



Transmission As a Market Enabler: The Costs and Risks of an Insufficiently Flexible Electricity Grid

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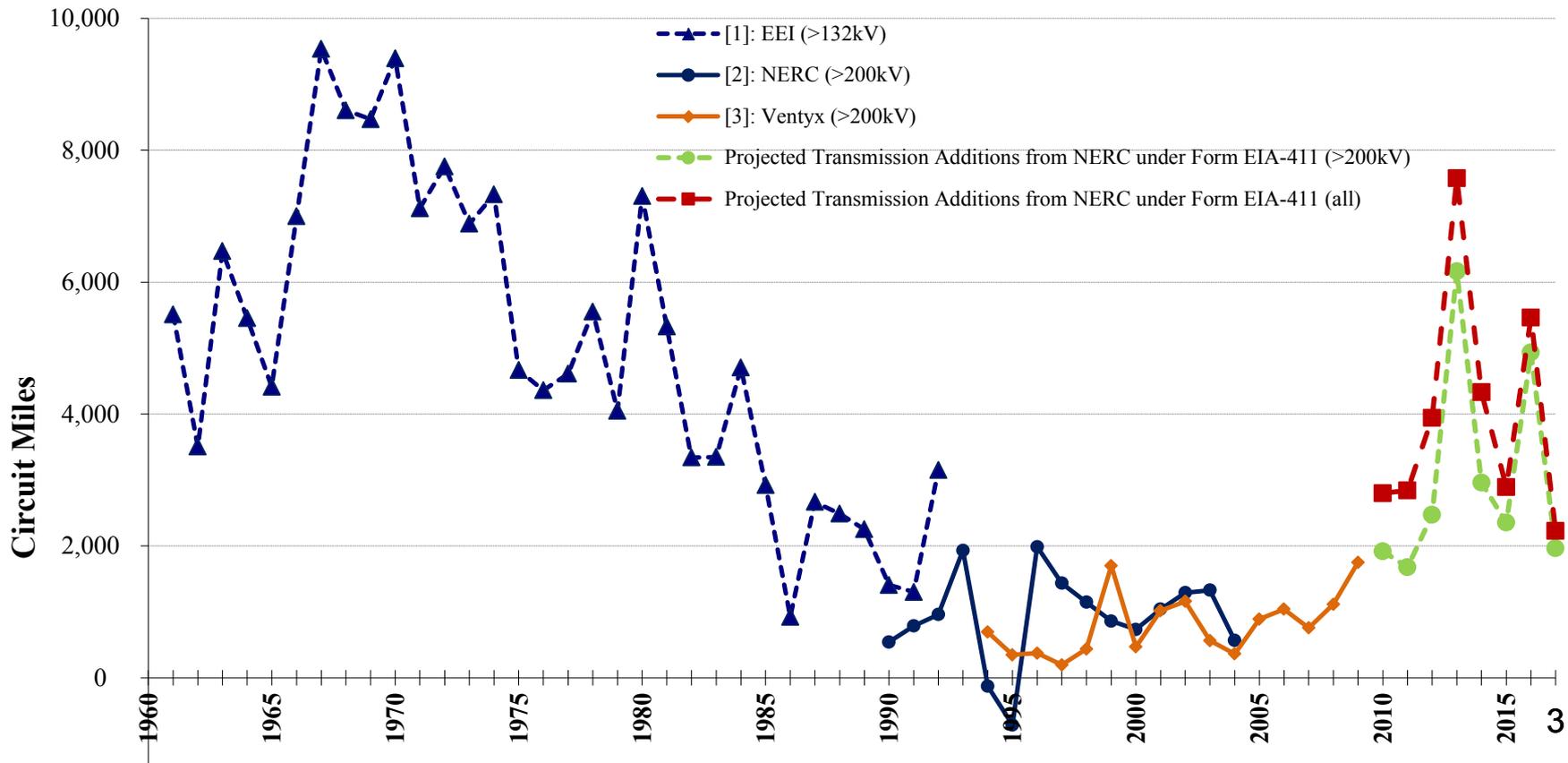
Agenda

