

# Investment Trends and Fundamentals in US Transmission and Electricity Infrastructure

PRESENTED TO:

**JP Morgan Investor Conference**

PRESENTED BY

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THE **Brattle** GROUP

# Introduction

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## **This presentation provides an overview of:**

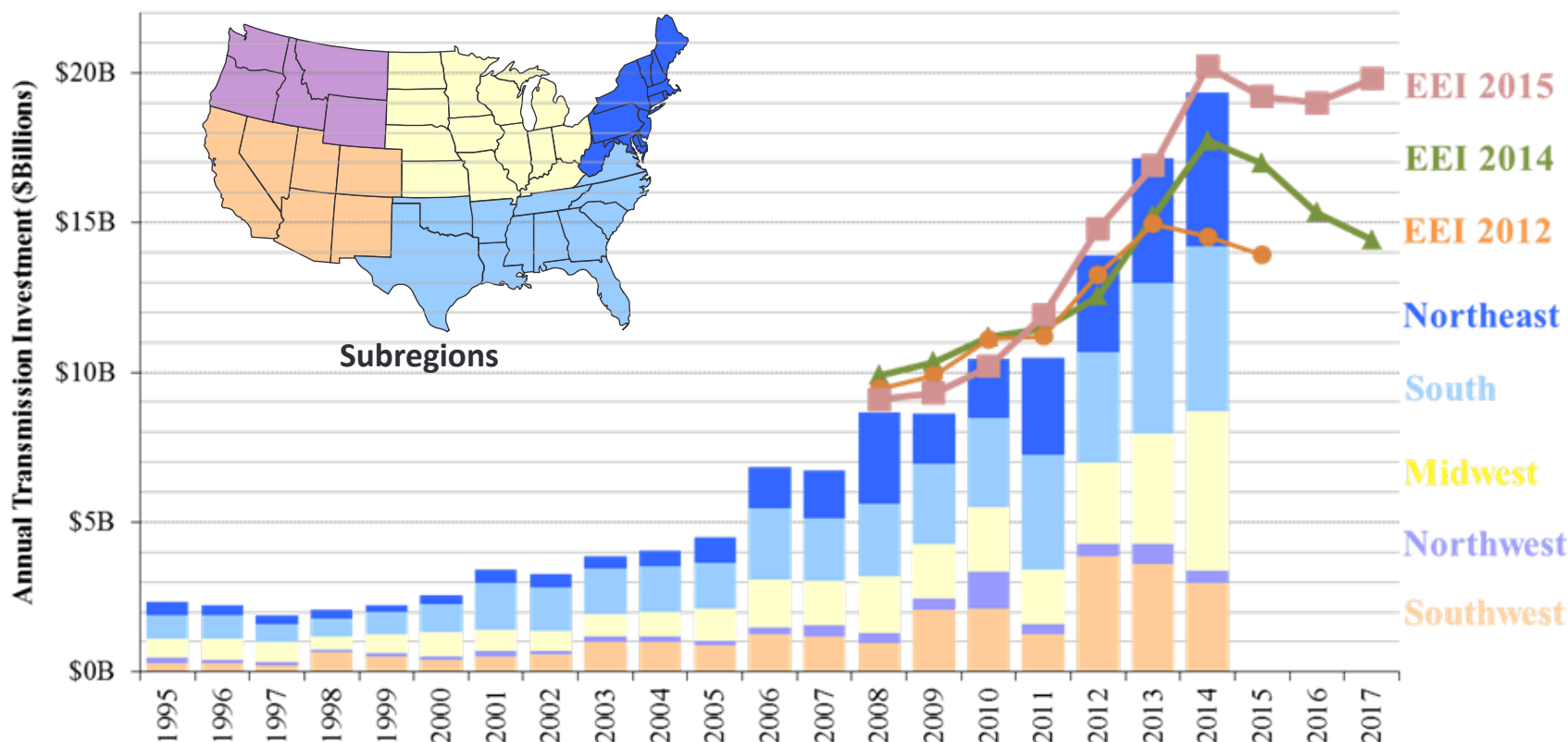
- Recent trends in U.S. transmission investments
- Transmission investment by type of equipment and compared to generation and distribution
- Impact of coal plant retirements, renewable generation development, and the need to replace aging transmission infrastructure
- Drivers of transmission needs and likely investments over next decades

## **Our analysis of a wide range of sources and drivers document the dynamics of transmission needs and investment opportunities:**

