

# Planning for Generation Interconnection

PRESENTED BY

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PREPARED FOR

ESIG Special Topic Webinar:  
Generation Interconnection  
Criteria

May 31, 2022



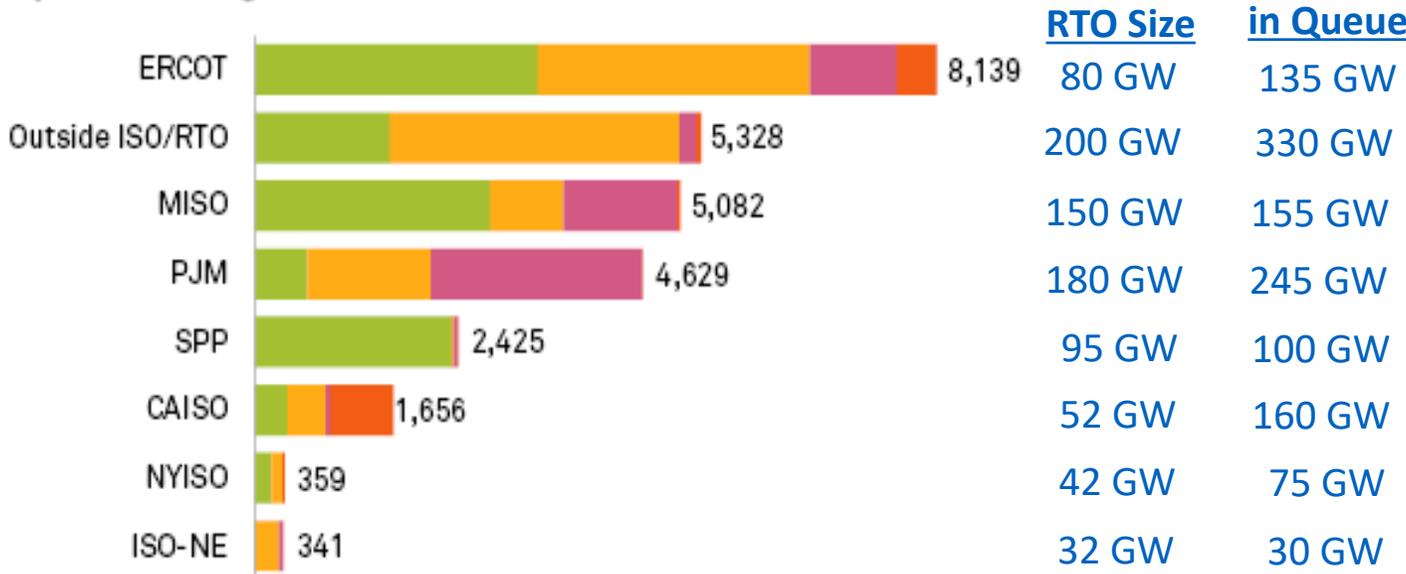
# Challenge: The Generation Interconnection Process

Some RTOs are able to interconnect more generation (and more quickly) than others.

## 2021 US capacity additions

■ Wind ■ Solar ■ Gas ■ Other\*

By ISO/RTO region (MW)



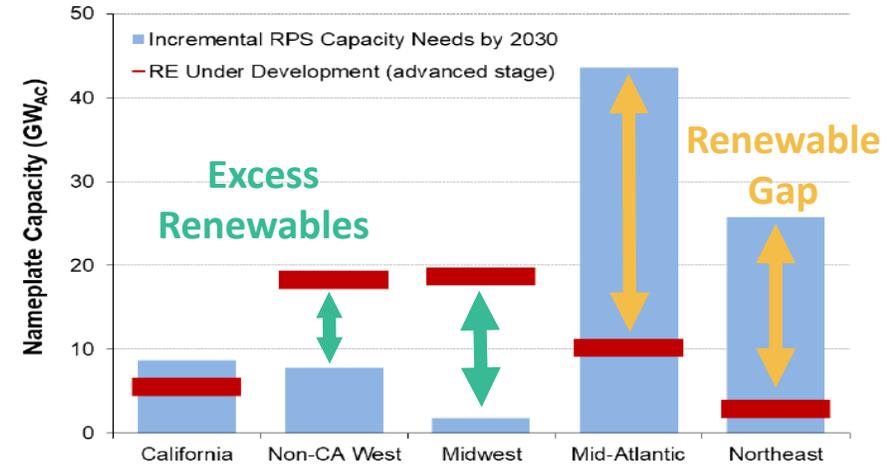
Data compiled Jan. 11, 2022.

