

Transmission for Renewables

The Electric Infrastructure Challenge

John Flynn
 Managing Director – Transmission
 Strategy & Business Development
 American Electric Power

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American Electric Power

Generation	Transmission	Distribution	Customers
 <ul style="list-style-type: none"> • Environmental Projects • Wind • IGCC • Carbon Capture & Storage 	 <ul style="list-style-type: none"> • I-765™ • Electric Transmission Texas JV • Electric Transmission America JV • AEP-ABB Alliance 	 <ul style="list-style-type: none"> • Distribution automation • Self-healing distribution circuits • Advanced metering • Communications infrastructure • Mobile workforce • Internal energy efficiency • Integration platform for advanced visualization and analytics • Distributed generation and energy storage 	 <ul style="list-style-type: none"> • Customer programs and incentives <ul style="list-style-type: none"> • Energy efficiency • Direct load control • Peak demand reduction • Energy storage • PHEVs
Existing generation and transmission control systems	gridSMART™: bridging the gap to provide integrated two-way communications & control across the electricity value chain		Home energy automation



Transmission & Renewables

- Renewable generators need transmission to connect and deliver energy to the marketplace, wherever the marketplace may be.
- The scale of transmission must match the scale of renewables, and the proposed scale of renewables in the U.S. today is unprecedented.
- A national RES and CO2 legislation will impact all states, and the ability to effectively comply with these policies is reliant on a transmission system built to adapt to changes.
- Renewable resources can pose operational challenges. A robust and flexible transmission system is critical to making sure those challenges do not jeopardize reliability to customers.
- Transmission must be in place first in terms of development with renewable generation.



Today's Challenge

UNITED STATES*

Population

303 Million

Square Miles

3,119,884 sq mi

Peak Load

782 GW**

Energy Consumption

3,890 billion kWh

Wind Connected

25,105 MW installed

49 TWh produced

Wind Capacity Feasibility

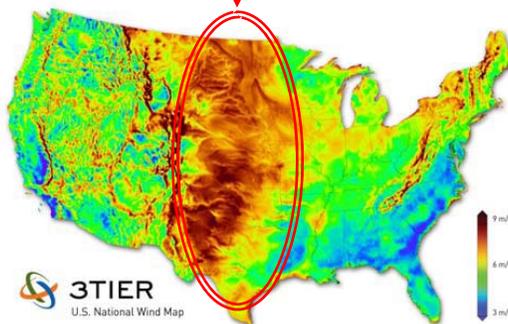
300 GW

(20% Scenario)

*Contiguous US

**Non-Coincident

47% of Nation's Generation
Interconnection Queue



GERMANY

Population

82 Million

Square Miles

137,847 sq mi

Peak Load

80 GW

Energy Consumption

550 billion kWh

Wind Connected

23,903 MW installed

39.5 TWh produced

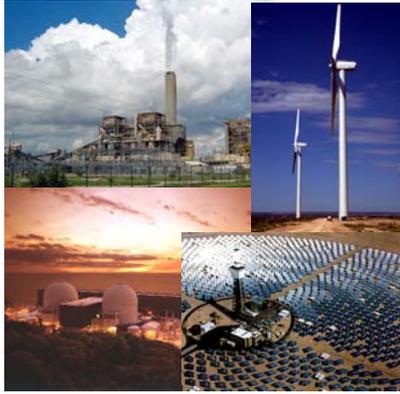
Wind Capacity Feasibility

55 GW

(25% Scenario)



Today's Challenge



- **Why Change Now?**
 - Dramatic shifts in generation profile.
 - Electrically isolated large scale renewables need to be interconnected and efficiently delivered.
 - Environmental requirements are likely to force retirement of large fossil units, potentially at a magnitude never before faced in this country.
 - The search for a “bright line” between reliability and economic transmission projects is increasingly artificial.
- **What Needs to Change?**
 - Planning for a new energy supply paradigm.
 - Cost allocation principles to encompass a strategic expansion of transmission.
 - Siting processes which are aligned with state, regional and national energy policy objectives.
- **“What got us here won’t get us there.”**



Planning & Building Smarter

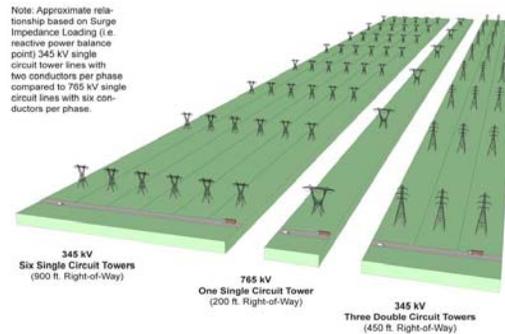
- Advance a long-term, strategic “system-based” approach to transmission planning.
- Transmission grid should be adaptable to address:
 - Policy driven goals to interconnect and ensure efficient deliverability of renewables.
 - Facilitate the retirement of aging and expensive resources.
 - Regional availability of resources and operational requirements of the grid.
- Extra-high voltage (EHV) planning is needed both “within and between” traditional planning regions, with:
 - Consistent planning criteria applied to EHV transmission.
 - Regional and inter-regional planning efforts and consensus on transmission development goals.
 - Longer time horizons to ensure development of strategic as opposed to “band-aid” solutions.