1. Historical Transmission Investment and Projected Needs
2. Key Barriers to Planning a More Robust Transmission Grid
3. Often Overlooked Benefits of a Flexible and Robust Transmission Grid
 - Numerous benefits that increase reliability and lower the cost of generating and delivering power to consumers
4. The High Costs and Risks of Inadequate Transmission Infrastructure
5. The Need for More Effective Interregional Transmission Planning
6. Recommendations for Policy Makers

Historical Circuit-Mile Additions

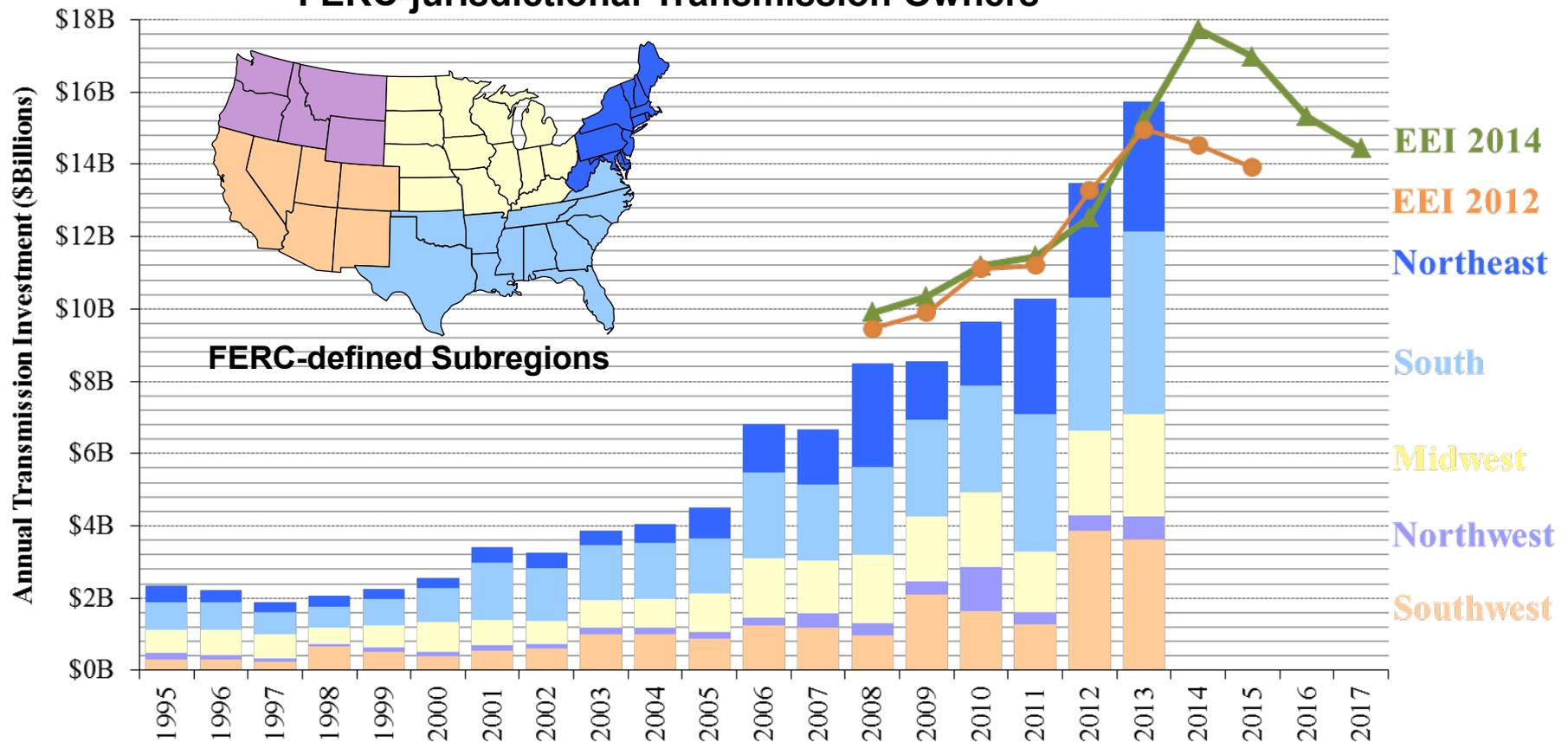
Document Aging Grid

- Most of the existing grid was built 30-50+ years ago
- Even relatively high recent and projected circuit miles additions are below levels of additions in 1960s and 1970s