\* Includes hydro, biomass, oil, geothermal and energy storage capacity.

Source: S&P Global Market Intelligence

See also: [Generation, Storage, and Hybrid Capacity in Interconnection Queues | Electricity Markets and Policy Group \(lbl.gov\)](#)

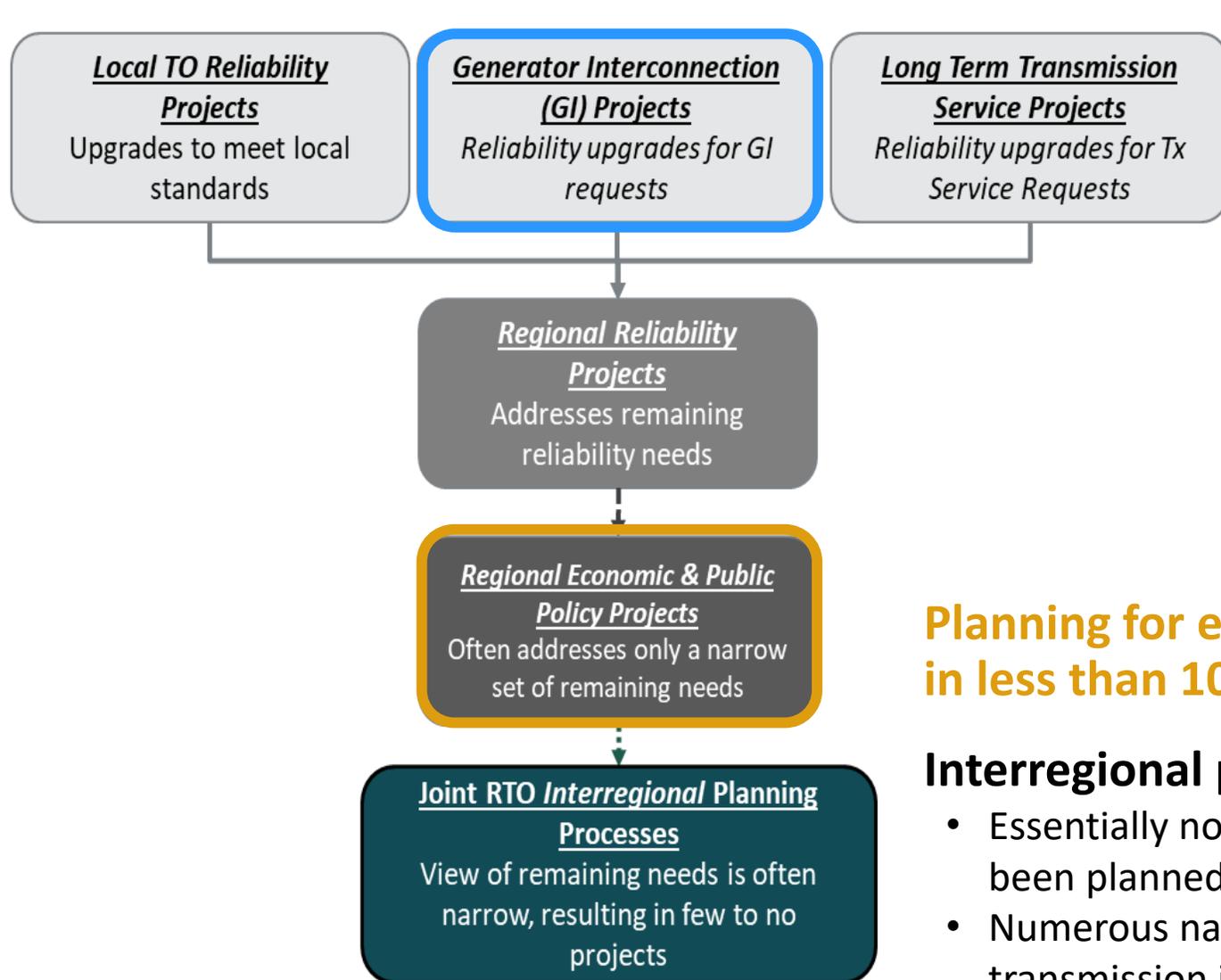
## Lawrence Berkeley National Lab Estimated Renewables Development Gap



