The Brattle Group

Modernizing America's Grid:
How can better planning deliver the grid we need?

Presented at:
New England Clean Energy Transmission Summit

Presented by:
Johannes Pfeifenberger

Boston
January 23, 2012

In this Presentation

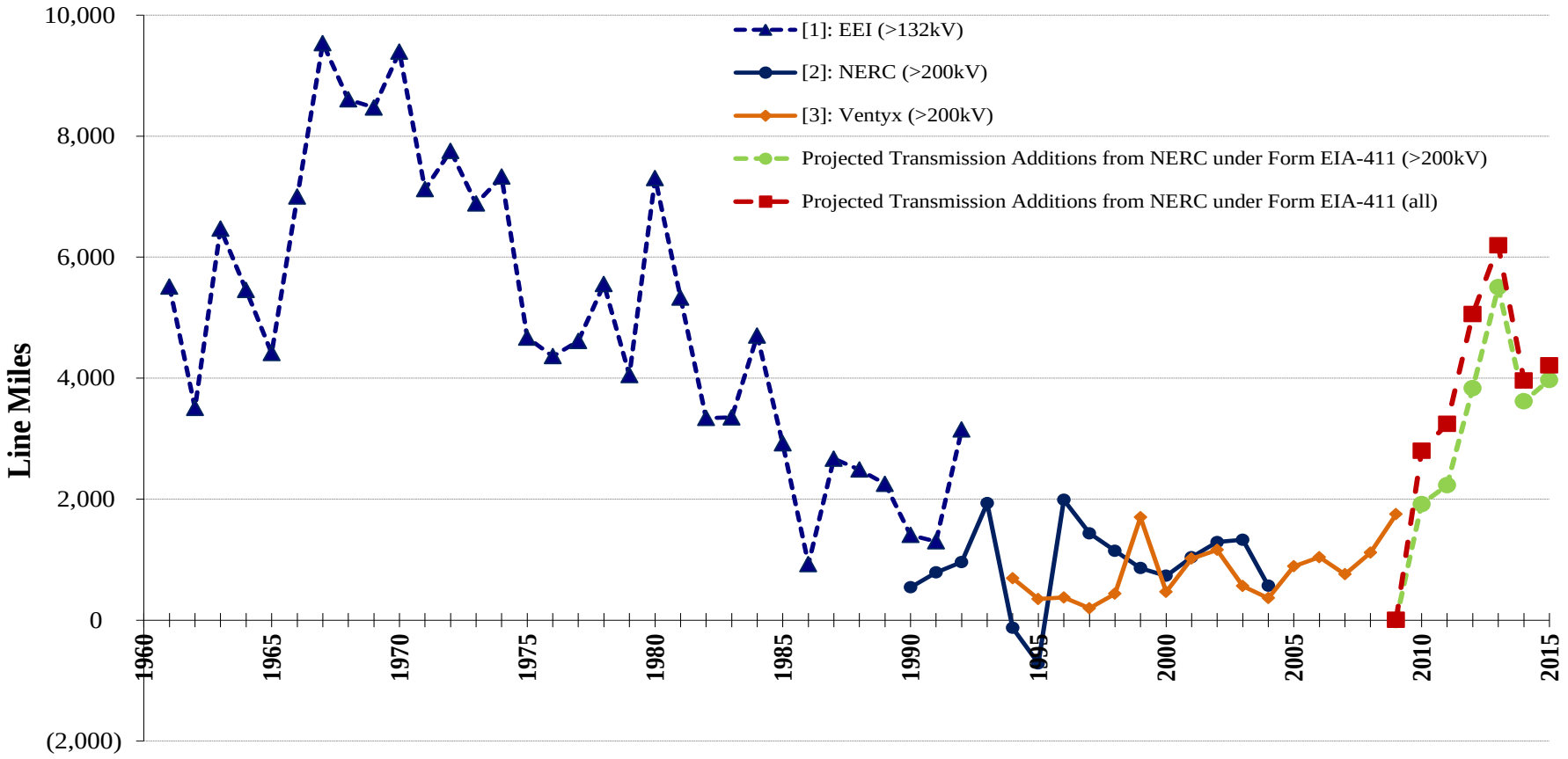
Review of Historical and Future Transmission Investments