Growing Transmission Investments

1995–2017 Annual Transmission Investment by FERC-jurisdictional Transmission Owners

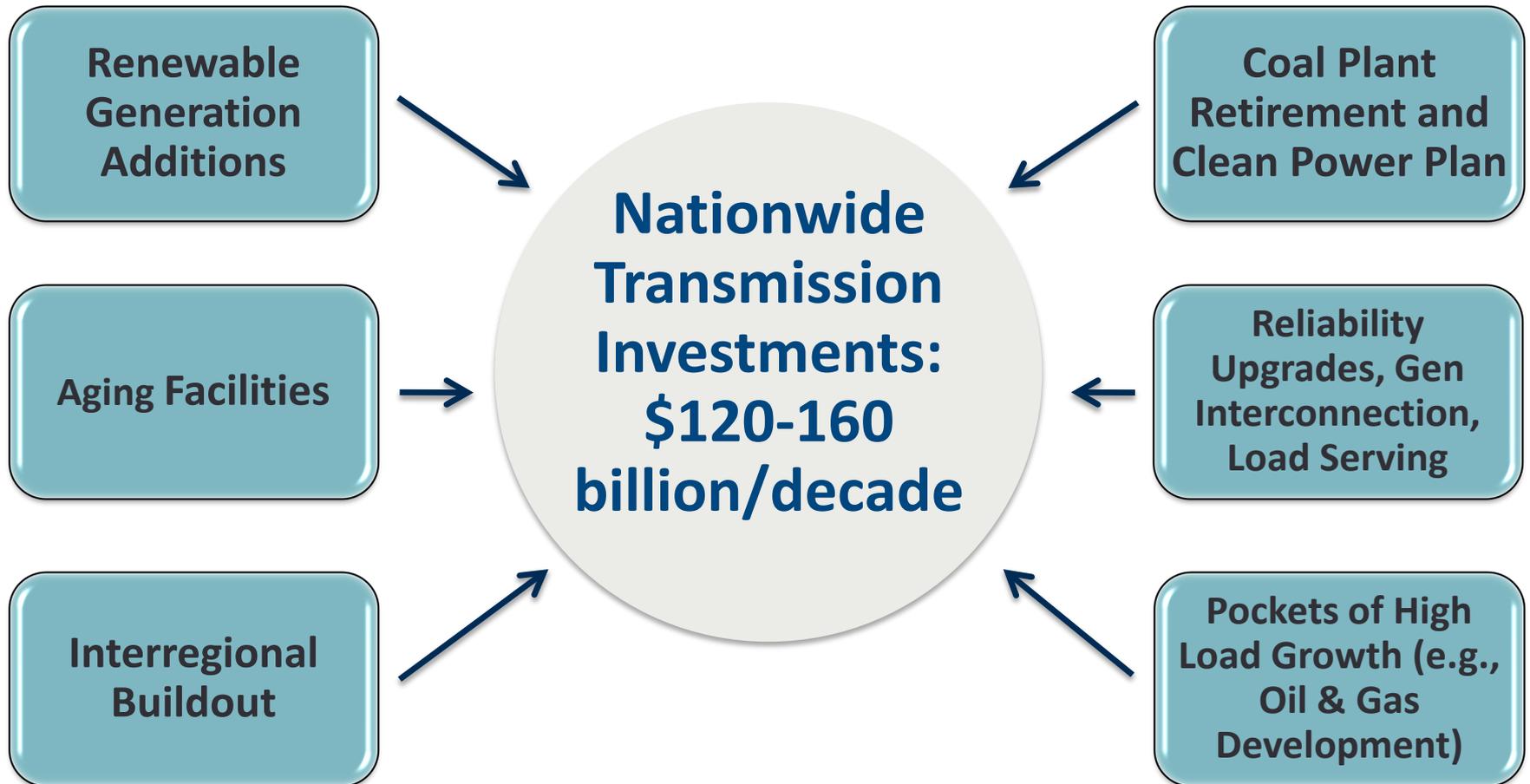


Sources and Notes: The Brattle Group's analysis of FERC Form 1 data compiled in Ventyx's Velocity Suite.

Based on EIA data available through 2003, FERC-jurisdictional transmission owners estimated to account for 80% of transmission assets in the Eastern Interconnection, and 60% in WECC and ERCOT. Facilities >300kV estimated to account for 60-80% of shown investments.