Source: Galen Barbose, "U.S. Renewables Portfolio Standards: 2021 Status Update (Early Release)," Lawrence Berkeley National Lab, Feb 2021. [rps.lbl.gov](https://www.lbl.gov/emp/eprp/reports/rps/)

The Mid-Atlantic and Northeast currently interconnect significantly less renewable generation -- making it challenging to meet the significant renewable development necessary to meet state clean-energy policies [brattle.com](https://brattle.com) | 1

# Current U.S. Transmission Planning Processes for...



**These solely reliability-driven processes account for > 90% of all transmission investments**

- None involve any assessments of economic benefits (i.e., cost savings offered by the new transmission)

**Generation interconnection processes have become the primary tool (and barrier) to support public policy goals for clean energy**

**Planning for economic & public-policy projects results in less than 10% of all U.S. transmission investments**

**Interregional planning processes are large ineffective**

- Essentially no major interregional transmission projects have been planned and built in the last decade
- Numerous national studies show that more interregional transmission is needed to reduce total system costs

# Five Elements of Generation Interconnection

Improving generation interconnection requires addressing all five elements of the GI process (with most current reform discussions focused mostly on Nos. 1 and 5):

1. **GI Process and Queue Management:** individual vs. cluster studies, type of studies and contractual agreements, readiness criteria, financial deposits, study and restudy sequences, etc.
2. **GI Scope and “Handoff” to Regional Transmission Planning:** are major (“deep”) network upgrades triggered by incremental generation interconnection requests or handled through regional transmission planning?
3. **GI Study Approach and Criteria:** study assumptions, modeling approaches, and specific criteria differ significantly across regions (e.g., ERIS vs. NRIS study differences, injection levels studied, are market-based redispatch opportunities considered?)
4. **Selecting Solutions to Address the Identified Criteria Violations:** most regions select only traditional transmission upgrades to address criteria violations; grid-enhancing technologies, such as power-flow-control devices or dynamic line ratings, are not typically considered or accepted
5. **Cost Allocation:** most regions require the interconnecting generator (or group of generators) to pay for all upgrades identified, even though (a) there may be significant regional benefits to loads and other market participants and (b) more cost effective (multi-value) regional solutions may exist

Focus of Today’s Webinar

# Improving the Generation Interconnection Process

Reducing the scope of upgrades triggered by generation interconnection processes likely will be necessary to both accelerate and lower the cost of renewable interconnection:

- Attractive: UK “Connect and Manage” (replaced prior “Invest and Connect”)
  - Similar to ERCOT; reduced lead times by 5 years; network constraints addressed later (e.g., with congestion management)  
<https://www.gov.uk/guidance/electricity-network-delivery-and-access#connect-and-manage>
- ERCOT’s generation interconnection process is perhaps most effective in the U.S.
  - Efficient handoff of study roles by ERCOT and Transmission Owners limits restudy needs
  - Projects can be developed and interconnected within 2-3 years; in other regions, the interconnection study process itself may take longer than that
  - Upgrades focused only on local interconnection needs and are recovered through postage stamp
  - Network constraints managed through market dispatch – which imposes high congestion and curtailment risks on interconnecting generators ... in part due to ERCOT’s insufficiently proactive multi-value grid planning
  - See [working-paper.pdf \(enelgreenpower.com\)](#) [Note: Brattle was not involved]

**Generation interconnection based on “connect and manage” when combined with proactive transmission planning offers more timely and cost-effective solutions**