- \$120–160 billion of total projected U.S. transmission investment over next decade
- Significant regional differences in level, timing, and non-incumbent access of likely needs

# Historical and Projected Transmission Investments

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

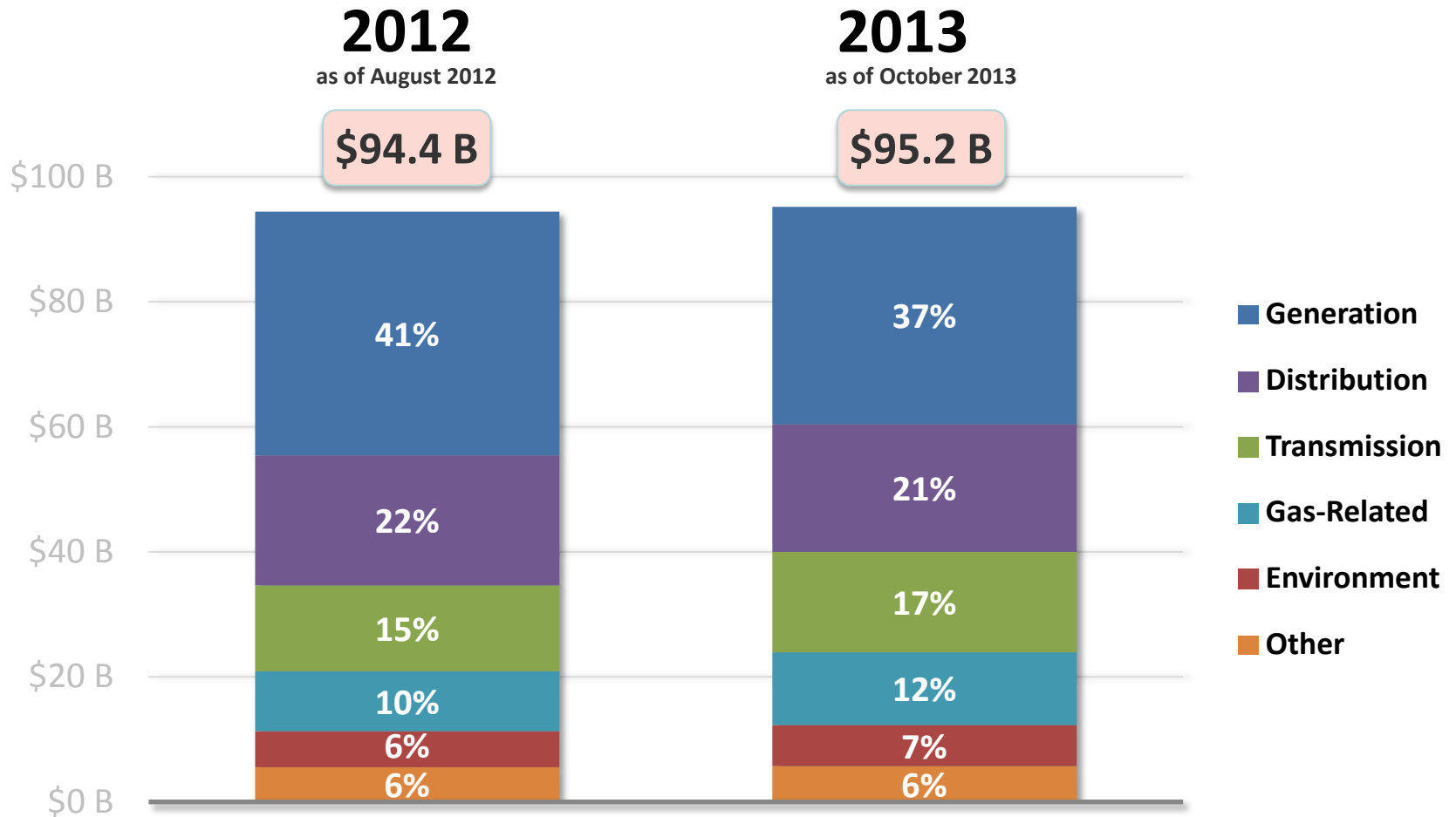


**Sources and Notes:** The Brattle Group's analysis of FERC Form 1 data compiled in Ventyx's Velocity Suite.

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.

