

Well-Planned Transmission to Integrate Customer Needs and Resources

PRESENTED AT:

WIRES

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THE **Brattle** GROUP

Agenda

Electricity Industry Trends

- Customers' Preferred Resources
- Electrification and Future Power Grid

Drivers of Transmission Investments

Transmission and the New Era

Electricity Industry Trends

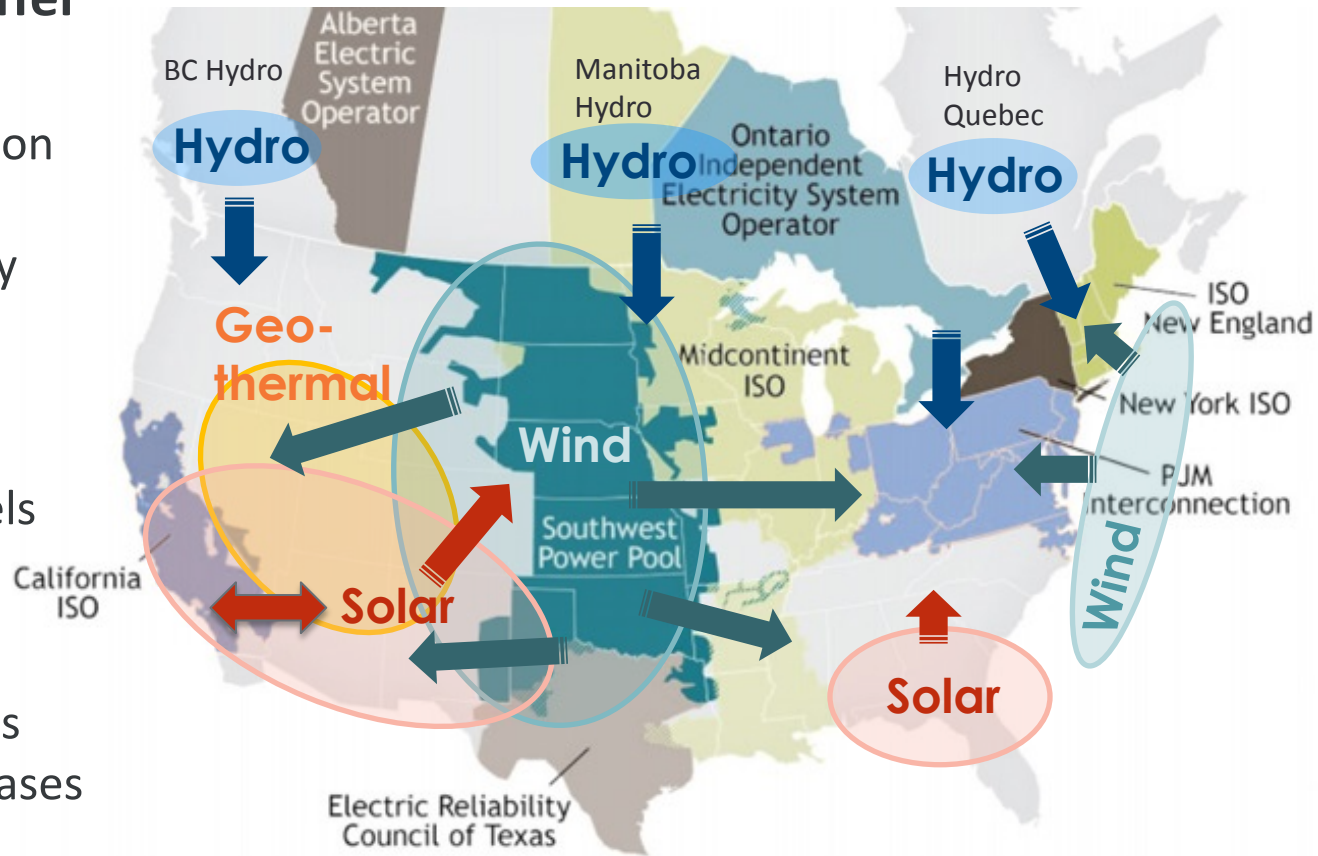
- **Reduced growth in traditional electricity consumption**, even in the age of internet of things
- **Increased customer preferences for conservation and clean energy**
- **Technological advances** that allow customers and electric utilities to better monitor and control electricity usage
- Significant **cost reduction in solar and wind generation** and innovative project financing, yielding low cost clean resources
- **Low natural gas prices** place significant downward pressure on coal and nuclear plants
- **Increased stringency in local environmental regulations** of air emissions, water usage, waste disposal, and land use for all power plants
- **Increasing electrification** of transportation and heating