FERC Order 1000 and Opportunities for New England

Additional Reading / About Brattle / Contact Info

Historical Transmission Addition – Line Miles

Significant recent and projected transmission additions are still well below additions made 40-50 years ago when much of the current grid was built

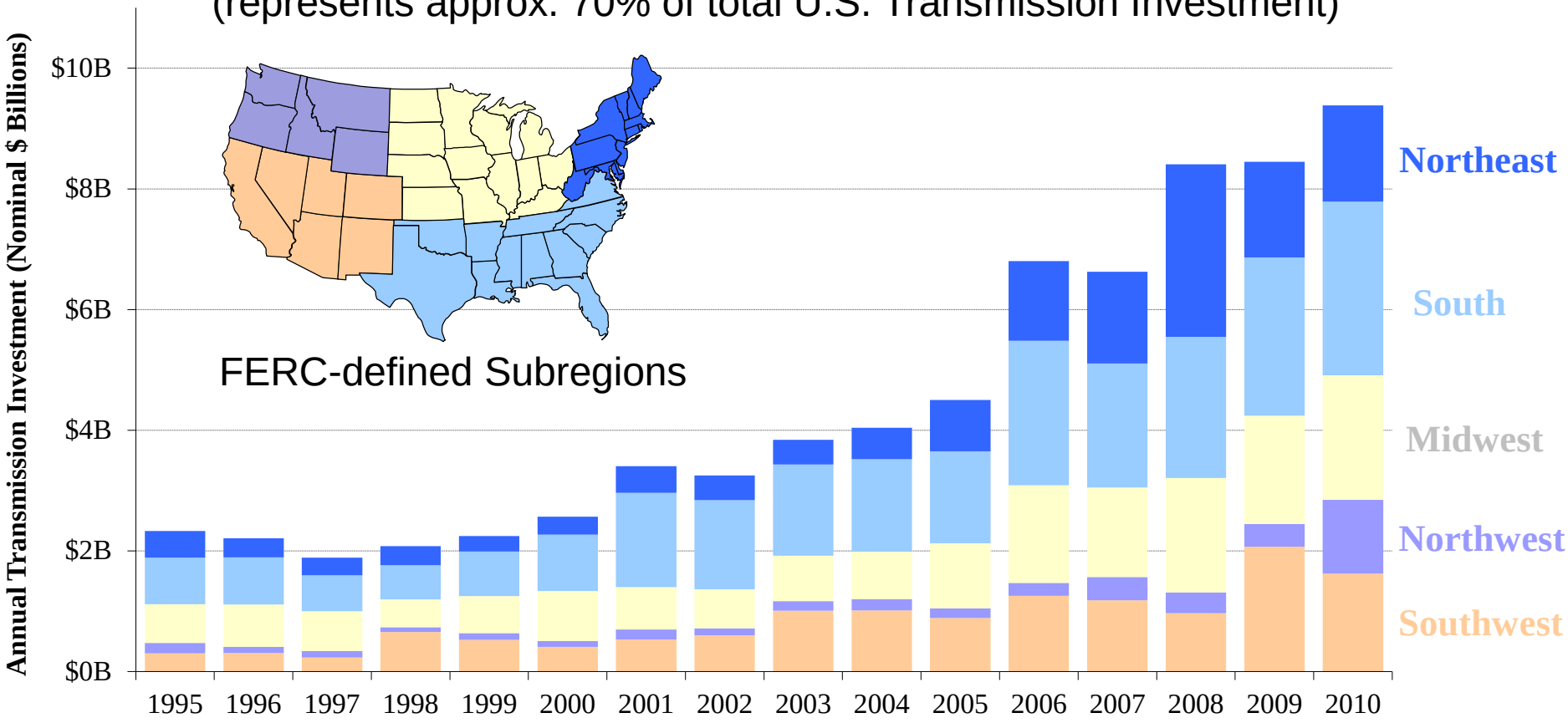


[1]: Circuit miles of overhead electric lines from EEI's Historical Statistical Yearbook. Data excludes REA cooperatives.
[2]: Courtesy of the North American Electric Reliability Corporation. NERC data is only available for lines 200kV and above. Note: transmission line additions are calculated as the difference in existing tranmission between the current and prior year (i.e. 2003 additions = 2003 miles - 2002 miles).
[3]: Ventyx Suite.