# Transmission vs. Other Electric Utility Investments



Notes: Total company functional spending of U.S. Shareholder-Owned Electric Utilities (representing approx. 70% of US total)

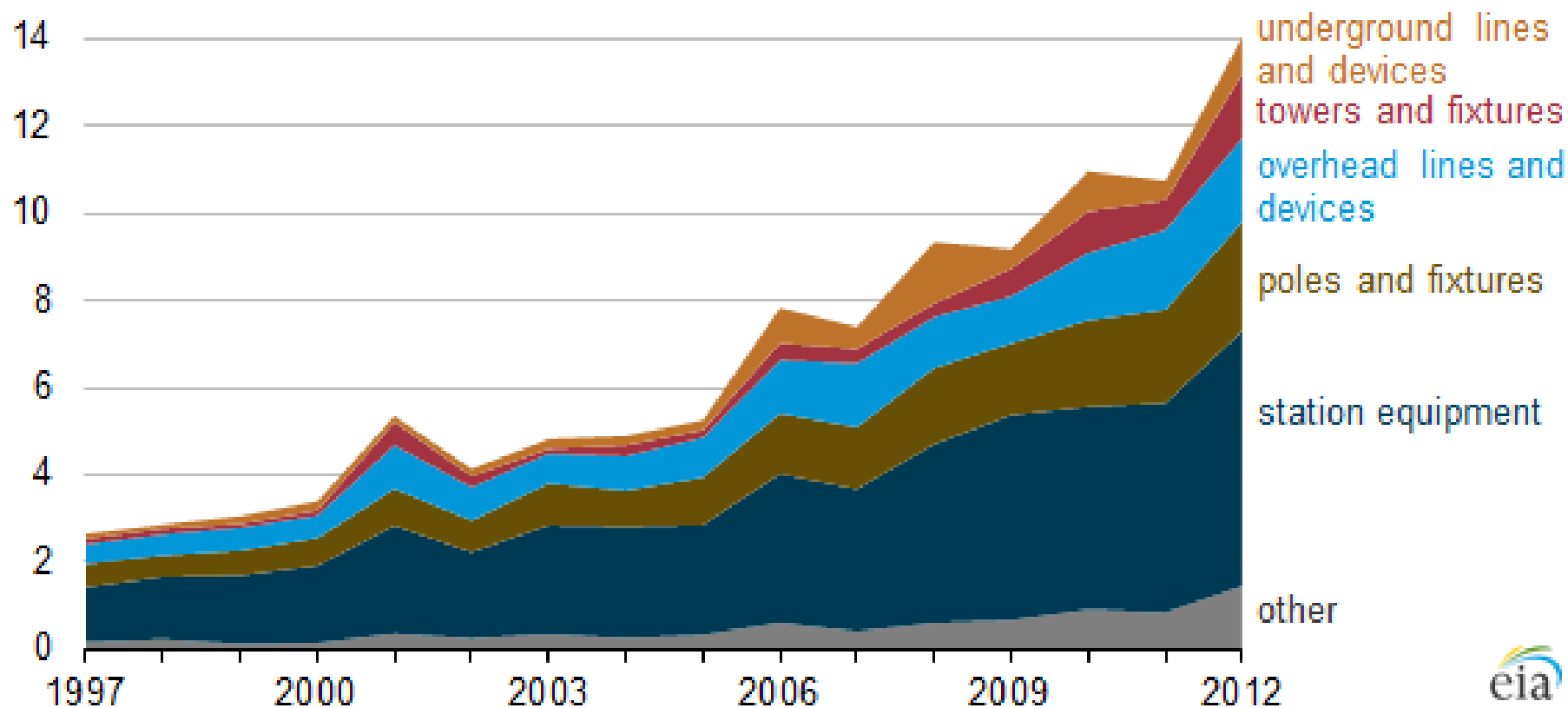
Source: **Edison Electric Institute**, Finance Department, company reports (October 2013)

<http://www.eei.org/resourcesandmedia/energynews/Pages/Electric%20Power%20Industry%20Capital%20Investment%20Expected%20to%20Remain%20at%20Record%20Level.aspx>

