

Transmission: A Valuable Investment for New England's Energy Future

PRESENTED TO

New England Energy Policy Discussion

Boston, MA

PRESENTED BY

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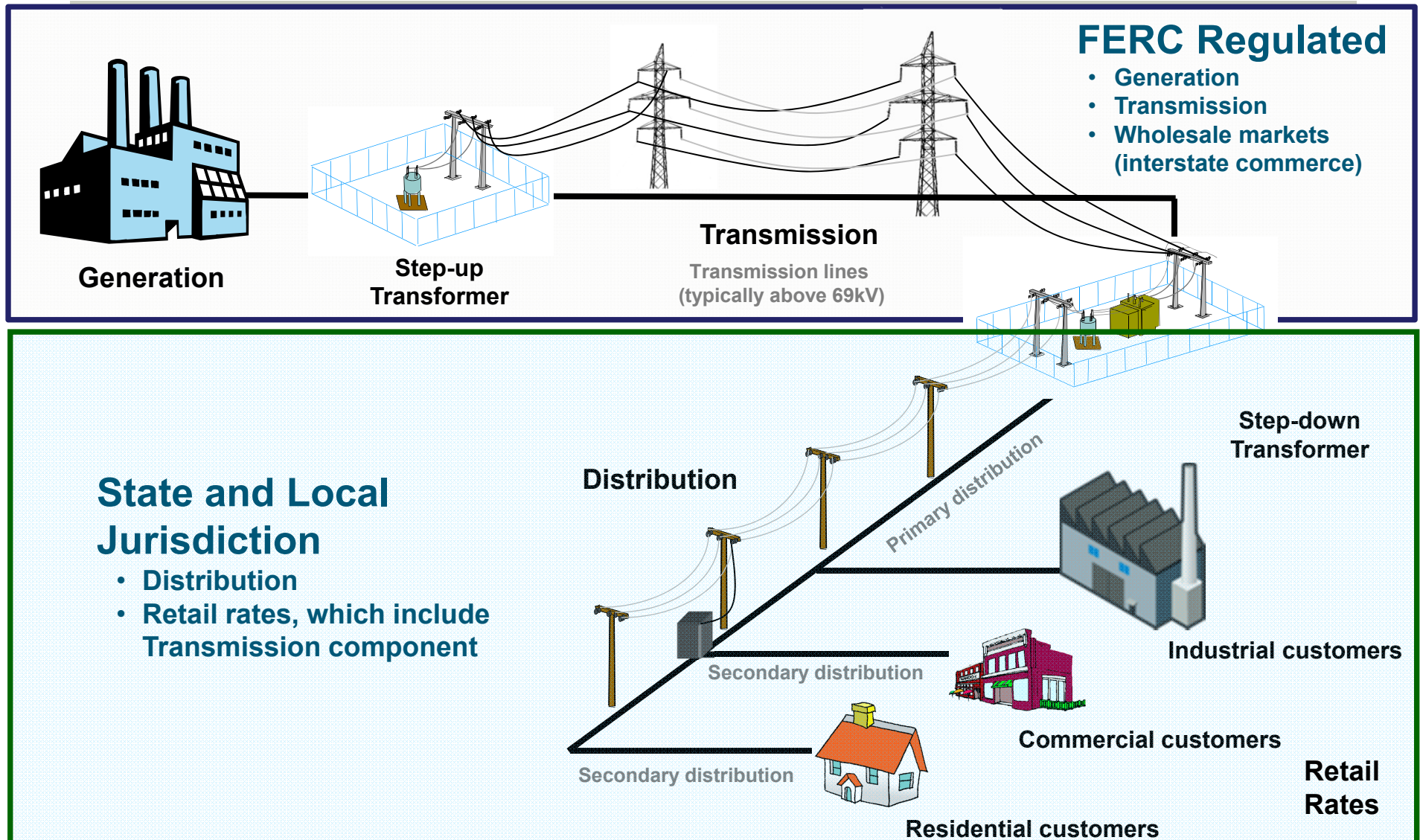
July 23, 2015

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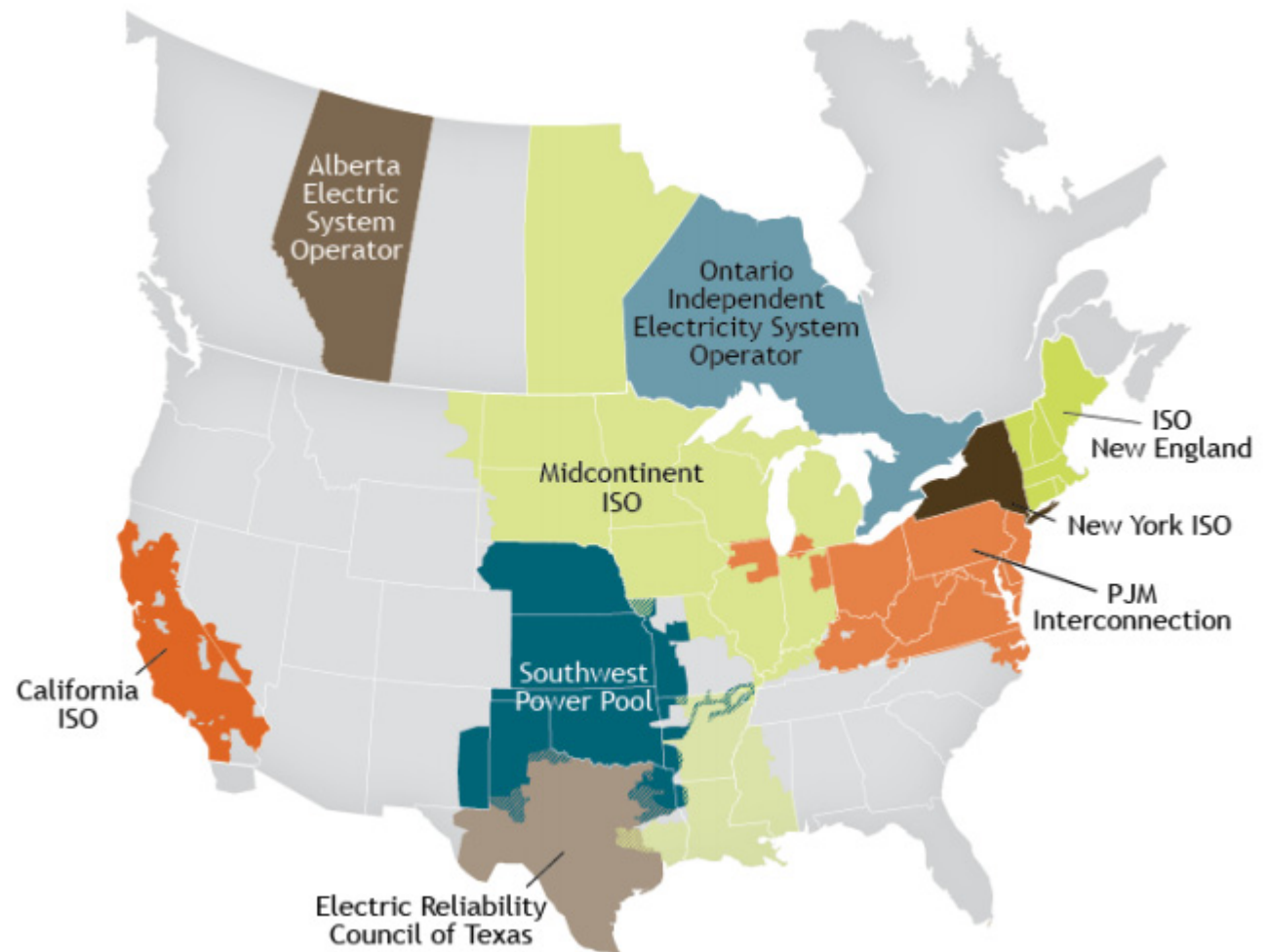
1. Background
2. Historical Transmission Investment and Projected Needs
3. Key Barriers to Planning a More Robust Transmission Grid
4. Benefits of a Flexible and Robust Transmission Grid
5. The High Costs and Risks of Inadequate Transmission Infrastructure
6. The Need for More Effective Interregional Transmission Planning
7. Recommendations for Policy Makers