EEI annual transmission expenditures updated May 2014 shown (2008-2017) based on prior year's actual investment through 2012 and planned investment thereafter.

Transmission Investment Drivers Looking Forward



Key Barriers to More Effective Grid Planning

We identified 3 key barriers to identifying and developing the most valuable transmission infrastructure investments:

1. Planners and policy makers **do not consider the full range of benefits** that transmission investments can provide and thus understate the expected value of such projects
2. Planners and policy makers **do not account for the high costs and risks** of an insufficiently robust and insufficiently flexible transmission infrastructure on electricity consumers and the risk-mitigation value of transmission investments to reduce costs under potential future stresses
3. **Interregional planning processes are ineffective** and are generally unable to identify valuable transmission investments that would benefit two or more regions.

Additional challenges related to regional cost recovery and state-by-state permitting processes

The Need for More Effective Grid Planning

If not addressed, the identified barriers to more effective regional and interregional transmission planning will lead to:

- Underinvestment in transmission, which results in higher overall costs of delivered electricity
- Lost opportunities to identify and select alternative infrastructure solutions that are lower-cost or higher-value in the long term than the (mostly reliability-driven) projects proposed by planners
- An insufficiently robust and flexible grid that exposes customers and other market participants to higher costs and higher risk of price spikes

The Full Range of Transmission-Related Benefits

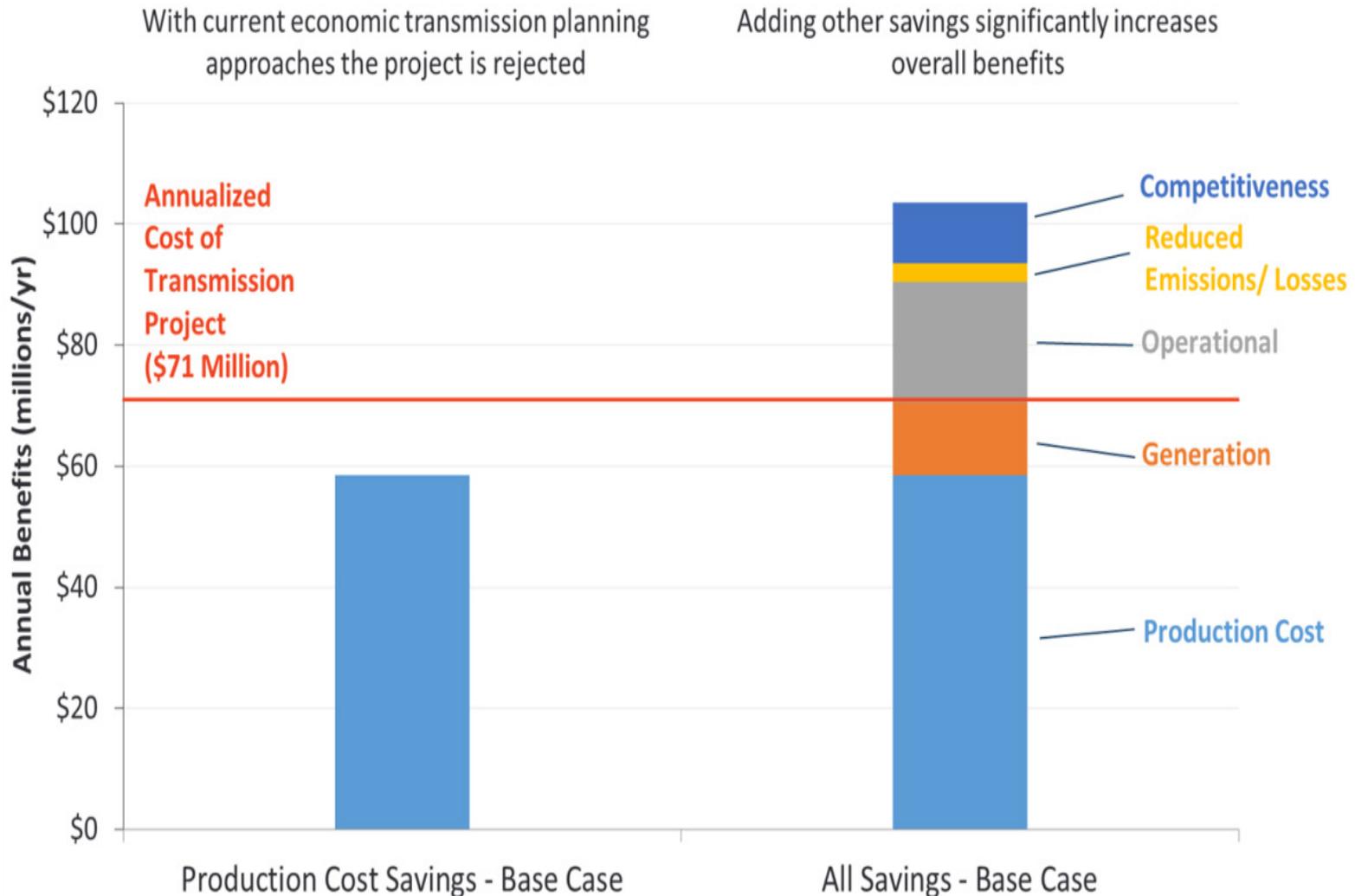


- Transmission accounts for 10% of customer bills but will greatly affect at least half of the other 90%
- Omitting many transmission-related benefits (or assuming they are zero) ignores the costs and risk imposed on customers through a higher overall cost of power

Checklist of Transmission Benefits

<u>Benefit Category</u>	<u>Transmission Benefit</u> (see Appendix for descriptions and detail)
Traditional Production Cost Savings	Production cost savings as currently