# Transmission Investments by Equipment Type

## Investment in transmission infrastructure by investor-owned utilities (1997-2012)

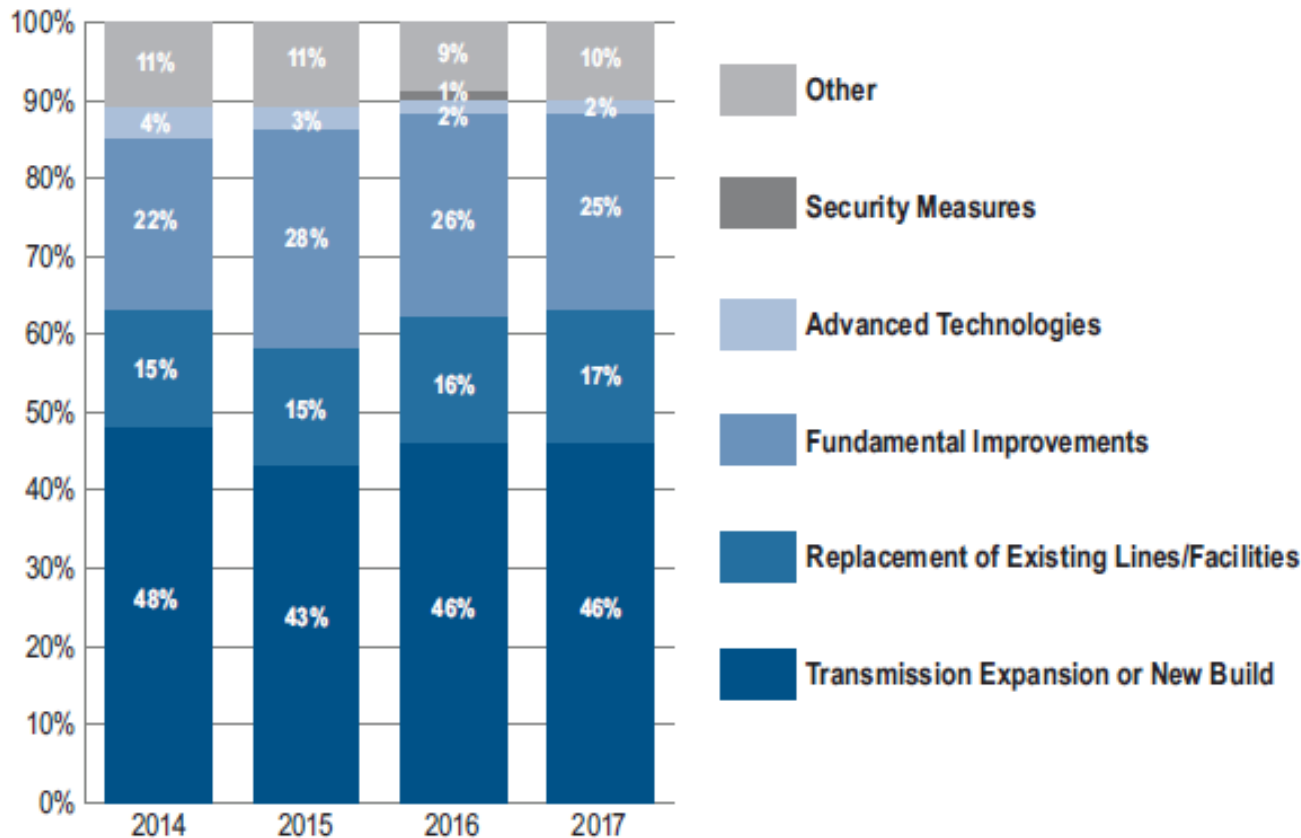
billions of 2012 dollars



Source: <http://www.eia.gov/todayinenergy/detail.cfm?id=17711>

# Transmission Investments by Type of Need

Projected Transmission Capital Expenditures by Type of Activity Years 2014 to 2017



\*Investment of investor-owned electric utilities and stand-alone transmission companies that provided a breakout of investment by type of activity on the EEI Transmission Capital Budget & Forecast Survey. Please note that the "Security Measures" activity type accounted for less than 1% of total transmission forecasted expenditures in 2014, 2015, and 2017.

Source: Edison Electric Institute, Business Information Group.

Updated November 2014.