Regulatory Jurisdictions for Generation, Transmission and Distribution



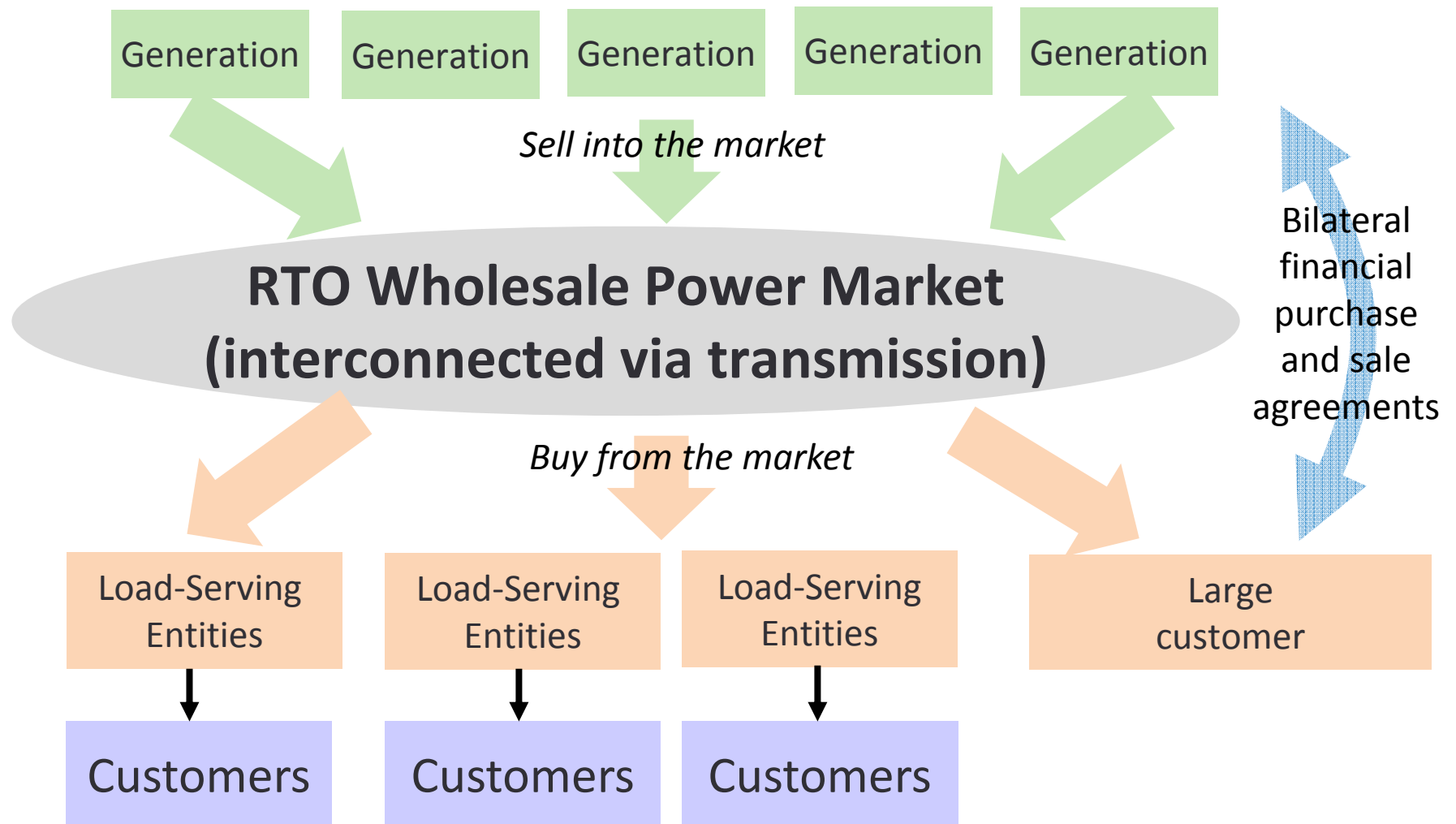
Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs)

- The sizes and shapes of the RTO/ISOs have evolved over time
- ISO-New England, PJM, MidContinent ISO and SPP are multi-state RTOs
- California, Texas, and New York are single state ISOs
- Alberta and Ontario are 2 Canadian provincial ISOs



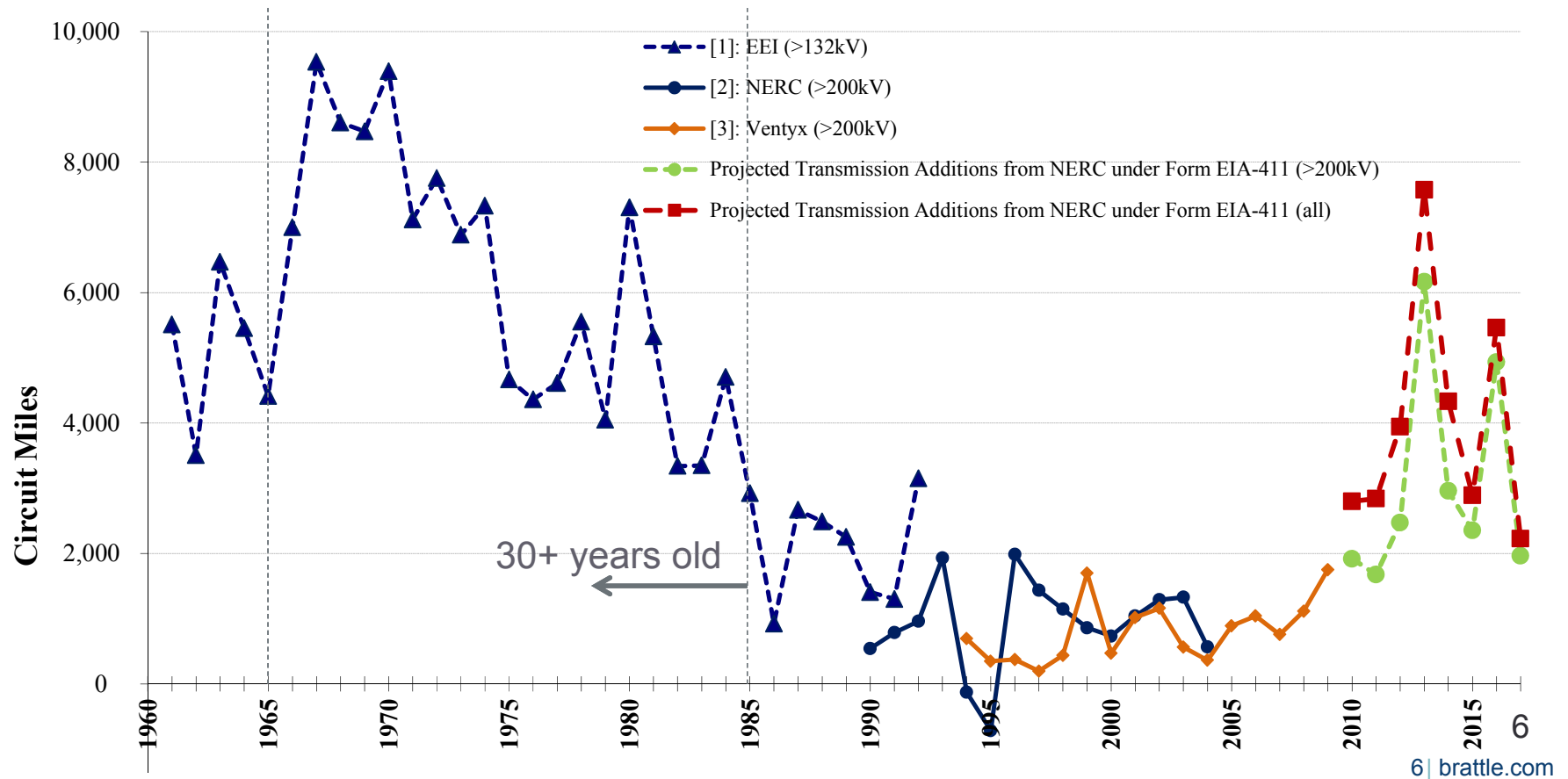
* According to ISO/RTO Council, RTO/ISOs serve about 2/3rd of U.S. electricity consumers and more than half in Canada.