Historical Transmission Investment Dollars

1995-2010 Annual Transmission Investment of FERC-Jurisdictional Entities

(represents approx. 70% of total U.S. Transmission Investment)

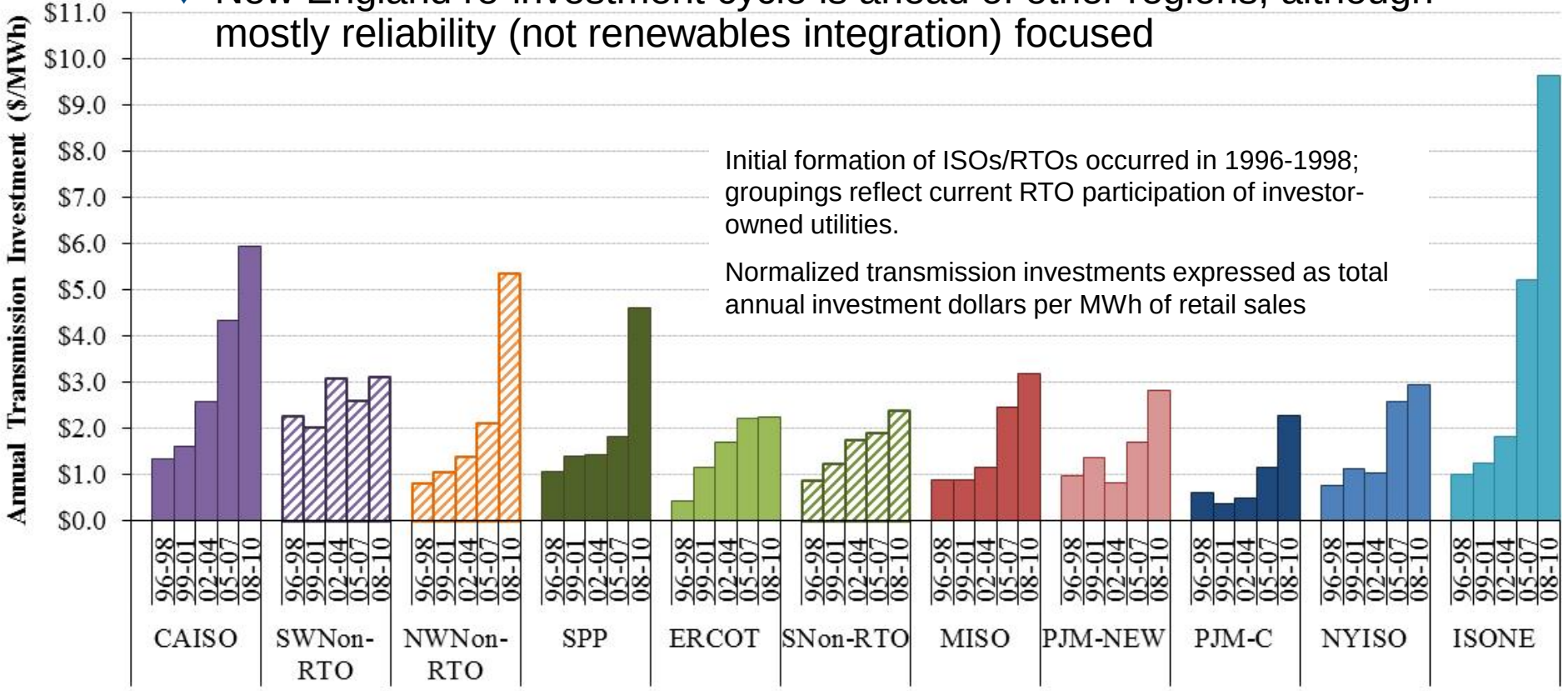


Source: *The Brattle Group* based on FERC Form 1 data compiled by Global Energy Decisions, Inc., The Velocity Suite for investor owned utilities.