# Examples: Benefit of Proactive Transmission Planning

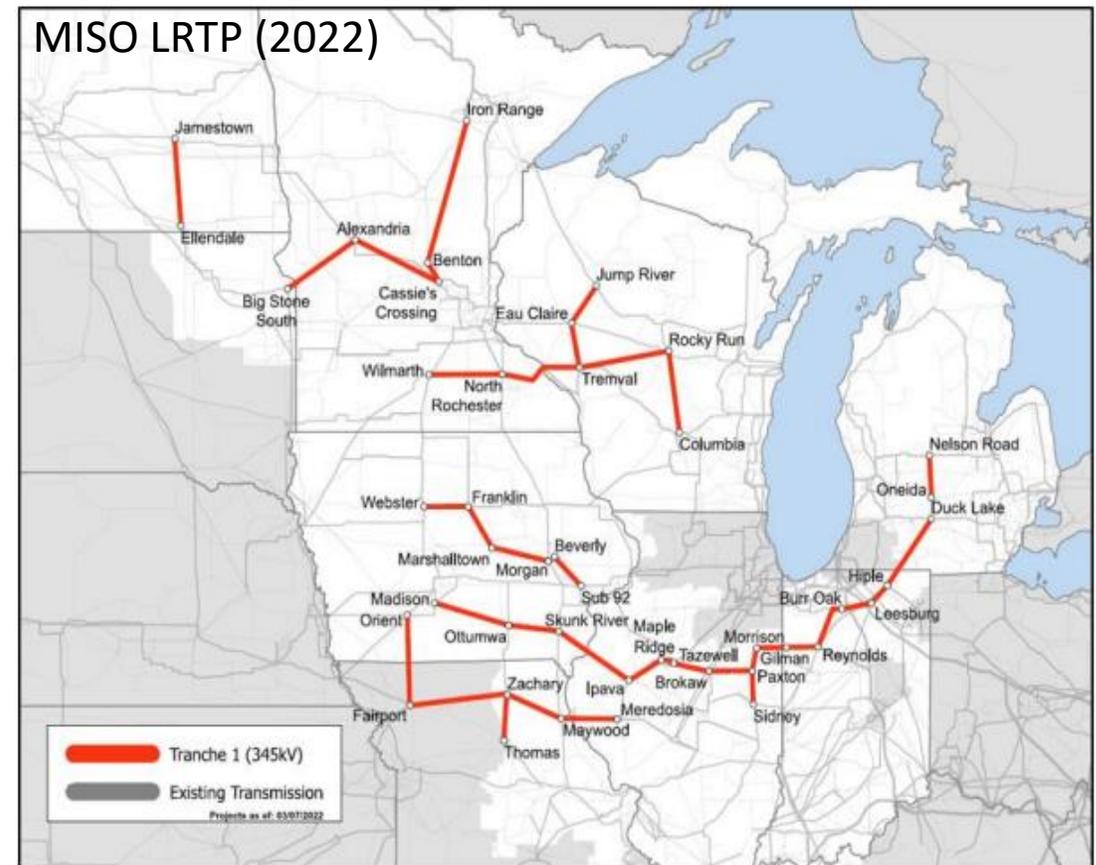
Proactive multi-value transmission planning can yield a more cost-effective grid and reduce the cost and time required to interconnect renewables at scale

## [MISO 2022 LRTP results](#) (weblink)

- Tranche 1: \$10 billion portfolio of proposed new 345 kV transmission projects for its Midwestern footprint
- **Supports interconnection of 53,000 MW of renewable resources**
- **Reduces other costs by \$37-68 billion**

## [PJM Transmission Study](#) (weblink)

- Proactively evaluated all existing state public policy needs
- **Identified only \$3.2 billion in upgrades to integrate 75,000 MW of renewables (\$40/kW)**
- Would be significantly more cost effective than continued reliance on incremental upgrades through PJM's interconnection process (which identified \$6.4b in transmission upgrades for 15,000 MW of OSW)



# About the Speaker

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**Johannes (Hannes) Pfeifenberger**, a Principal at The Brattle Group, is an economist with a background in electrical engineering and over twenty-five years of experience in wholesale power market design, renewable energy, electricity storage, and transmission. He also is a Visiting Scholar at MIT's Center for Energy and Environmental Policy Research (CEEPR), a Senior Fellow at Boston University's Institute of Sustainable Energy (BU-ISE), a IEEE Senior Member, and currently serves as an advisor to research initiatives by the U.S. Department of Energy, the National Labs, and the Energy Systems Integration Group (ESIG).

