Proactive Planning for a Changing Generation Mix

PREPARED BY

Joe DeLosa III

Johannes Pfeifenberger

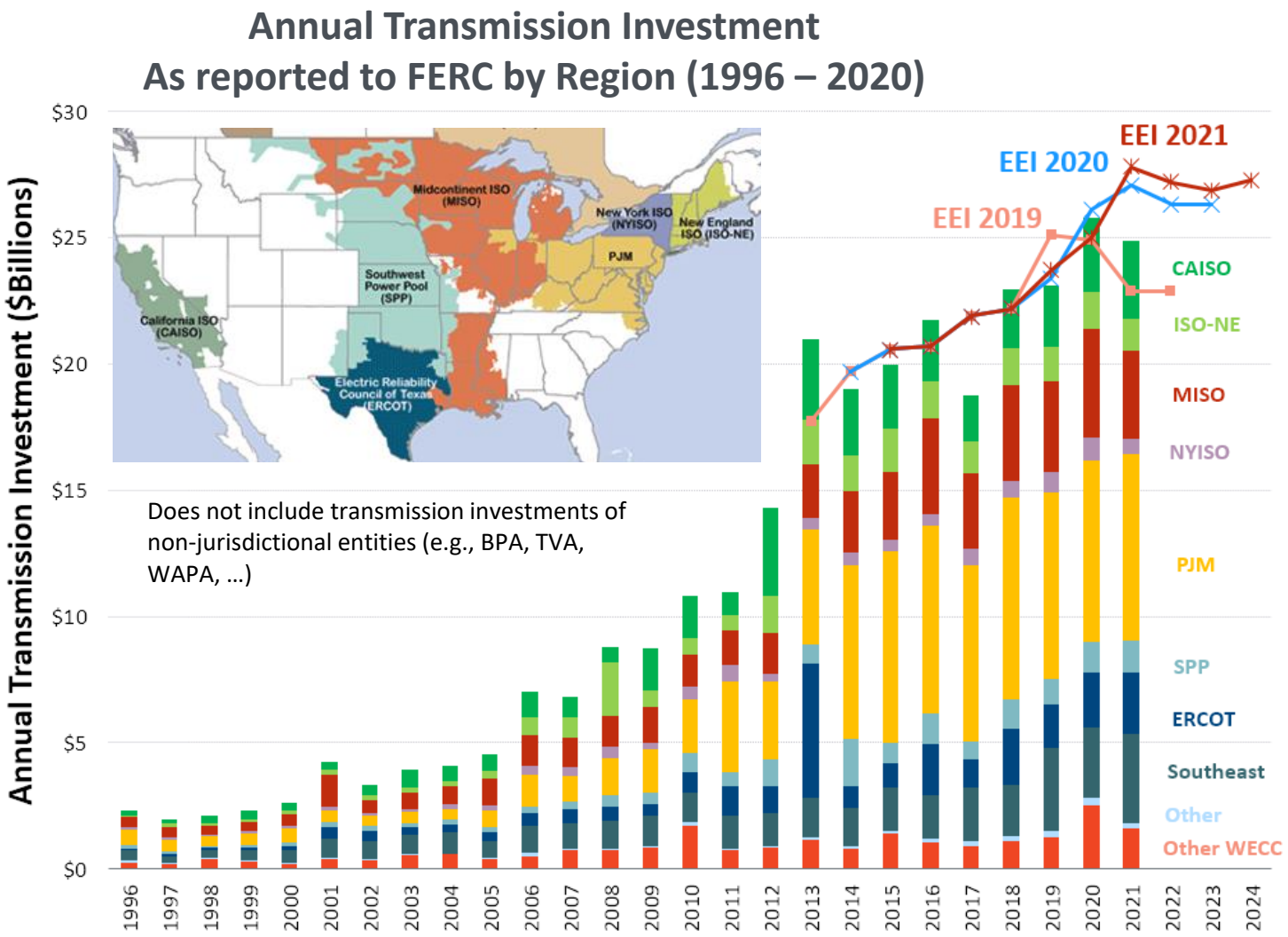
PRESENTED TO

Independent State Agencies Committee

May 22, 2023

Brattle

Transmission Investment is at Historically High Levels



Source: FERC Form 1 Data, EEI "Historical and Projected Transmission Investment" most recent accessed here: https://www.eei.org/resourcesandmedia/Documents/Historical%20and%20Projected%20Transmission%20Investment.pdf