Historical Transmission Investment, Load Normalized

1995-2010 Load-Normalized Annual Transmission Investments of FERC-Jurisdictional Entities in RTO and Non-RTO Regions

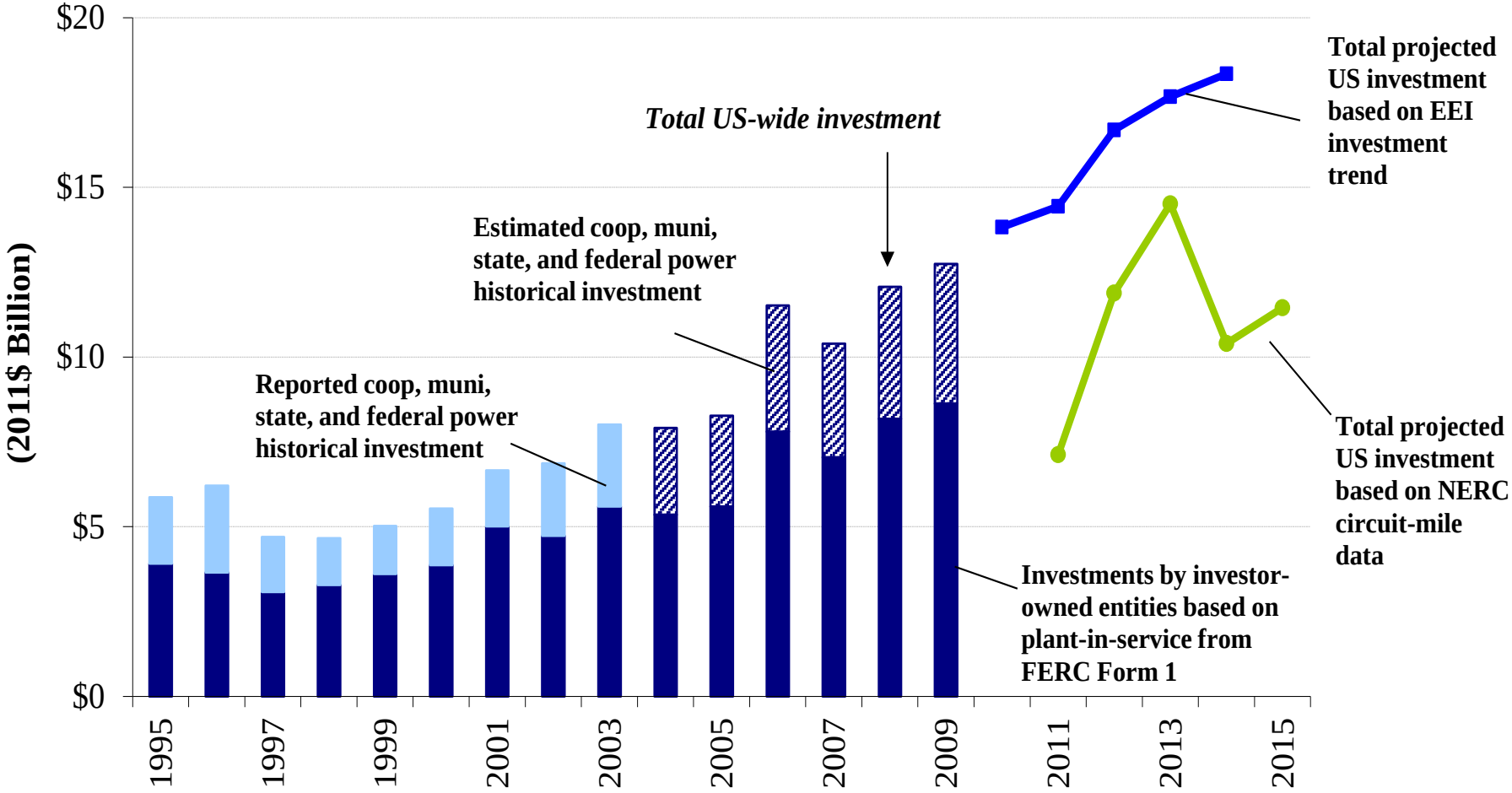
- New England re-investment cycle is ahead of other regions, although mostly reliability (not renewables integration) focused



Sources and Notes: © 2012 *The Brattle Group. The Brattle Group's* analysis of FERC Form 1 data compiled in Ventyx's Velocity Suite.