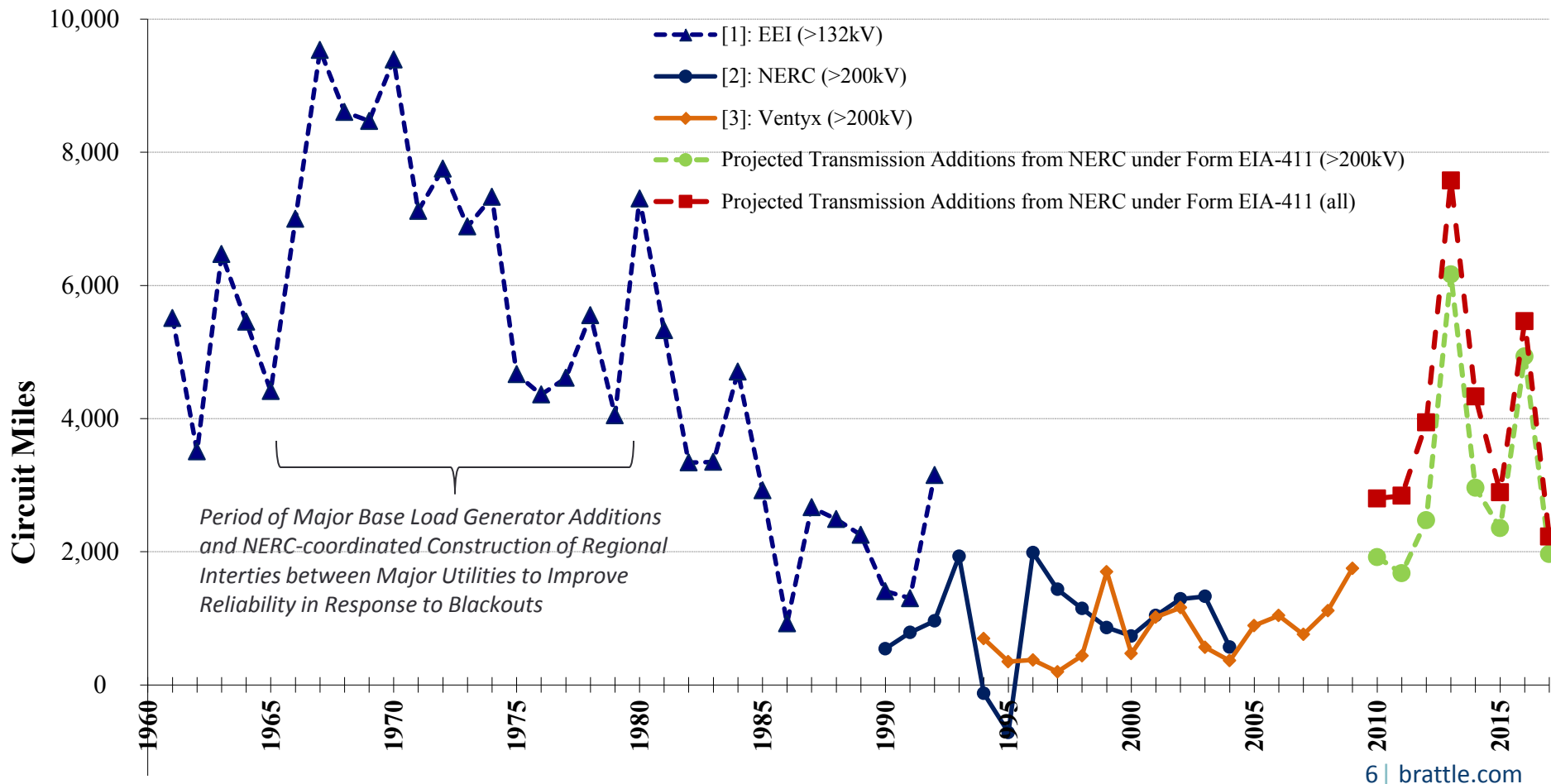
© 2014 by the Edison Electric Institute. All rights reserved.

Source: **Edison Electric Institute** (2014)

[http://www.eei.org/issuesandpolicy/transmission/documents/bar\\_transmission\\_investment.pdf](http://www.eei.org/issuesandpolicy/transmission/documents/bar_transmission_investment.pdf)