Role of the Wholesale Market



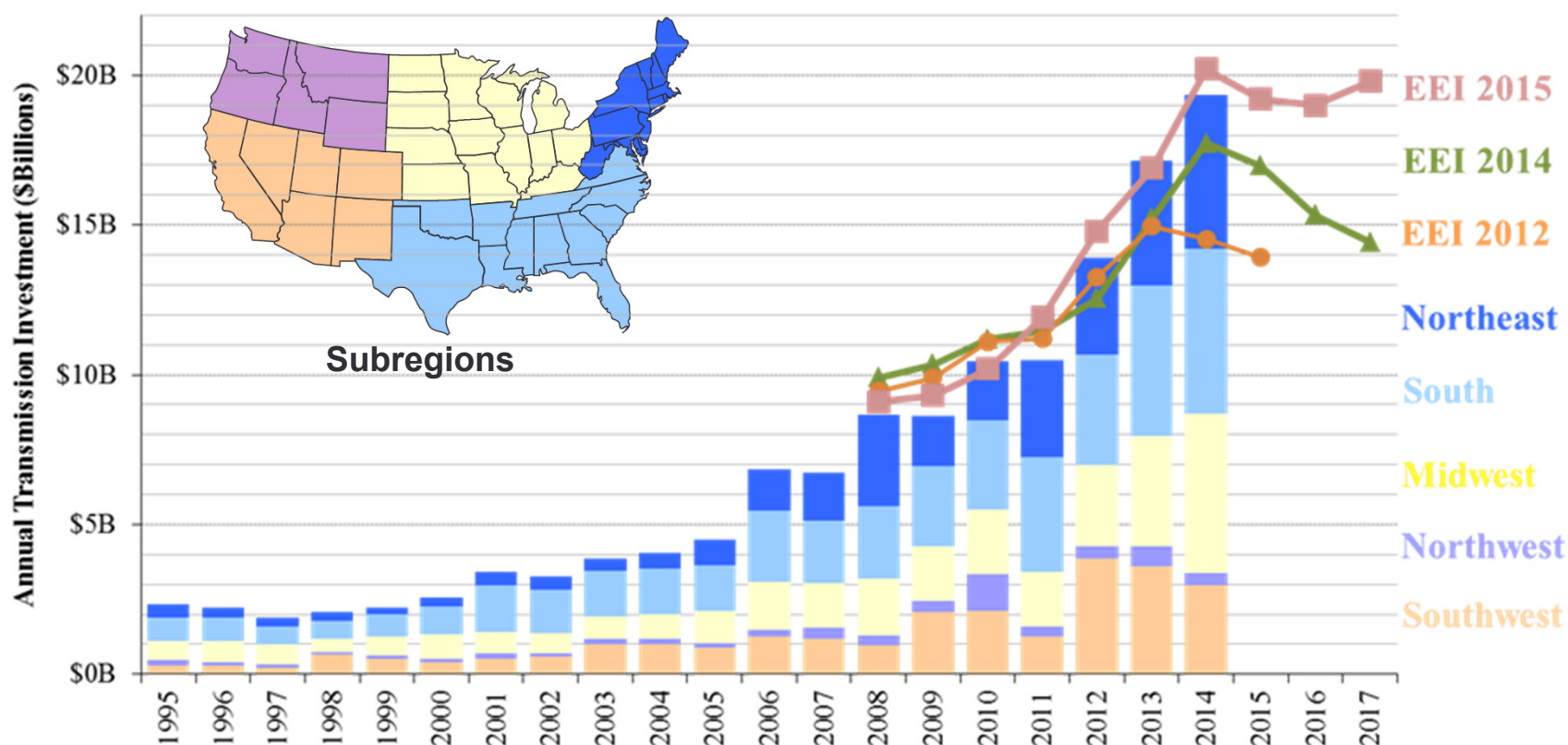
Historical Circuit-Mile Additions Demonstrates Aging Infrastructure

- 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



Historical and Projected Transmission Investments

1995-2017 Annual Transmission Investment of Investor-Owned Utilities by FERC Subregion

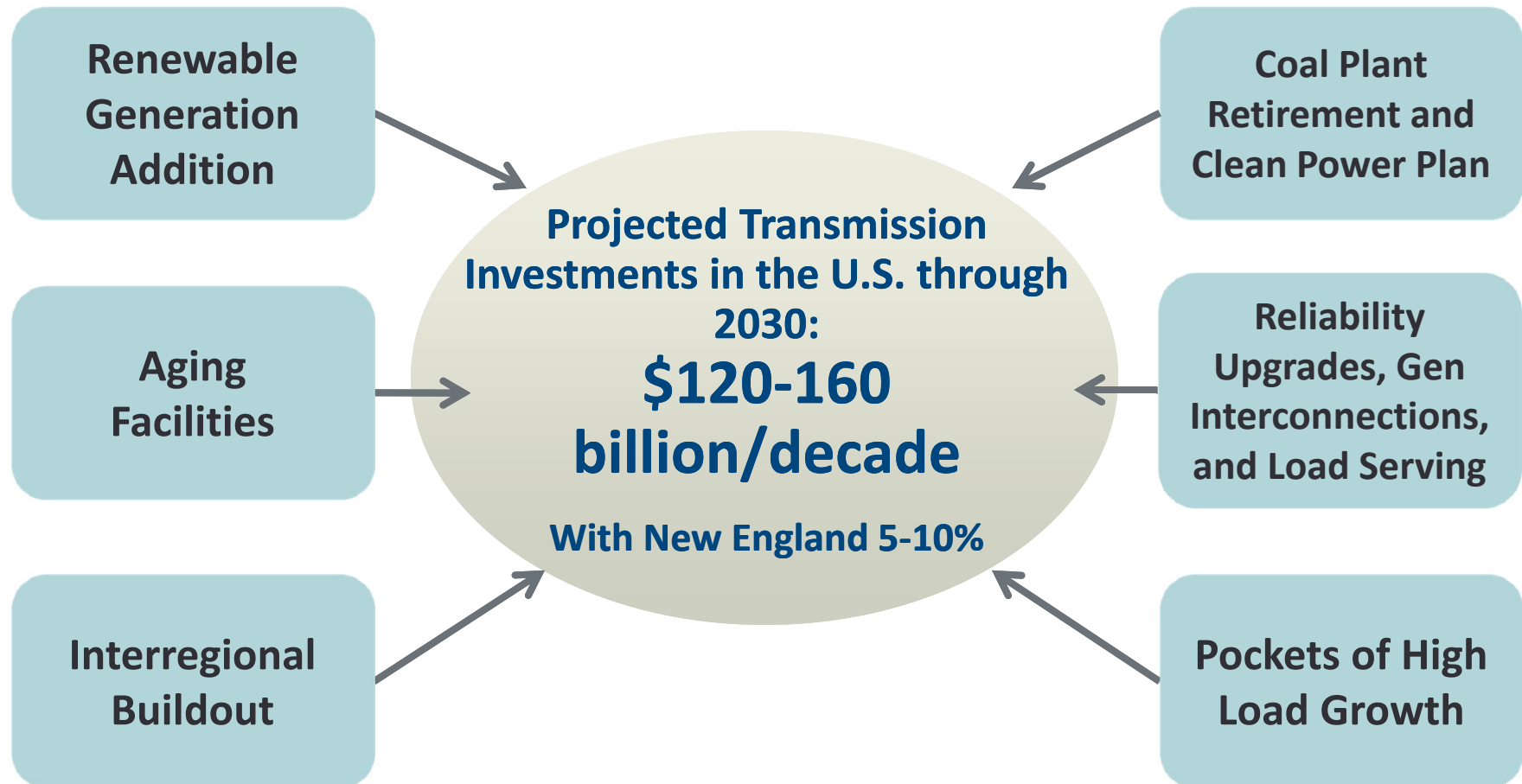


Sources and Notes: The Brattle Group's analysis of FERC Form 1 data compiled in Ventyx's Velocity Suite.