U.S. Transmission Investments through 2015

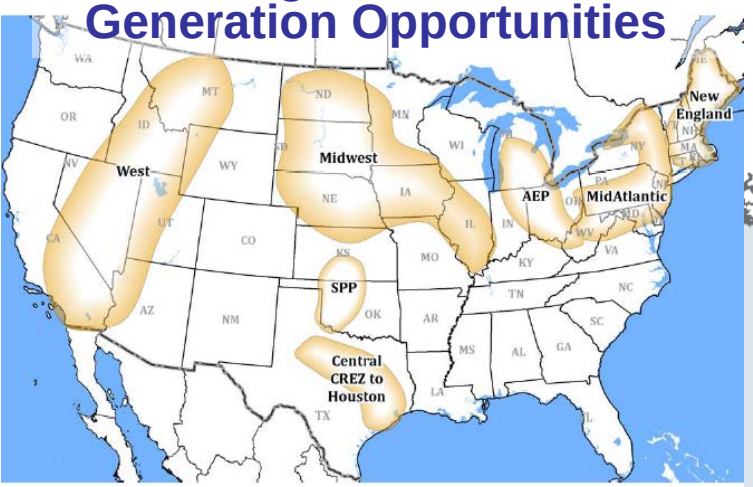
$60-80 billion in projected (2011$) investment for 2011-15



Sources and Notes: *The Brattle Group* © 2012. *The Brattle Group, Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada*, prepared by J. Pfeifenberger and D. Hou for WIRES, May 2011.

Renewables Drive Significant Investment Activity

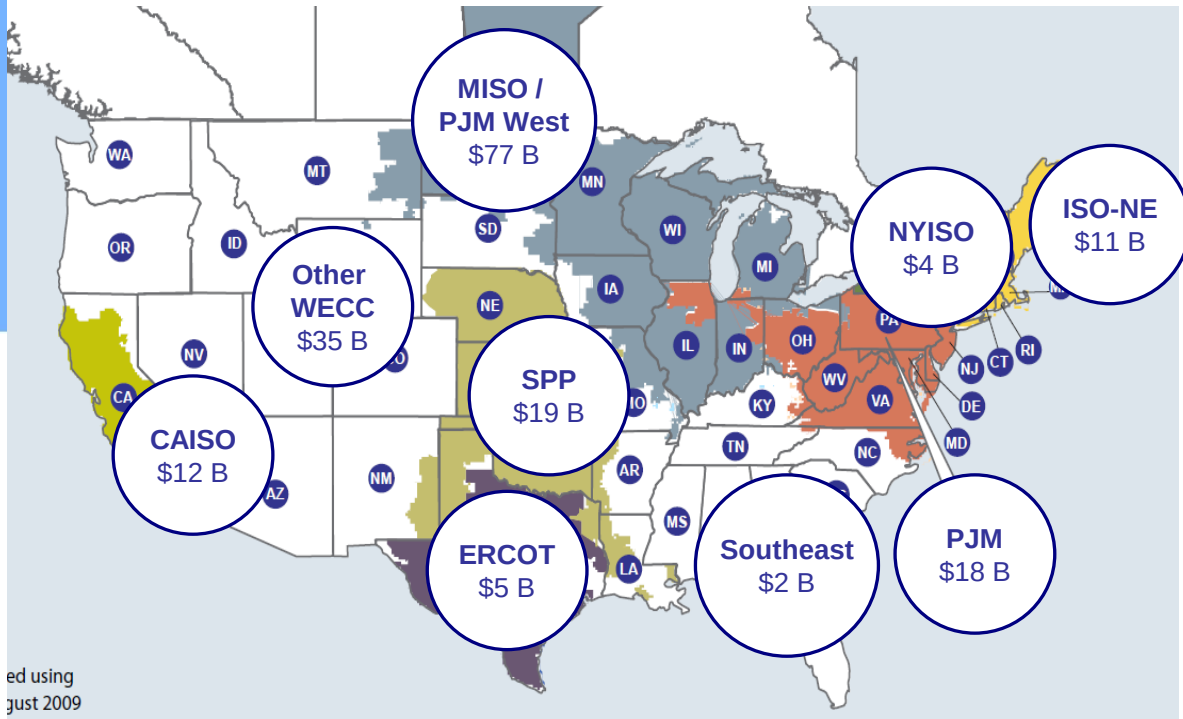
Main Regions with Wind Generation Opportunities



Approx.130 mostly conceptual and often overlapping projects (>$100 million each) for a total of over $180 billion

1/3 to 1/2 of these regional projects unlikely to be realized.