# Historical Circuit-Mile Additions Document Aging Grid

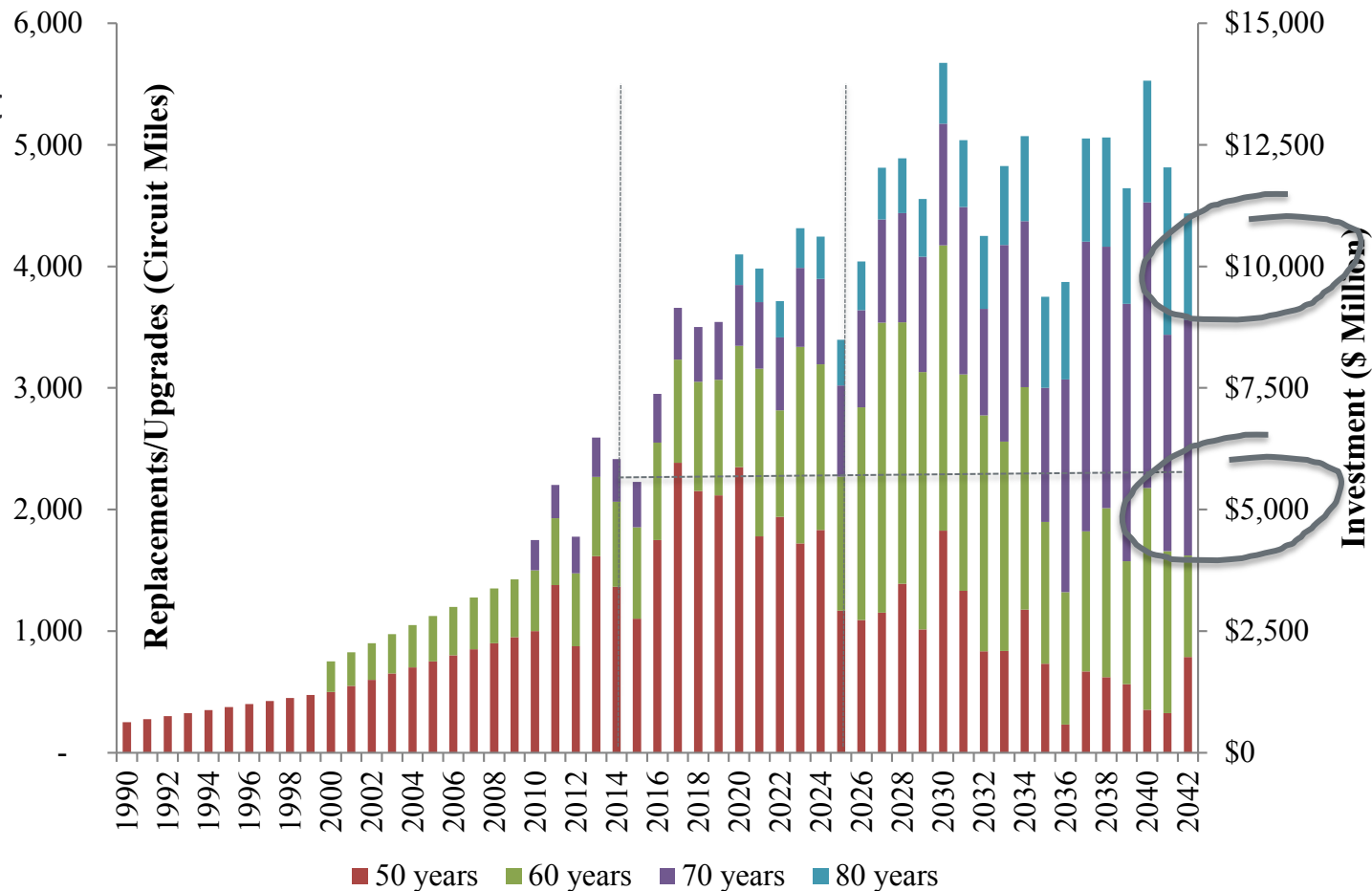
- Most of the existing grid was built 30-50+ years ago
- Even relatively high recent and projected circuit miles additions are below levels of additions in 1960s and 1970s



# Replacing and Upgrading Aging Transmission Will Require Significant Investments

- If all facilities had to be replaced after 50 to 80 years, investment need could increase by \$5 billion/yr over next decade
- Some of these replacements may become large upgrades open to non-incumbents

**Projected Circuit Miles Replaced/Upgraded and Total Projected Investment (\$m)**



Assumes circuit mile costs equal to those of new lines



# Renewables Additions to Meet RPS and the CPP will Drive Transmission Investment

- We estimate \$25-40 billion of transmission is still needed nationwide to accommodate ramp-up of existing state RPS requirements through 2025
- EPA estimates about 90 GW of new wind/renewables to meet Clean Power Plan, implying almost \$50 billion of likely additional transmission needs
- With alternative assumptions, 110 GW of new wind generation and \$60 billion of transmission could be needed to achieve the CPP's emission rate reductions