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 June 2015 shown (2008-2017) based on prior year's actual investment through 2013 and planned investment thereafter.

Drivers of Transmission Needs Development

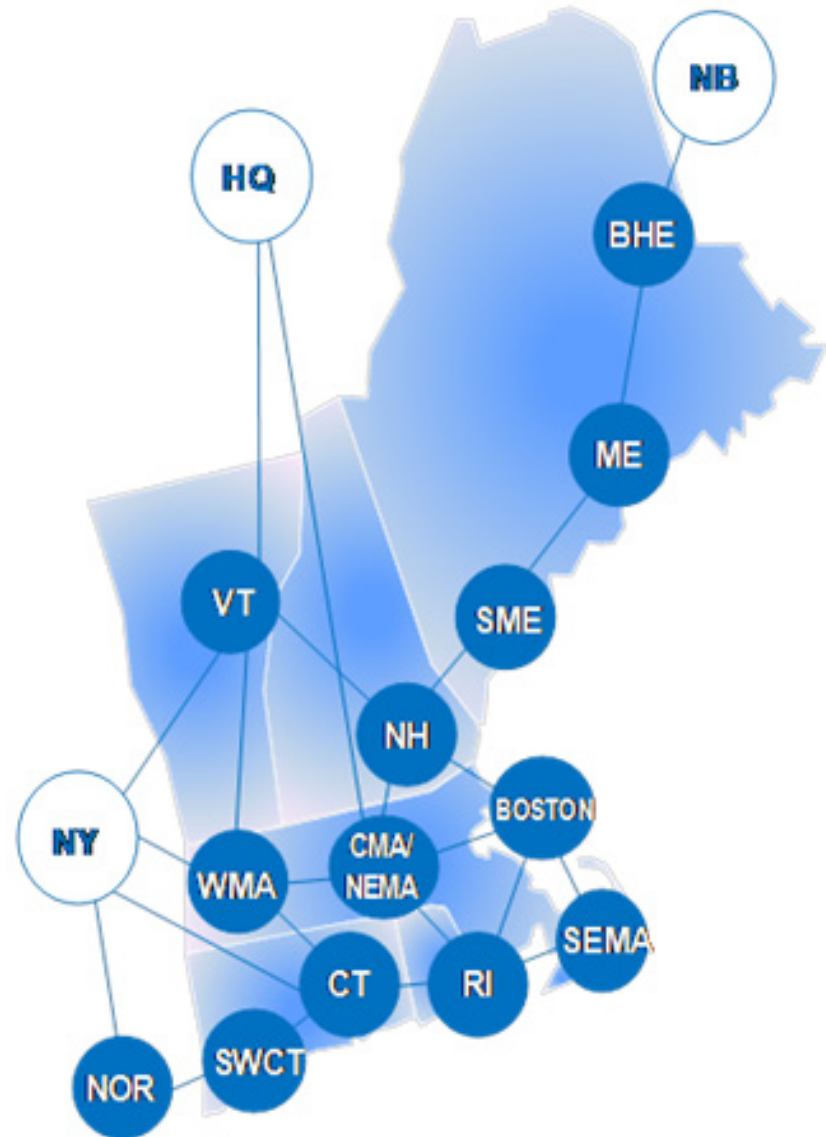


Sources and Notes:

The \$120-160 billion projection per decade was originally developed in conjunction with WIRES for "Employment and Economic Benefits of Transmission Investment in the US and Canada," May 2011. This projection has since been refined and regionalized in several client-confidential analyses.

ISO-New England as Transmission Planner

- ISO-New England coordinates future transmission plans for the region.
 - Coordinates planning across multiple transmission owners and market subareas.
- ISO-New England helps analyze the merits of proposed transmission projects and determine the best projects to pursue, considering:
 - Regional reliability needs
 - Congestion relief
 - Delivered power costs
 - Public policy objectives
- ISO-New England recommends or decides on future transmission expansions based on input from transmission owners.



Addressing Major Energy Policy Questions in New England

- How does the region **decarbonize**?
 - Aggressive targets for the next 2 decades – actions need to begin now.
- How does New England meet the **existing Renewable Portfolio Standards**?
- Do we need to agree on the “**optimal**” **mix** of supply and demand-side resources? If so, how?
- How do we **work together to plan the region’s infrastructure**?

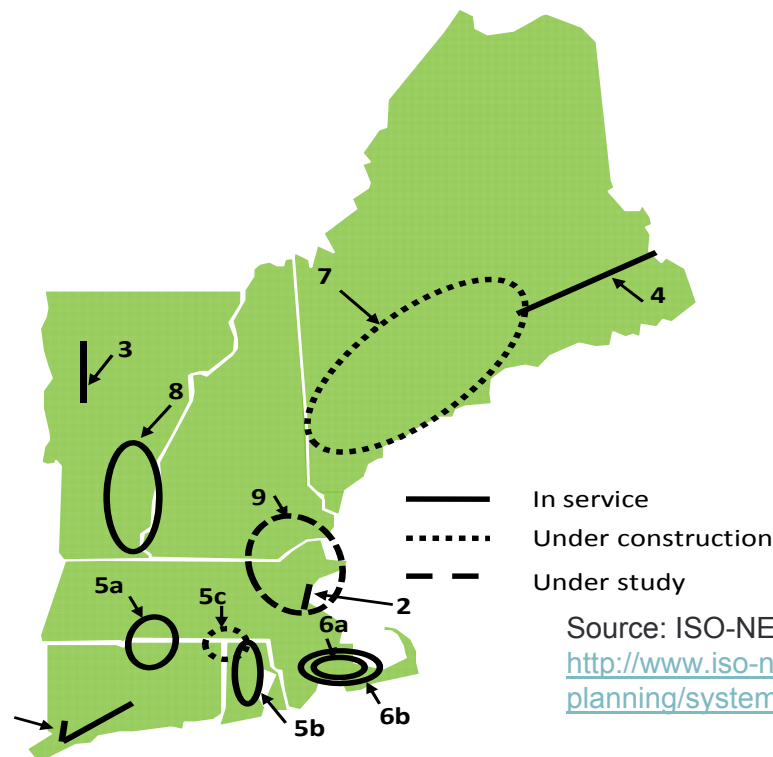
Transmission Provides Answers to a Significant Portion of the Questions

- To reliably gather and deliver new clean energy resources, transmission will be needed in New England.
- Transmission provides significant additional value to New England:
 - Opens and expands future supply and demand-side choices.
 - Mitigates the impact of extreme weather events.
 - Reduces cost of generation.
 - Reduces cost of integrating renewable energy.
 - Reliability and sustainability.

ISO-NE Major Recent Transmission Projects

- These transmission projects are what we need to deliver power reliably. These are “reliability projects” and not optimized to simultaneously address public policy objectives.
- The cost of reliability projects are shared by all customers in all states.