$180 Billion of Planned and Still Conceptual Transmission Projects as of 2010



A significant portion of these proposed and often highly conceptual projects (many not yet part of regional planning efforts by RTOs) are driven by large-scale renewables integration

U.S. Transmission Investment: 20-year Outlook

Brattle database for $180 billion of major projects

$30 billion … already in RTO-approved plans

$80 billion … additionally proposed (non-overlapping)

$50-100 billion in US-wide incremental transmission needed to integrate renewables:

- To satisfy existing state-level RPS requirements

  $40-70 billion

- For higher of existing state and 20% federal RPS

  $80-130 billion

$240-320 billion in investments through 2030 (in 2011$)

- Major reliability, economic, and renewables projects
- Local baseline investments, including lower voltages and facilities replacements

Review of Historical and Future Transmission Investments

FERC Order 1000 and Opportunities for New England

Additional Reading / About Brattle / Contact Info

FERC Order 1000

Jurisdictional transmission owners need to participate in regional and inter-regional planning efforts that produce:

- Regional transmission plans
- Regional cost allocations
- Interregional planning process (but no plans)
- Interregional cost allocation methods
- Specify non-incumbent process and eliminate federal ROFR

Important considerations:

- The rule applies only to “new” transmission facilities and allows different planning and cost allocation methods for different types of projects (e.g., reliability, market efficiency, public policy)
- Most ISOs/RTOs believe they are 90% compliant already, but “compliance” may not realize opportunities to fully address gaps in regional and interregional planning and cost allocation

Transmission Costs and Long-term Benefits

Transmission may seem expensive, but benefits can significantly impact the 50% wholesale portion of electricity bills, substantially reduce the cost of renewables, and stimulate the economy.

- Broad range of transmission benefits include:
  - Increased **reliability** and operational **flexibility**
  - Reduced **congestion**, **dispatch costs**, and **losses**
  - **Renewables integration** and environmental benefits
  - Lower **capacity** needs and generation costs
  - Increased **competition** and market liquidity
  - Insurance and **risk mitigation** benefits
  - Fuel **diversification** and **fuel market** benefits
  - Economic **stimulus and development**
- But quantification is difficult, benefits are wide-spread geographically, diverse in their impacts on market participants, and occur/change over decades. **This makes benefit-cost studies and cost allocation very challenging**

Some Thoughts About New England

New England has made great progress toward upgrading its transmission system. However, concerns remain about ability to integrate most cost-effective renewables:

- An additional **$4-7 billion** of transmission investments might be needed to integrate remaining RPS needs
  - Based on experience with renewable transmission overlays and direct interconnection costs elsewhere, large-scale integration of renewables requires between $400-700 of transmission per kW of wind generation
- High costs of New England reliability upgrades may cause backlash, making it difficult to fund additional transmission needed to integrate the most cost-effective renewables
- RPS requirements are reviewed in some states, driving more locally developed projects at potentially higher total costs. Low gas prices and the slow economy has created more challenges for renewables
- North-south differences on transmission cost allocation for renewables makes it more difficult to develop cost-effective solutions
- NESCOE's effort should increase collaboration to find most cost-effective transmission+renewables solution and agree on cost allocation

Some Thoughts About New England

Suboptimal regional transmission planning process:

- Separate evaluation processes for reliability, market efficiency, and public policy projects unlikely to find lowest-cost, integrated transmission solutions
- Still limited exploration of non-transmission alternatives (NTAs) in reliability planning process may result in over-spending on transmission solutions when lower-cost alternatives (including through FCM) may be available

NESCOE's planning framework for public policy requirements is promising. However:

- The proposed multi-step process for public policy and solution for multi-purpose projects may not mitigate planning inefficiencies
- Proposed case-by-case and state-by-state cost allocation for public policy projects is complex undertaking that may significantly delay implementation

Review of Historical and Future Transmission Investments

FERC Order 1000 and Opportunities for New England

Additional Reading / About Brattle / Contact Info

Additional Reading

Pfeifenberger, Hou, *Transmission's True Value: Adding up the Benefits of Infrastructure Investments*, Public Utilities Fortnightly, February 2012.