A strategically planned EHV grid can provide the required transmission capacity and operating flexibility while drawing on diverse resources that will insulate consumers from resource shortages and catastrophic events.



Planning & Building 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.



Siting transmission projects will become increasingly difficult into the future. We need to minimize our footprint while maximizing the benefits to the system.



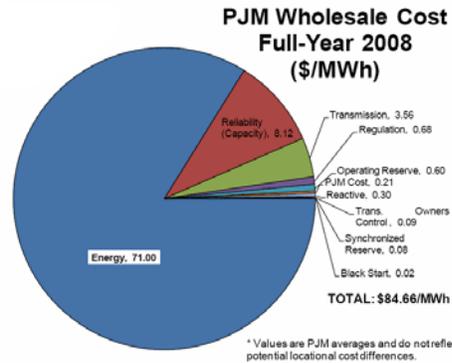
Fair Allocation of Costs & Benefits

- RTOs and planning authorities need to ensure cost allocation structures support systems that are robust, efficient and capable of meeting their long term energy needs.
- “Beneficiary based” models which consider a line by line cost benefit analysis for EHV are not consistent with the need to build a robust backbone grid to meet national energy policy goals.
 - These fail to capture the full system benefits afforded by such facilities.
 - Determination of “who benefits” is complex, can change over time, and is often met with objection and debate.
- We have seen that broad based regional cost allocation methodologies have resulted in projects that provide regional benefits. Similarly, interconnection-wide cost allocation can result in a system that provides inter-regional benefits.
- Consider all benefits – electrical and economic - of large-scale transmission development:
 - Lowered emissions.
 - Generation diversity and reserve sharing.
 - Loss savings.
 - Reduction of congestion and production cost savings.
 - Avoidance or deferment of incremental upgrades.
 - Enhanced reliability and national security.



Fair Allocation of Costs & Benefits

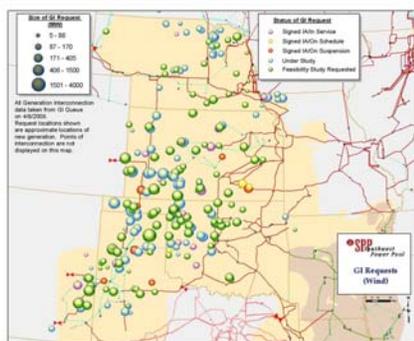
- Transmission represents a very small part of the customer bill.
- Substantial investments in transmission have a small impact.
- Transmission expansion facilitates lower delivered energy costs due to:
 - Increased competition and less constrained markets.
 - Reduced energy losses.
- Studies often show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



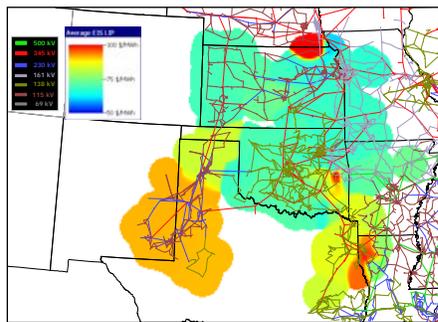
"Least Cost" is rarely "Best Value"



Case Study: Southwest Power Pool



Significant interest in developing SPP's superb wind resources, but currently no way to connect and deliver the added generation.



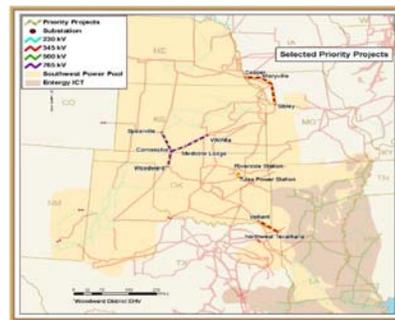
Transmission constraints limit import/export within SPP, limit generation development opportunities, and increase costs.



Case Study: Southwest Power Pool



Long-term vision of a 765-kV transmission overlay that would provide the ability to develop these resources and move power freely across the entire SPP footprint.



“Priority Projects” recently developed as a starting point to begin the development of SPP’s future transmission system.



Conclusions...

To make significant strides in developing clean, domestic energy and reducing emissions, we as a nation need:

- National energy policy with specific goals and guidelines, particularly as it relates to renewables and CO₂.
- Federal planning authorities that can mandate RTOs, utilities, or other planning entities to develop long-term, interconnection-wide transmission plans that will facilitate national energy goals.
- Mandates to develop reasonable regional and interregional cost allocation methodologies to support EHV transmission that is in the national interest.
- Support for the siting of national-interest transmission lines where necessary.
- Benchmarks to check progress of plans and ensure timely construction.