## Estimated U.S. Transmission Investment Driven by Renewables through 2025

		Existing State RPS	EPA Estimate w/ CPP	Brattle Estimate w/ CPP
Estimated Wind Capacity	GW	50-70	90	110
<b>Regional Transmission</b>	<b>\$billion</b>	<b>20-33</b>	<b>40</b>	<b>50</b>
Interconnection related	\$billion	5-7	9	11
<b>Total Transmission</b>	<b>\$billion</b>	<b>25-40</b>	<b>50</b>	<b>60</b>

Sources and Notes:

Brattle Estimate with the CPP assumes 50% of required emission rate reduction achieved through added wind generation.

# Transmission Investments Driven by Coal Retirements: Likely Relatively Modest

- Large-scale coal retirements projected even without EPA's CPP
  - EPA estimates 60 GW of coal retirements by 2025 in its Base Case (w/o CPP, driven by MATS, low gas prices, etc.)
- EPA estimates 50 GW of additional coal retirements due to CPP by 2025
- We estimated potential U.S. transmission needs driven by coal retirements based on PJM experience
  - \$10 billion without implementation of CPP
  - \$20 billion with CPP

## Estimated Transmission Needs Driven by Coal Retirements through 2025

	EPA Projected Coal Retirements (GW)	Potential Transmission Investment (\$ billion)
Base Case (w/o CPP)	60	\$10
Under the CPP	110	\$20

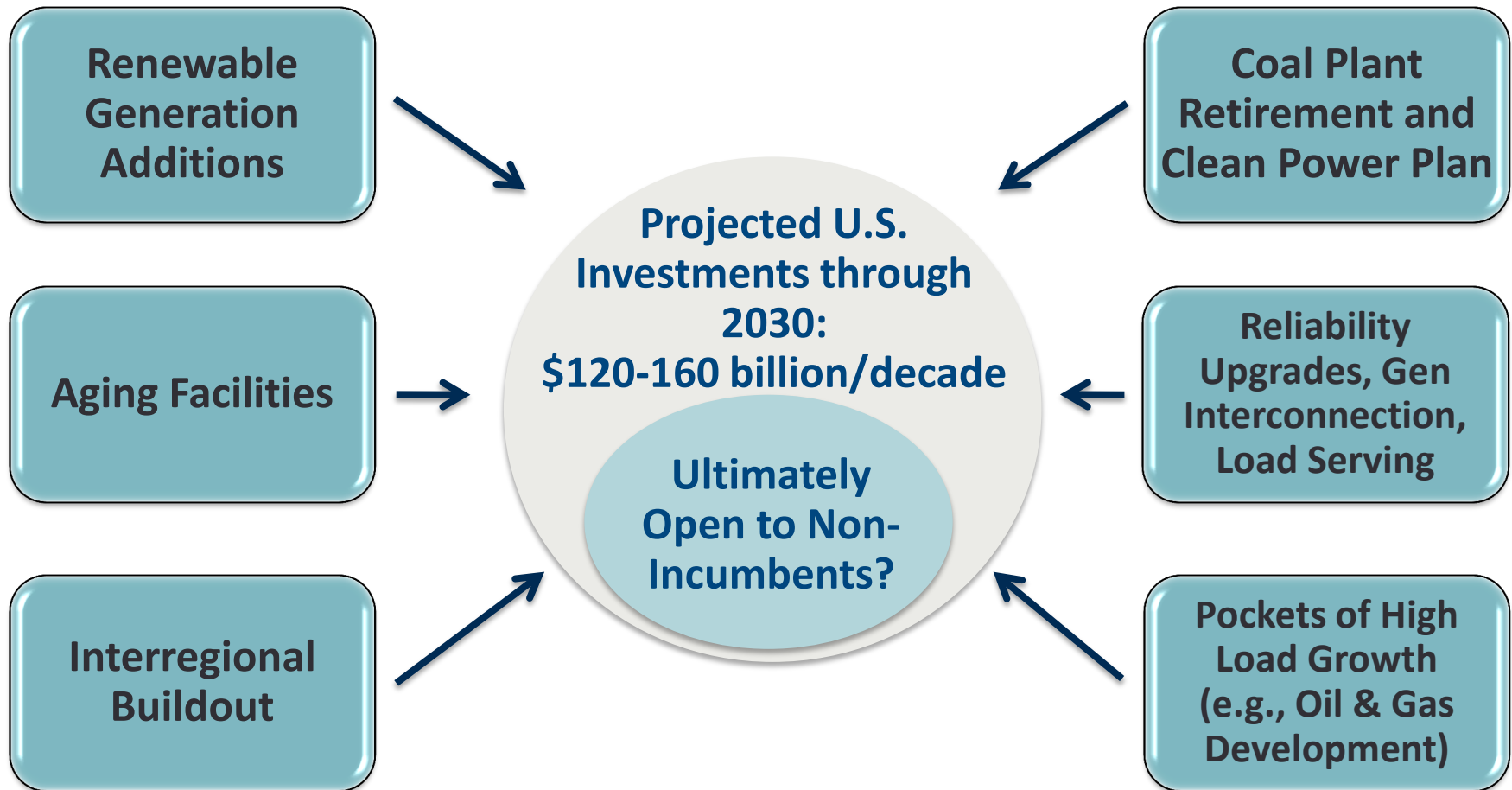
# Transmission Investment Driven by Coal Retirements: Key Uncertainties Remain