These are significant changes that utilities, grid operators, and regulators are trying to manage.

Diversifying Use of Low-Cost Clean Energy

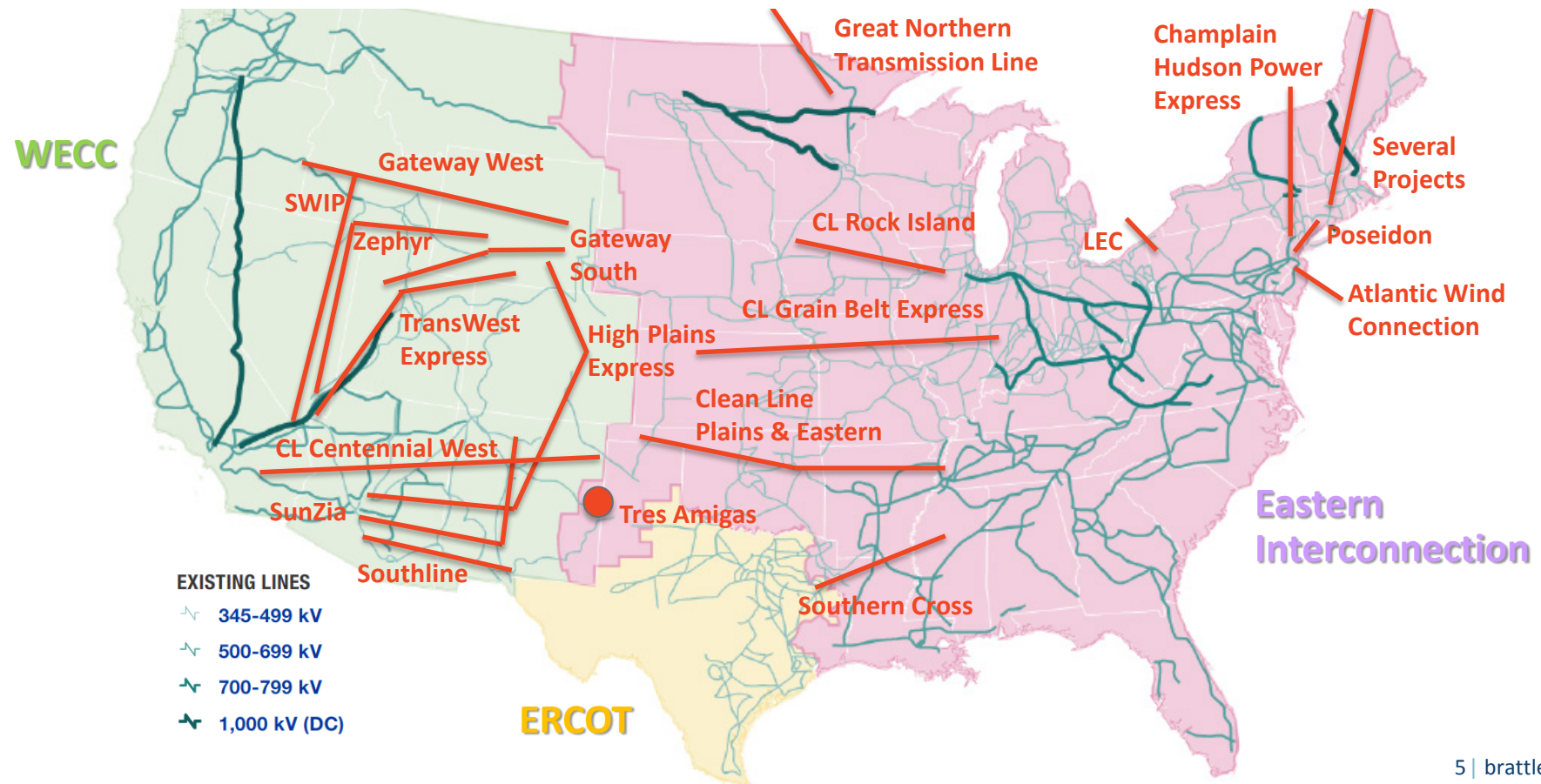
Focusing on resource diversification can offer significant benefits:

- Regional diversification of resources (and customers' electricity usage) reduces the investment and balancing cost in a future with high levels of intermittent resources
- Diversity of resources (and load) also increases the value of transmission that interconnects them



Already-Proposed Interregional Projects

- Numerous developers have already proposed participant-funded or merchant transmission projects, most of which are driven by plans to deliver low-cost wind, solar, or hydro resources to regions with desired clean energy needs. Their location choices are right on!

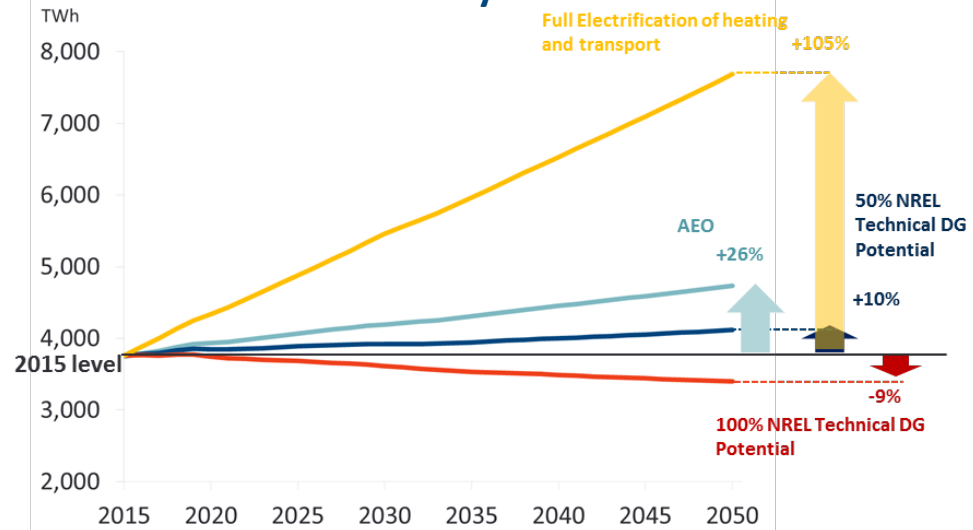


Electrification of Transportation

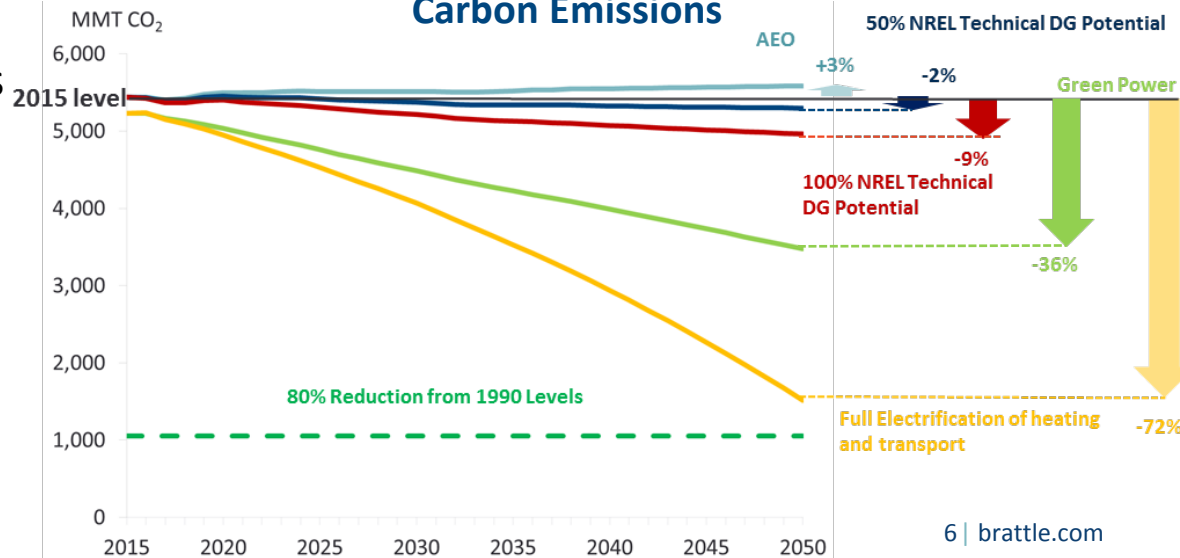
With full electrification:

- Electrification could double electricity sales and (mostly) achieve even ambitious long-term emissions reduction goals
- Utility sales could double by 2050, even with significant distributed PV penetration
- Economy-wide GHG emissions reductions could be achieved if coupled with clean generation
- **Utilities could grow in size and relevance, and help decarbonize the US economy**