1. Additional Production Cost Savings	a. Impact of generation outages and A/S unit designations
	b. Reduced transmission energy losses
	c. Reduced congestion due to transmission outages
	d. Mitigation of extreme events and system contingencies
	e. Mitigation of weather and load uncertainty
	f. Reduced cost due to imperfect foresight of real-time system conditions
	g. Reduced cost of cycling power plants
	h. Reduced amounts and costs of operating reserves and other ancillary services
	i. Mitigation of reliability-must-run (RMR) conditions
	j. More realistic "Day 1" market representation
2. Reliability and Resource Adequacy Benefits	a. Avoided/deferred reliability projects
	b. Reduced loss of load probability <u>or</u> c. reduced planning reserve margin
3. Generation Capacity Cost Savings	a. Capacity cost benefits from reduced peak energy losses
	b. Deferred generation capacity investments
	d. Access to lower-cost generation resources
4. Market Benefits	a. Increased competition
	b. Increased market liquidity
5. Environmental Benefits	a. Reduced emissions of air pollutants
	b. Improved utilization of transmission corridors
6. Public Policy Benefits	Reduced cost of meeting public policy goals
7. Employment and Economic Stimulus Benefits	Increased employment and economic activity; Increased tax revenues
8. Other Project-Specific Benefits	Examples: storm hardening, fuel diversity, flexibility, reducing the cost of 9 future transmission needs, wheeling revenues, HVDC operational benefits

Example: Why Considering all Transmission Benefits is Important



Inadequate Transmission Imposes High Risks

Most transmission planning efforts do not adequately account for short- and long-term risks and uncertainties affecting power markets

- Economic transmission planning generally evaluates on only “normal” system conditions
 - Ignores the high cost of short-term challenges and extreme market conditions triggered by weather, outages, fuel supply disruption, unexpected load growth
- Planning does not adequately consider the full range of long-term scenarios and does not capture the extent to which a less robust and flexible transmission infrastructure will foreclose lowest-cost options

Costs of inadequate infrastructure typically are not quantified but, under some circumstances, can be much greater than the costs of the transmission investments