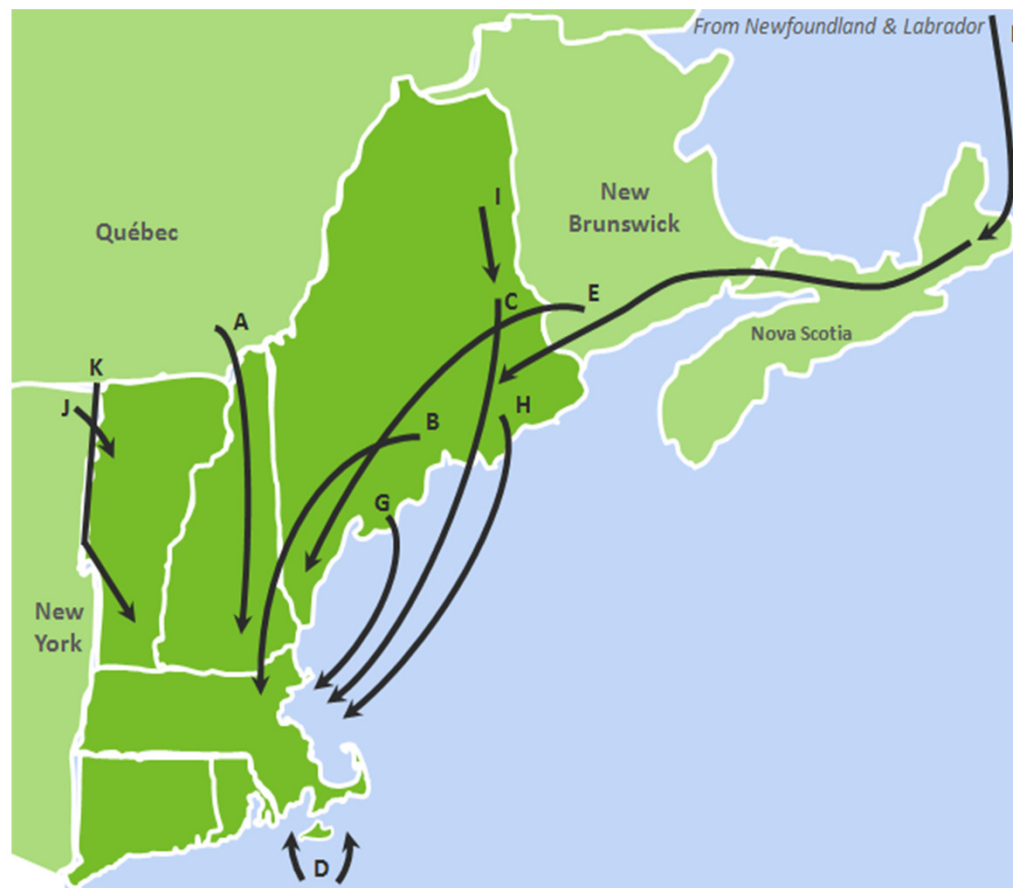
1. Southwest CT Reliability Project, Phases 1 & 2
2. Boston 345 kV Transmission Reliability Project, Phases 1 & 2
3. Northwest Vermont Reliability Project
4. Northeast Reliability Interconnection Project
5. New England East-West Solution
 - a. Greater Springfield components
 - b. Rhode Island components
 - c. Interstate Reliability Project
6. Southeast Massachusetts
 - a. Short-term Lower SEMA upgrades
 - b. Long-term Lower SEMA Project
7. Maine Power Reliability Program
8. Vermont Southern Loop
9. Greater Boston upgrades



Source: ISO-NE
<http://www.iso-ne.com/system-planning/system-plans-studies/rsp>

Transmission to Address Public Policy Needs

Current ISO-New England transmission planning processes are ineffective to comprehensively evaluate projects designed to fulfill public policy objectives of the region or design multi-value projects that offer lower overall costs.



Representative Projects and Concept Proposals

- A Northern Pass**—Hydro-Québec/ Northeast Utilities
- B Northeast Energy Link**— Emera Maine/National Grid
- C Green Line**— New England ITC
- D Bay State Offshore Wind Transmission System**— Anbaric Transmission
- E Northeast Energy Corridor**— Maine/New Brunswick/Irving
- F Muskrat Falls/Lower Churchill**— Nalcor Energy
- G Maine Yankee**— Greater Boston
- H Maine**— Greater Boston
- I Northern Maine**— New England
- J Plattsburgh, NY**— New Haven, VT
- K New England Clean Power Link**— TDI New

Source: ISO-NE

<http://www.iso-ne.com/system-planning/system-plans-studies/rsp>

Key Barriers to More Effective Grid Planning

There are 3 key barriers to identifying and developing the most valuable transmission infrastructure investments:

- 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
- 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
- **Interregional planning processes are ineffective** and are generally unable to identify valuable transmission investments that would benefit two or more regions.

These barriers exist across the country, including New England.

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

The Need for More Effective Grid Planning

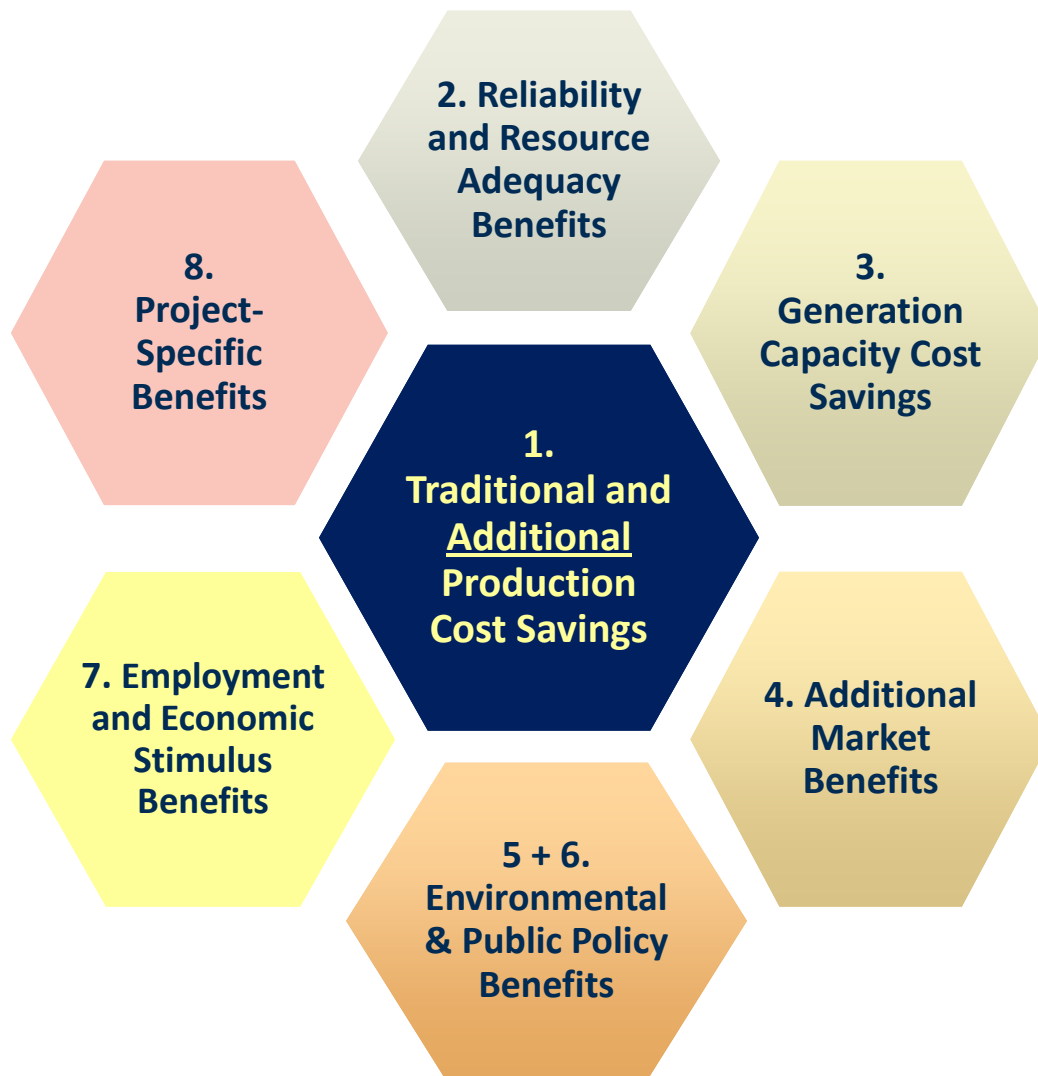
If not addressed, barriers to effective regional and interregional transmission planning (faced nation-wide) will lead to:

- **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.