Pfeifenberger, Hou, *U.S. Transmission Needs and Planning Challenges*, EEI's 2011 Transmission and Wholesale Markets School , August 4, 2011

Pfeifenberger, Hou, *Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada*, on behalf of WIRES, May 2011.

Pfeifenberger, *Easier Said Than Done: The Continuing Saga of Transmission Cost Allocation*, Harvard Electricity Policy Group meeting, Los Angeles, February 24, 2011.

Pfeifenberger, Newell, *Direct testimony on behalf of The AWC Companies re: the Public Policy, Reliability, Congestion Relief, and Economic Benefits of the Atlantic Wind Connection Project*, filed December 20, 2010 in FERC Docket No. EL11-13.

Pfeifenberger, "Transmission Investments and Cost Allocation: What are the Options?" ELCON Fall Workshop, October 26, 2010.

Pfeifenberger, "Transmission Planning: Economic vs. Reliability Projects," EUCI Conference, Chicago, October 13, 2010.

Fox-Penner, Pfeifenberger, Hou, *"For Grid Expansion, Think 'Subregionally'," The Energy Daily*, June 8, 2010.

Fox-Penner, *"Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*," Island Press, 2010.

Pfeifenberger, Chang, Hou, Madjarov, *"Job and Economic Benefits of Transmission and Wind Generation Investments in the SPP Region," The Brattle Group, Inc.*, March 2010.

"Comments of Peter Fox-Penner, Johannes Pfeifenberger, and Delphine Hou," in response to FERC's Notice of Request for Comments on Transmission Planning and Cost Allocation (Docket AD09-8).

Pfeifenberger, Fox-Penner, Hou, *"Transmission Investment Needs and Cost Allocation: New Challenges and Models,"* The Brattle Group, Inc., presented to FERC Staff, Washington, DC, December 1, 2009.

Fox-Penner, Pfeifenberger, *"The Anchor-Tenant Model – And Some of the Chickens and Eggs,"* The Electricity Journal Guest Editorial, Volume 22, Issue 6, July 2009.

Pfeifenberger, *"Assessing the Benefits of Transmission Investments,"* presented at the Working Group for Investment in Reliable and Economic Electric Systems (WIRES) meeting, Washington, DC, February 14, 2008.

Pfeifenberger, Direct Testimony on behalf of American Transmission Company re: Transmission Cost-Benefit Analysis Before the Public Service Commission of Wisconsin, Docket 137-CE-149, January 17, 2008.

Pfeifenberger, Testimony on behalf of Southern California Edison Company re: economic impacts of the proposed Devers-Palo Verde No. 2 transmission line, before the Arizona Power Plant and Transmission Line Siting Committee, Docket No. L-00000A-06-0295-00130, Case No. 130, September and October, 2006.

About *The Brattle Group*

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies around the world.

We combine in-depth industry experience, rigorous analyses, and principled techniques to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

- Climate Change Policy and Planning
- Cost of Capital
- Demand Forecasting and Weather Normalization
- Demand Response and Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation
- Energy Contract Litigation
- Environmental Compliance
- Fuel and Power Procurement
- Incentive Regulation
- Rate Design, Cost Allocation, and Rate Structure
- Regulatory Strategy and Litigation Support
- Renewables
- Resource Planning
- Retail Access and Restructuring
- Risk Management
- Market-Based Rates
- Market Design and Competitive Analysis
- Mergers and Acquisitions
- Transmission

Johannes Pfeifenberger (hannes.pfeifenberger@brattle.com)
44 Brattle Street, Cambridge, MA 02138
617-864-7900 (www.brattle.com)