Electricity Sales



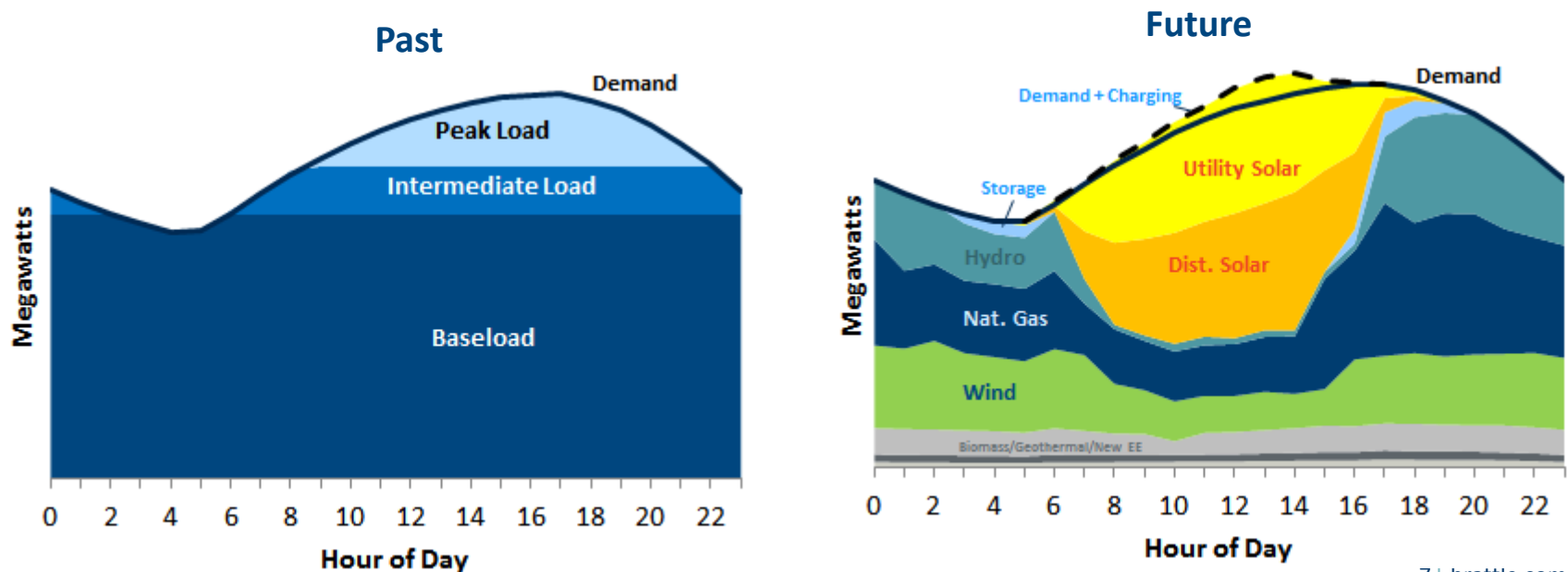
Carbon Emissions



Changing Resource Mix and Operational Needs

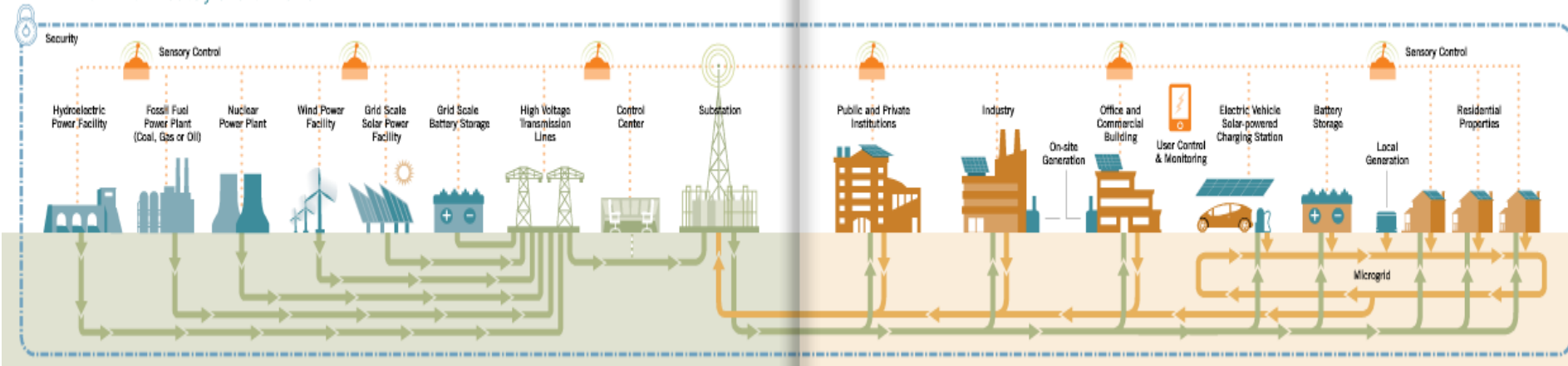
Evolving policy goals, customer preferences, and technologies are fundamentally changing how we use the grid

- Resource planning requirements have already moved past traditional planning for baseload, intermediate load, and peak load needs
- Flexibility is becoming increasingly valuable and operationally important
- Regional/interregional diversification as low-cost solution to reduce flexibility needs and manage surplus (baseload) generation challenges



The Future Power Grid

The Power Industry of the Future



Source: New York Power Authority: <http://www.nypa.gov/PDFs/StraVis2014/#?page=16>

- Customers becoming “Prosumers”: simultaneously producers and consumers
- This creates tremendous opportunities for:
 - Customers to control electricity usage
 - Customers to engage with other customers and new service providers

The “new” transmission system needs to interface with the “new” distribution systems to ensure efficient operations and investment on both systems

Main Drivers of Transmission Needs

- Serve growing load
- Generation interconnections
- Local and regional reliability
- Congestion relief

**Traditional
Drivers**

- Access to low-cost renewable and clean energy
- Capture renewable energy and fuel diversity
- Help meet regional economic and public policy needs
- Cost reductions offered by better interregional coordination
- Mitigate risks and create valuable options to address uncertainties proactively

**New
Drivers**

Industry Studies Show Well-Planned Transmission Investments Reduce Total Costs

European studies offer valuable insights:

- **Integration of Distributed Generation in Europe:**
 - Choice between centralized, utility-scale generation and distributed generation does not have a direct impact on transmission needs
 - **Germany:** three new north-south transmission lines needed to reduce the cost of a clean energy future despite substantial reliance on distributed generation
- **European E-Highway 2050 Study:** Interregional transmission investments significantly reduce the cost of a low-carbon electricity sector by facilitating the integration and diversification of lower-cost renewable resources region-wide
- **Transformation of Europe's Power System Until 2050:**
 - McKinsey study found that the most cost-effective way to reach 40–45% renewables by 2050 would require a doubling of existing region-wide transmission capabilities by 2020 and an almost fourfold increase in transmission capabilities by 2050.
 - Local approach would be 30–35% more expensive Europe-wide interregional coordination.
- **Integration of Renewable Energy in Europe:**
 - Most cost-effective path to achieving Europe's overall renewable energy policy objectives requires a substantial expansion of its transmission networks; delay in investments increases the overall system-wide costs and price volatility.

Well-Planned Transmission Investments Can Reduce Electricity Costs for Customers

U.S. industry studies also consistently show that well-planned transmission investment can significantly reduce overall customer costs:

- **SPP:** \$3.4 billion on transmission projects previously planned are expected to reduce customer costs by \$12 billion at a benefit to cost ratio of 3.5-to-1 (retrospective evaluation)
- **MISO MVP:** Previously planned multi-value projects to integrate 40 million MWh of renewables and improve reliability provide benefits that exceed costs by factor of 2.6-3.1
- **Brattle:** Providing access to areas with lower-cost renewable generation that will meet RPS and clean energy needs through 2030 has the potential to reduce the combined generation and transmission investment needs by \$30-70 billion
- **Eastern Interconnection States Planning Council:** Multi-stage anticipatory planning can reduce total generation costs by \$150 billion, while increasing interregional transmission investments by \$60 billion, with an overall savings of \$90 billion system-wide
- **Eastern Interconnection Planning Collaborative:** Combination of interregional environmental policy compliance and interregional transmission may offer net savings of up to \$100 billion in a future with stringent environmental policy goals
- **University of Colorado/National Oceanic and Atmospheric Administration:** Building more robust transmission grid would enable reducing U.S. carbon emissions from electricity sector by 80%, saving consumers \$47 billion/year at benefit-to-cost ratio of almost 3-to-1.

The Need to Improve Regional and Inter-Regional Transmission Planning

20th Century approaches to transmission planning are ill-suited to address 21st Century challenges

- Existing planning approaches are focused predominantly on projected local and regional reliability needs for next 3-10 years
- Full consideration of broad range of economic and public-policy benefits remains rare in regional planning, though promising examples are emerging:
 - SPP Value of Transmission and benefits metrics for regional cost allocation review
 - NYISO consideration of broad set of benefits for public policy projects
 - MISO MVPs and occasional CAISO economic and public policy projects
- Interregional planning remains largely dysfunctional
- Needed: anticipatory planning for “known and unknown” uncertainties
 - Need to go beyond rudimentary consideration of uncertainties in base case and “scenarios” to quantify economic and public policy benefits
 - Need to focus on options (and their value) created by investments
 - Need to document the risks and potentially high costs of inadequate infrastructure
- Needed: Better understanding by policy makers

Speaker Bio and Contact Information



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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.

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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 20 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 power market designs, contract issues, and transmission rate design. She has authored numerous reports 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 Brattle Group, and the founding Director of New England Women in Energy and the Environment.

Additional Reading

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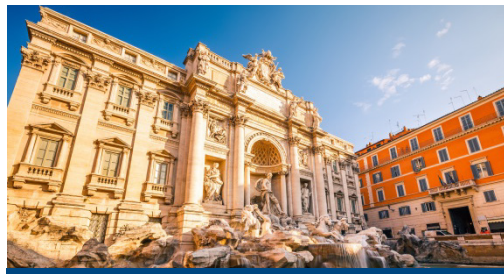
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About The Brattle Group

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

We combine in-depth industry experience and rigorous analyses 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:

- Climate Change Policy and Planning
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