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**Key factors remain unclear about the relationship between coal retirements and transmission investment**

- Uncertainty about final version of the Clean Power Plan
- Uncertainty about how states will choose to implement it
  - Regional cooperation will likely reduce the amount of retirements and transmission investment needed
- Uncertainty about coal-to-gas conversions
  - Regulated entities likely to face pressure to convert existing facilities
  - Conversions less likely in regions with deregulated retail markets because coal plant locations often not attractive for new merchant gas plants
- Older coal units most effected by regulation and declining economics
  - Likely connected to lower-voltage transmission lines
- Available low-cost transmission solution
- Expansion of EE and DR may manage peak loads and mitigate some need for transmission investment

# Projected Transmission Investment Opportunities



## Sources and Notes:

The \$120-160 billion 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.

# Emerging Non-Incumbent Business Models

Non-incumbent transmission developers have become increasingly active through a number of distinct business models:

	<b>Business Model</b>	<b>Examples</b>
1	<b>Project-specific transmission partnerships with incumbents</b>	AEP and ITC “Novation” JVs in SPP, JVs to bid transmission in Alberta, Ontario, and CAISO
2	<b>Public-private partnerships</b>	MATL, Transbay Cable, Path15
3	<b>Independent transmission project developers</b>	Cleanline, Anbaric/PowerBridge, TDI, TransElect, AWC, Anschutz, ...
5	<b>Transmission (initially) bundled with renewables/generation</b>	NextEra, LS Power, RES Americas, First Wind
6	<b>Incumbent-owned transmission development subsidiaries and JVs</b>	Transource, Duke-ATC; BHE and Ameren Transmission Cos.
7	<b>Independent and semi-independent transmission companies</b>	ITC, ATC, Hunt

# Conclusions

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## **Transmission investment will remain strong over the next decade**

- Key Drivers: aging facilities, renewable additions, coal retirements replaced by new generation, pockets of strong load growth
- Significant opportunities for competitive transmission but timing, level, and non-incumbent access of investments will vary significantly across regions
- Uncertainties paralyzes industry, which is currently delaying the planning of valuable new infrastructure investments

## **Uncertain impact of coal retirements on transmission needs**

- Implementation details of EPA's Clean Power Plan still uncertain
- Coal retirements and shift in generation mix already occurring
- Transmission solutions may vary greatly in costs; targeted EE/DR can reduce transmission need
- Coal retirements will accelerate natural gas and renewable generation development opportunities with their own transmission needs

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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.*

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.

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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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John Tsoukalis has an educational background in economics and expertise several field of public utility economics and regulation. John has experience analyzing developments in the transmission sector, including regional transmission planning regimes, recent regulatory changes involving competitively sourced investment, and the changing drivers of transmission investment growth. He has participated in the formation of transmission investment projections, particularly in predicting the coming patterns of competitive transmission investment across the U.S. He has experience evaluating compliance with regional transmission planning processes, in the evaluation of transmission utilities, and in assisting utilities in the development of strategic transmission plans.

John received a M.Sc. in Economics from The Barcelona Graduate School of Economics and B.A. in Economics from Washington and Lee University.

# About The Brattle Group

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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.

Our services to the electric power industry include:

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- Demand Response & Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation & Risk Management
- Energy Contract Litigation
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