Higher overall cost of delivered electricity and public policy goals from underinvestment in transmission infrastructure

The Full Range of Transmission-Related Benefits

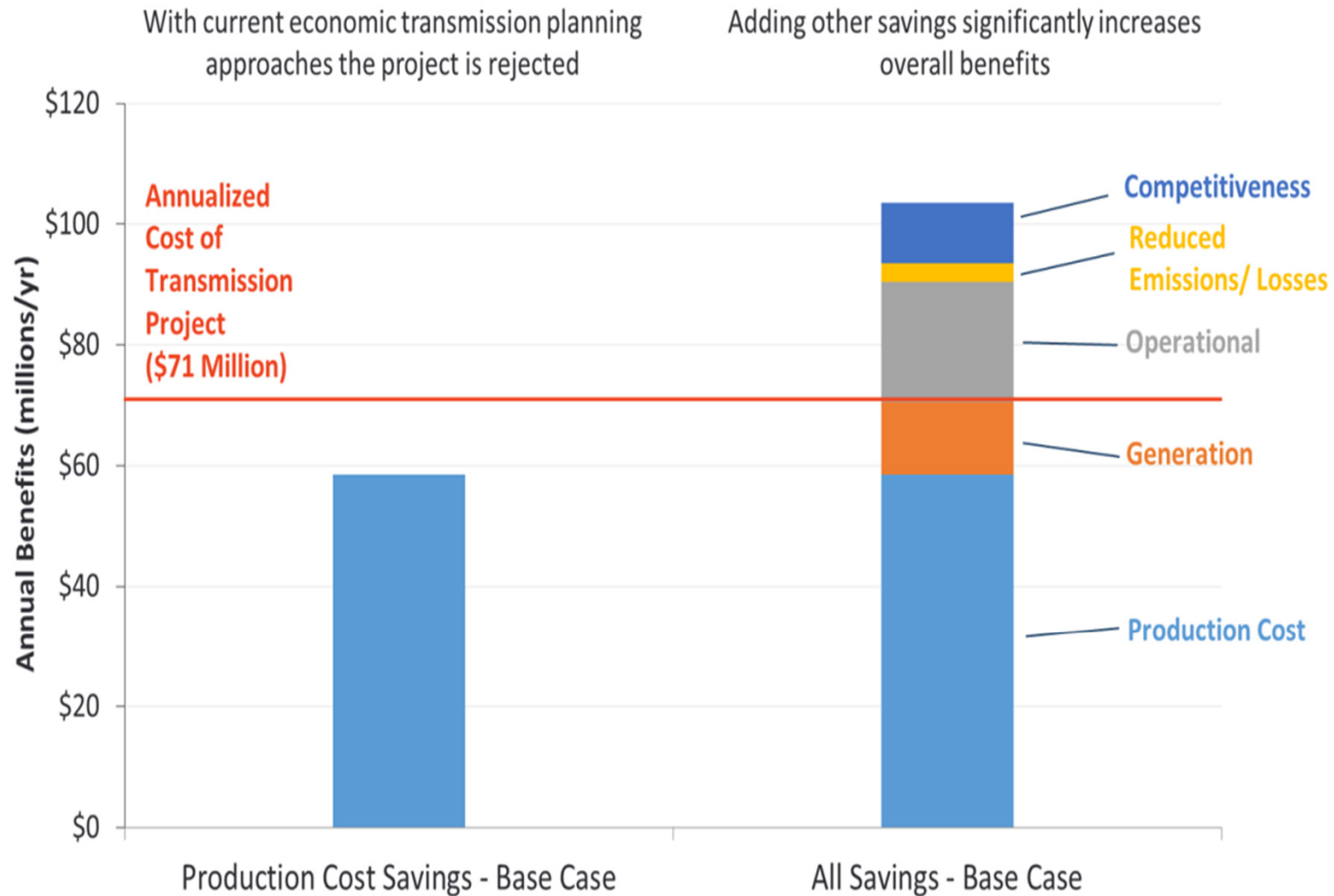


- Transmission accounts for 10% of customer bills but greatly affects at least half of the other 90%
- Omitting many transmission-related benefits (or assuming they are zero) ignores the costs and risk imposed on customers through a higher overall cost of power

“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 future transmission needs, wheeling revenues, HVDC operational benefits

Illustrative Example: 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 only “normal” system conditions.
 - Planning process typically 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

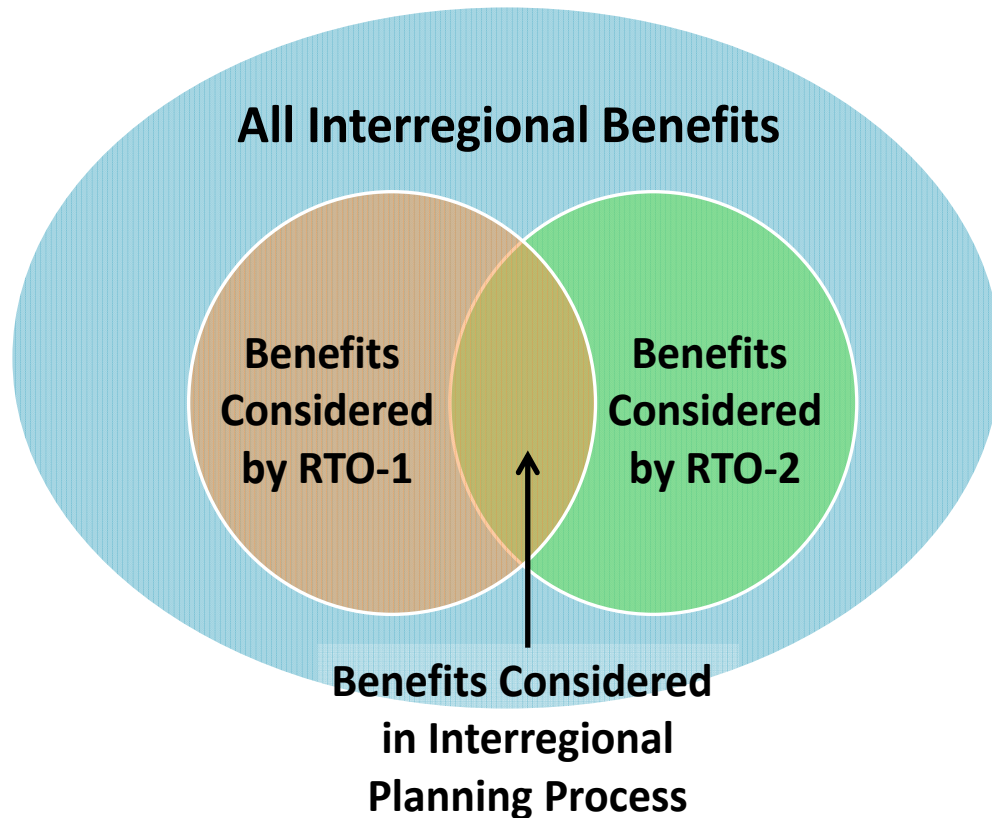
- Given that it can take a decade to develop new transmission, delaying investment can easily **limit future options** and result in a **higher-cost, higher-risk** overall outcomes.
 - “Wait and see” approaches limit options, so can be very costly in the long term.
 - The industry needs to plan for short- and long-term uncertainties more proactively – and develop "anticipatory planning" processes.
- “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.

Planning Across Seams

- **Divergent criteria create barriers** for transmission between RTOs.
 - For example, cross border tariffs should not narrowly defined economic drivers in neighboring systems.
 - New England needs to work closely with New York and Canadian provinces to identify the most valuable infrastructure, considering the benefits to all neighboring systems.
- **Planner need to consider the combined benefits** to find transmission projects that benefit across regions.
- **Planners need to avoid this “least common denominator” outcome** by evaluating interregional projects based on benefits.

Ineffective Inter-Regional Transmission Planning

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



- 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 “Compartmentalized” Planning

Experience from around the country shows that most planners compartmentalize needs into “reliability,” “market efficiency,” “public policy,” and “multi-value” projects – which in turn fails to identify valuable projects.