Hannes specializes in wholesale power markets and transmission. He has analyzed transmission needs, transmission benefits and costs, transmission cost allocations, and transmission-related renewable generation challenges for independent system operators, transmission companies, generation developers, public power companies, industry groups, and regulatory agencies across North America. He has worked on transmission matters in SPP, MISO, PJM, New York, New England, ERCOT, CAISO, WECC, and Canada.

He received an M.A. in Economics and Finance from Brandeis University's International Business School and an M.S. and B.S. ("Diplom Ingenieur") in Power Engineering and Energy Economics from the University of Technology in Vienna, Austria.

# Brattle Reports on Transmission Planning

**Well-Planned Electric Transmission Saves Customer Costs:**  
Improved Transmission Planning is Key to the Transition to a Carbon-Constrained Future

PREPARED FOR  
 **Link: [Well-Planned Transmission](#)**

PREPARED BY  
Judy W. Chang  
Johannes P. Pfeifenberger

May 2014

THE **Brattle** GROUP

**Toward More Effective Transmission Planning:**  
Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid

PREPARED FOR  
 **Link: [Effective Transmission Planning](#)**

PREPARED BY  
Johannes P. Pfeifenberger  
Judy W. Chang  
Akarsh Shellenbranath

April 2015

*The Brattle Group*

**Link: [Transmission Benefits](#)**

**The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments**

July 2013

Judy W. Chang  
Johannes P. Pfeifenberger  
J. Michael Hagerty

**Link: [Diversity Value](#)**

 Boston University Institute for Sustainable Energy

The Value of Diversifying Uncertain Renewable Generation through the Transmission System

September • 2020



**Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs**

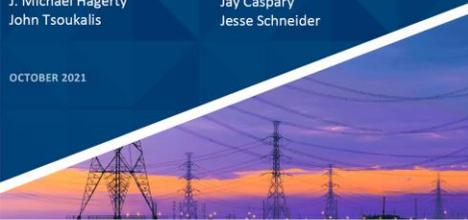
**Link: [Brattle Grid Strategies](#)**

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*The Brattle Group:*  
Johannes Pfeifenberger  
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J. Michael Hagerty  
John Tsoukalis

*Grid Strategies:*  
Rob Gramlich  
Michael Goggin  
Jay Caspary  
Jesse Schneider

OCTOBER 2021



**A Roadmap to Improved Interregional Transmission Planning**

**Link: [Interregional Roadmap](#)**

PREPARED BY  
Johannes P. Pfeifenberger  
Kasparas Spokas  
J. Michael Hagerty  
John Tsoukalis

