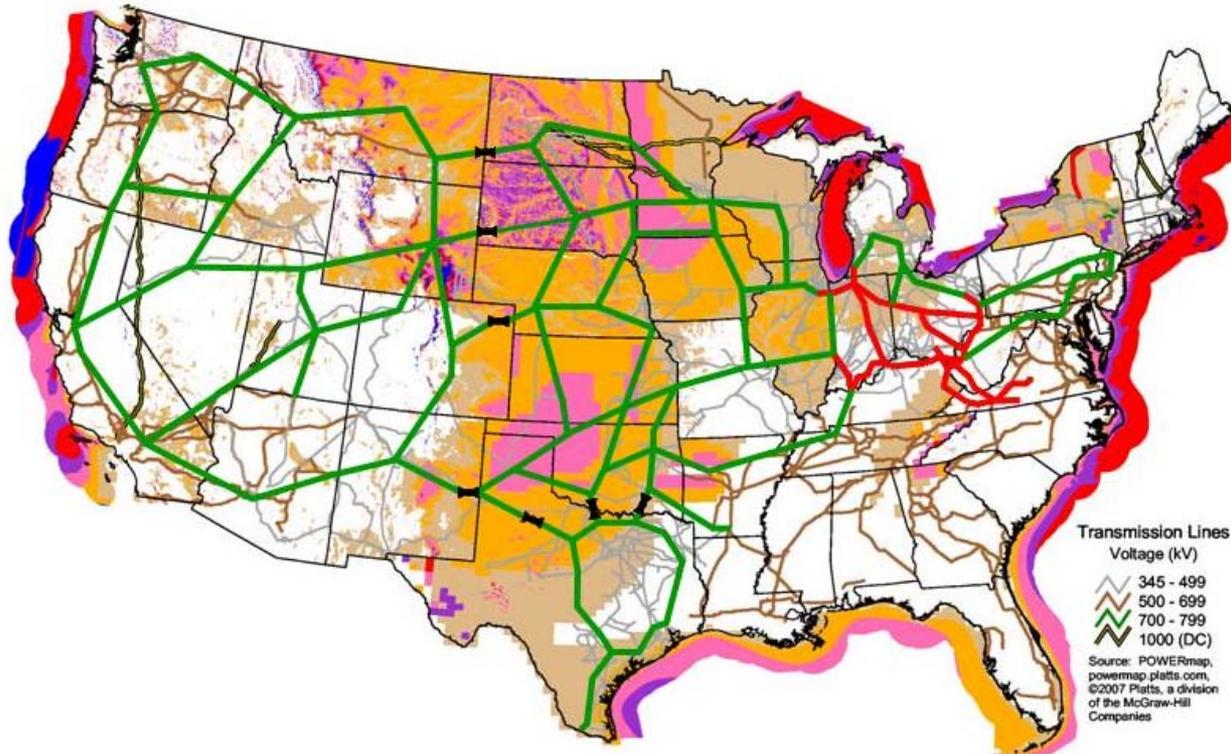
Transmission Development Benefits

- Reduced congestion and fluctuations in energy prices
- Enhanced reliability, mitigating risk of blackouts
- Integration of renewable and other new generation
- Projects driven by cost/benefit analyses, ensuring customer value
- Long-term investments that help create jobs



Vision for Interstate Transmission

- U.S. developed interstate highway versus “just in time” upgrades to the existing roads:
 - Interstate commerce flourished with increased access and mobility
 - National security and safety were enhanced
 - Local U.S. routes were upgraded to serve local needs; some routes were retired



3 Key Points...

- Evolving energy policies are changing the generation mix and the way the transmission system is used
- Both expanding and refurbishing the transmission system are critical to meeting energy goals and mitigating price volatility is needed to ensure flexibility of the system
- Customers across broad regions that will share in the benefits of new EHV transmission facilities should share in the costs