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

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

Project Type in RTO-2

- Compartmentalizing creates additional barriers at the interregional level by limiting projects to be of the same type in neighboring regions (see Mid-Atlantic/Midwest example).
- It eliminates many projects from consideration simply because they don't fit into the existing planning “buckets.”

Recommendations for Policy Makers

Policy makers and 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 understand and estimate 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 developing projects that can provide multiple values at lower combined overall costs.
- Improve interregional planning processes to avoid least-common-denominator approaches and consider the multiple but different values that projects can provide to individual regions.

All of these steps are necessary for New England to meet the energy and environmental needs of the region.

Speaker Bio and Contact Information



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Note:

The views expressed in this presentation are strictly those of the presenter and do not necessarily state or reflect the views of *The Brattle Group, Inc.*

Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering and 18 years of experience in advising energy companies and project developers with regulatory and financial issues. Ms. Chang has submitted expert testimonies to the U.S. Federal Energy Regulatory Commission, U.S. state and Canadian provincial regulatory authorities on topics related to transmission access, power market designs and associated contract issues. She also has authored numerous reports and articles detailing the economic issues associated with system planning, including comparing the costs and benefits of transmission. In addition, she assists clients in comprehensive organizational strategic planning, asset valuation, finance, and regulatory policies.

Ms. Chang has presented at a variety of industry conferences and has advised international and multilateral agencies on the valuation of renewable energy investments. She holds a BSc. In Electrical Engineering from University of California, Davis, and Masters in Public Policy from Harvard Kennedy School, is a member of the Board of Directors of the Massachusetts Clean Energy Center, and the founding Executive Director of New England Women in Energy and the Environment.

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Johannes (Hannes) Pfeifenberger is an economist with a background in power engineering and over 20 years of experience in the areas of public utility economics and finance. He has published widely, assisted clients and stakeholder groups in the formulation of business and regulatory strategy, and submitted expert testimony to the U.S. Congress, courts, state and federal regulatory agencies, and in arbitration proceedings.

Hannes has extensive experience in the economic analyses of wholesale power markets and transmission systems. His recent experience includes reviews of RTO capacity market and resource adequacy designs, testimony in contract disputes, and the analysis of transmission benefits, cost allocation, and rate design. He has performed market assessments, market design reviews, asset valuations, and cost-benefit studies for investor-owned utilities, independent system operators, transmission companies, regulatory agencies, public power companies, and generators across North America.

Hannes received an M.A. in Economics and Finance from Brandeis University and an M.S. in Power Engineering and Energy Economics from the University of Technology in Vienna, Austria.

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.

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Our services to the electric power industry include:

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- Transmission

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Additional Reading

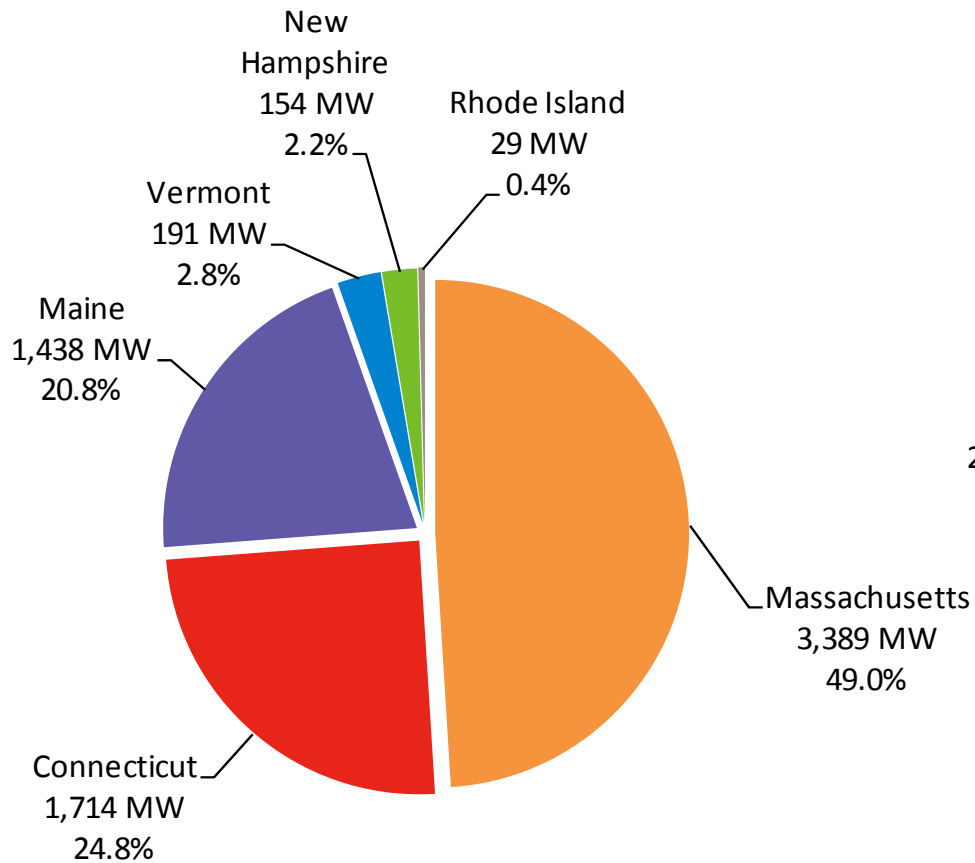
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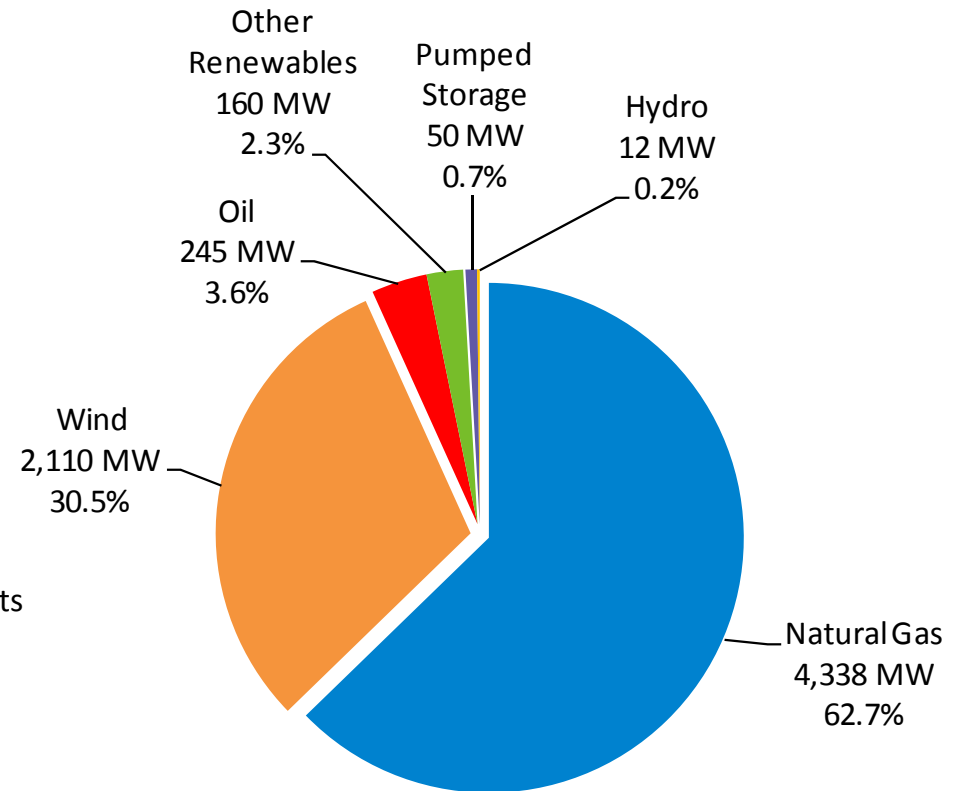
Appendix