November 30, 2021



Summarizes proven approaches to quantifying various benefits

# Additional Reading on Transmission

- Pfeifenberger, [New York State and Regional Transmission Planning for Offshore Wind Generation](#), NYSERDA Offshore Wind Webinar, March 30, 2022.
- Pfeifenberger, [The Benefits of Interregional Transmission: Grid Planning for the 21st Century](#), US DOE National Transmission Planning Study Webinar, March 15, 2022.
- Pfeifenberger, [21st Century Transmission Planning: Benefits Quantification and Cost Allocation](#), Prepared for the NARUC members of the Joint Federal-State Task Force on Electric Transmission, January 19, 2022.
- Pfeifenberger, Spokas, Hagerty, Tsoukalis, [A Roadmap to Improved Interregional Transmission Planning](#), November 30, 2021.
- Pfeifenberger, Tsoukalis, Newell, "[The Benefit and Cost of Preserving the Option to Create a Meshed Offshore Grid for New York](#)," Prepared for NYSERDA with Siemens and Hatch, November 9, 2022.
- Pfeifenberger, [Transmission—The Great Enabler: Recognizing Multiple Benefits in Transmission Planning](#), ESIG, October 28, 2021.
- Pfeifenberger et al., [Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs](#), Brattle-Grid Strategies, October 2021.
- Pfeifenberger, [Transmission Options for Offshore Wind Generation](#), NYSERDA webinar, May 12, 2021.
- Pfeifenberger, [Transmission Planning and Benefit-Cost Analyses](#), presentation to FERC Staff, April 29, 2021.
- Pfeifenberger et al., [Initial Report on the New York Power Grid Study](#), prepared for NYPSC, January 19, 2021.
- Pfeifenberger, Ruiz, Van Horn, "[The Value of Diversifying Uncertain Renewable Generation through the Transmission System](#)," BU-ISE, October 14, 2020.
- Pfeifenberger, Newell, Graf and Spokas, "[Offshore Wind Transmission: An Analysis of Options for New York](#)", prepared for Anbaric, August 2020.
- Pfeifenberger, Newell, and Graf, "[Offshore Transmission in New England: The Benefits of a Better-Planned Grid](#)," prepared for Anbaric, May 2020.
- Tsuchida and Ruiz, "[Innovation in Transmission Operation with Advanced Technologies](#)," T&D World, December 19, 2019.
- Pfeifenberger, "[Cost Savings Offered by Competition in Electric Transmission](#)," Power Markets Today Webinar, December 11, 2019.
- Chang, Pfeifenberger, Sheilendranath, Hagerty, Levin, and Jiang, "[Cost Savings Offered by Competition in Electric Transmission: Experience to Date and the Potential for Additional Customer Value](#)," April 2019. "[Response to Concentric Energy Advisors' Report on Competitive Transmission](#)," August 2019.
- Ruiz, "[Transmission Topology Optimization: Application in Operations, Markets, and Planning Decision Making](#)," May 2019.
- Chang and Pfeifenberger, "[Well-Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning is Key to the Transition to a Carbon-Constrained Future](#)," WIRES and The Brattle Group, June 2016.
- Newell et al. "[Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades](#)," on behalf of NYISO and DPS Staff, September 15, 2015.
- 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 2015.
- Chang, Pfeifenberger, Hagerty, "[The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments](#)," on behalf of WIRES, July 2013.
- Chang, Pfeifenberger, Newell, Tsuchida, Hagerty, "[Recommendations for Enhancing ERCOT's Long-Term Transmission Planning Process](#)," October 2013.
- Pfeifenberger and Hou, "[Seams Cost Allocation: A Flexible Framework to Support Interregional Transmission Planning](#)," on behalf of SPP, April 2012.
- Pfeifenberger, Hou, "[Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada](#)," on behalf of WIRES, May 2011.

# Brattle Group Practices and Industries

## ENERGY & UTILITIES

Competition & Market  
Manipulation  
Distributed Energy  
Resources  
Electric Transmission  
Electricity Market Modeling  
& Resource Planning  
Electrification & Growth  
Opportunities  
Energy Litigation  
Energy Storage  
Environmental Policy, Planning  
and Compliance  
Finance and Ratemaking  
Gas/Electric Coordination  
Market Design  
Natural Gas & Petroleum  
Nuclear  
Renewable & Alternative  
Energy

## LITIGATION

Accounting  
Analysis of Market  
Manipulation  
Antitrust/Competition  
Bankruptcy & Restructuring  
Big Data & Document Analytics  
Commercial Damages  
Environmental Litigation  
& Regulation  
Intellectual Property  
International Arbitration  
International Trade  
Labor & Employment  
Mergers & Acquisitions  
Litigation  
Product Liability  
Securities & Finance  
Tax Controversy  
& Transfer Pricing  
Valuation  
White Collar Investigations  
& Litigation

## INDUSTRIES

Electric Power  
Financial Institutions  
Infrastructure  
Natural Gas & Petroleum  
Pharmaceuticals  
& Medical Devices  
Telecommunications,  
Internet, and Media  
Transportation  
Water

# Our Offices

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