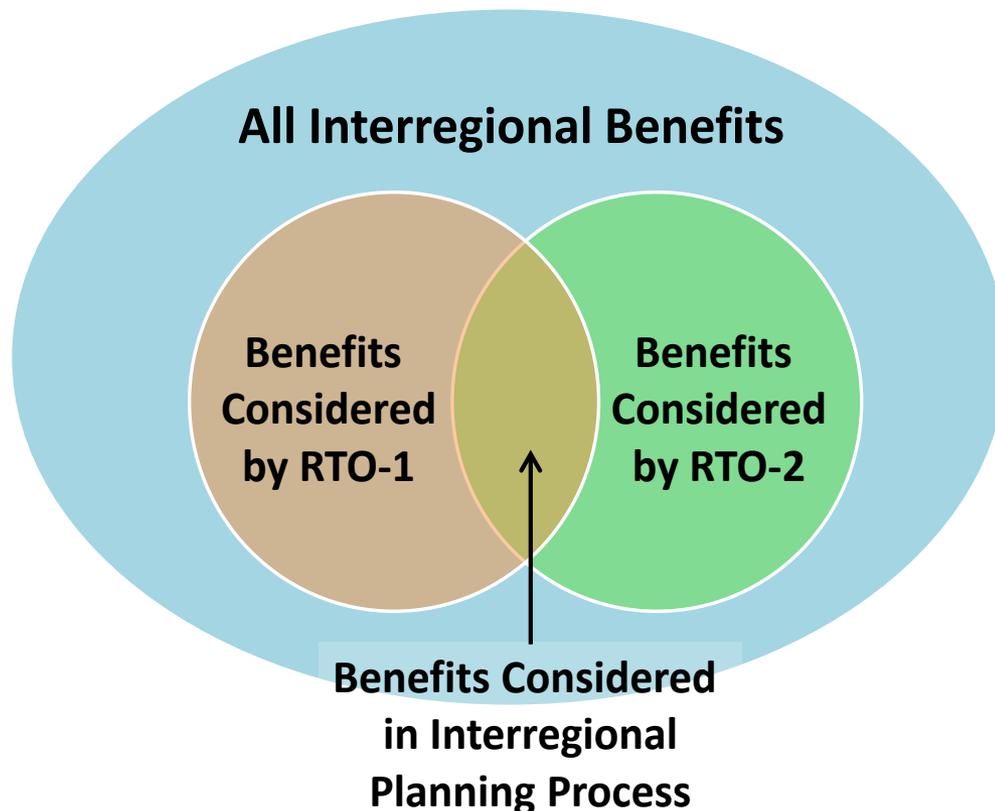
Inadequate Transmission Imposes High Risks

Planning processes largely ignore the risk mitigation and insurance value of transmission infrastructure

- Given that it can take a decade to develop new transmission, delaying investment can easily limit future options and result in a higher-cost, higher-risk outcomes
 - “Wait and see” approaches limits options, so can be very costly in the long term;
 - The industry needs to plan for short- and long-term uncertainties more proactively
- “Least regrets” planning today mostly focuses on identifying those projects that are beneficial under most circumstances
 - Does not consider the many potentially “regrettable circumstances” that could result in very high-cost outcomes
 - Focuses too much on the cost of insurance without considering the cost of not having insurance when it is needed

Ineffective Inter-Regional Transmission Planning

Divergent criteria result in “least-common-denominator” planning approaches that create significant barriers for transmission between RTOs



Experience already shows that few (if any) interregional projects will be found to be cost effective under this approach

Multiple threshold tests create additional hurdles

Ineffective Inter-Regional Transmission Planning

Need is compartmentalized into “reliability,” “market efficiency,” “public policy,” and “multi-value” projects within most regional planning processes.

Projects Considered in MISO-PJM Planning:
(as Ordered by FERC)

Project Type in RTO-1				
Reliability	Yes	no	no	no
Market Efficiency	no	Yes	no	no
Public Policy	no	no	Yes	no
Multi Value	no	no	no	no
	Reliability	Market Efficiency	Public Policy	Multi-Value
	Project Type in RTO-2			

Creates additional barriers at the interregional level by limiting projects to be of the same type in both regions

Eliminates many projects from consideration

Recommendations for State and Federal Policy Makers

Policy makers, including industry regulators, play a key role in influencing the scope of regional and interregional transmission planning efforts. We therefore recommend that they encourage planners to:

- Consider the full range of transmission-related benefits
- Better document and understand the high risks and high costs of an insufficiently robust and flexible grid
- Move from compartmentalizing projects into “reliability,” “economic,” and “public policy” projects to considering the multiple values provided by all transmission investments
- Improve interregional planning processes to avoid least-common-denominator approaches and consider the multiple but different values that projects can provide to individual regions

Additional Reading / About Brattle

Pfeifenberger, Chang, and Sheilendranath, “Toward More Effective Transmission Planning: Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid,” WIRES and The Brattle Group, April 2014, forthcoming April 23, 2014 at www.wiresgroup.com

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