Future Power Generation Plants in New England

Resources by State



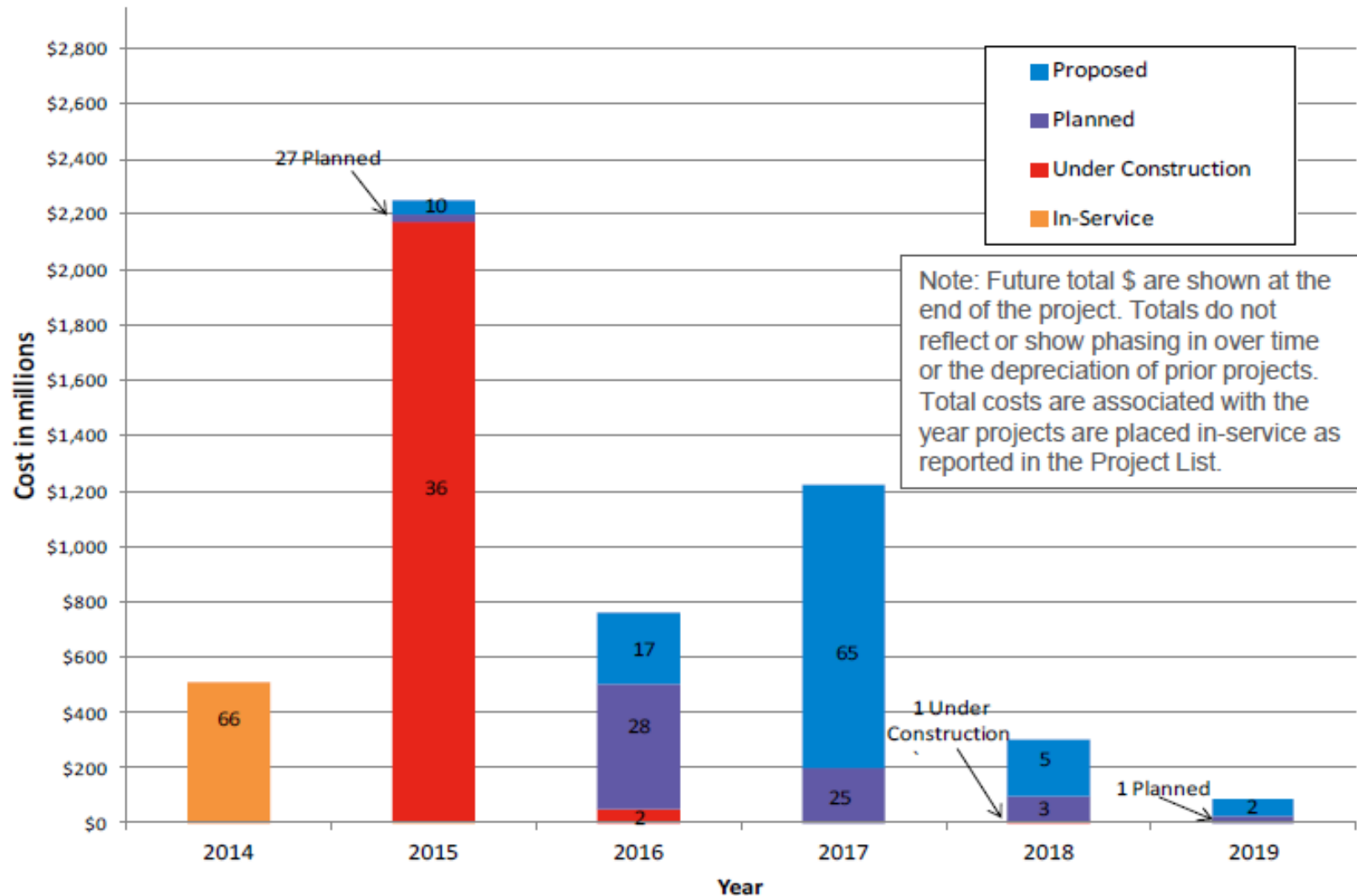
Resources by Type



Source: ISO-NE

<http://www.iso-ne.com/system-planning/system-plans-studies/rsp>

ISO-NE Transmission Reliability Projects 2014-19

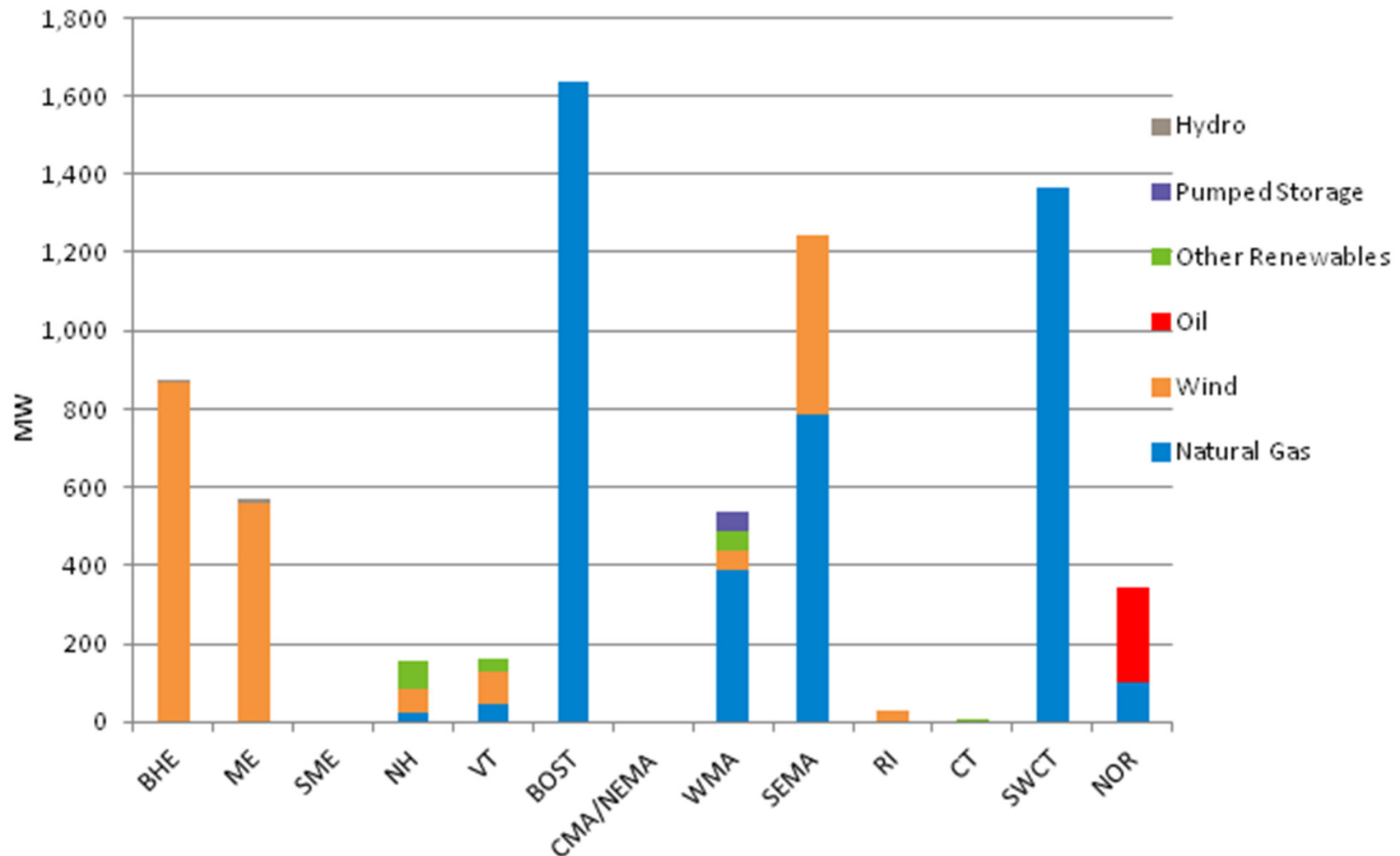


Source: ISO-NE

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Proposed New Generating Plants in ISO-NE



Source: ISO-NE (Transmission Interconnection Queue as of April 1 2014;
excludes projects not directly interconnecting with the transmission system)
<http://www.iso-ne.com/system-planning/system-plans-studies/rsp>