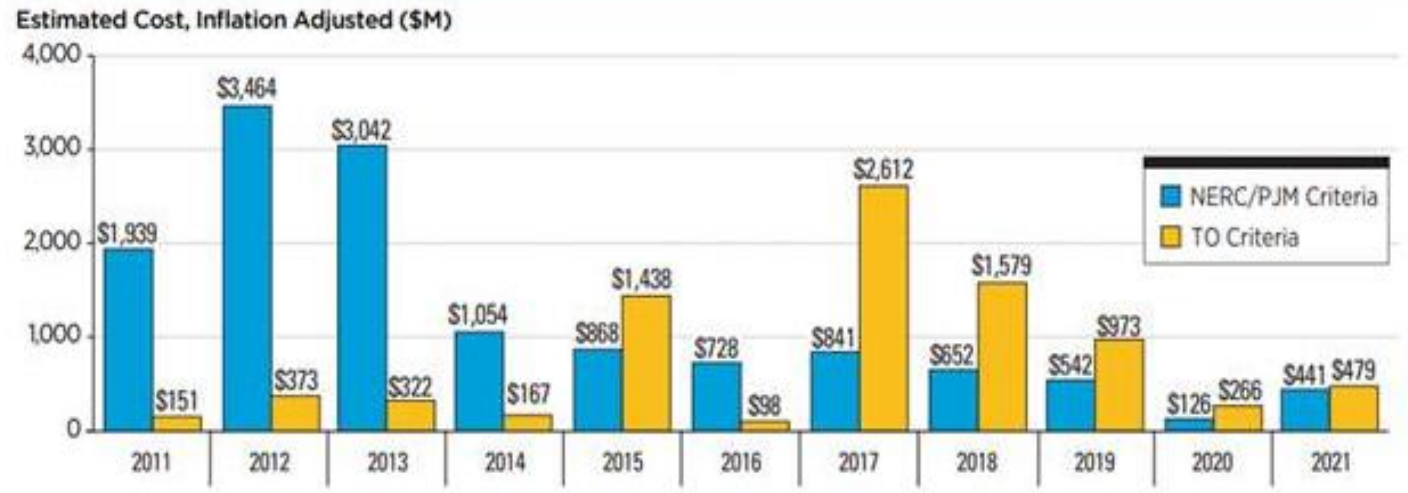
$20-25 billion in annual U.S. transmission investment, but:

- More than 90% of it justified solely based on reliability needs without benefit-cost analysis
  - About 50% solely based on "local" utility criteria (without going through regional planning processes)
  - The rest justified by regional reliability and generation interconnection needs
- While significant experience with transmission benefit-cost analyses exists, very few projects are justified based on economics and overall cost savings

PJM Transmission Investments: Predominantly Reliability Driven

Figure 5.2: Baseline and Supplemental Projects by Year

Figure 5.3: PJM Baseline Projects by Criteria



Source: [2021-rtep-report.ashx (pjm.com)]

"Baseline" and "Supplemental" projects account for the large majority of PJM transmission investments, with trends toward fewer Baseline projects and fewer projects triggered by NERC/PJM criteria

- This trend may be inconsistent with the large-scale, regional system needs associated with PJM states' clean-energy goals and mandates
- More proactive multi-driver planning will be necessary to cost-effectively meet regional needs
- PJM's State Agreement Approach (SAA), if used more broadly, can help but will not be a substitute for achieving most cost-effective solutions

Benefits of Proactive Planning: PJM's 75 GW Renewable GI Study

Generation interconnection processes, studying one generator at a time, are ineffective in determining the cost-effective transmission solutions. More pro-active GI processes are needed:

- For example: A review of PJM generation interconnection studies for 15.5 GW of individual offshore wind plants identified $6.4 billion in onshore transmission upgrades ($400/kW)
- In contrast: the recent PJM Offshore Wind Transmission Study that proactive evaluated all existing state public policy needs identified only **$3.2 billion in onshore upgrades for over 75 GW of renewable resources** (up to 17 GW of offshore wind, 14.5 GW of onshore wind, 45.6 GW of solar, and 7.2 GW of storage) ($40/kW)
- Upgrades also provide substantial PJM-wide economic benefits: reduced congestion, curtailments, emissions (App B)

State RPS Targets*

NJ: 50% by 2030**	VA: 100% by 2045/2050 (IOUs)
MD: 50% by 2030	NC: 12.5% by 2021 (IOUs)
DE: 40% by 2035	OH: 8.5% by 2026
DC: 100% by 2032	MI: 15% by 2021
PA: 18% by 2021***	IN: 10% by 2025***
IL: 25% by 2025/2026	

* RPS targets at time of study
** Includes an additional 2.5% of Class II resources each year
*** Includes non-renewable "alternative" energy resources

Table 10. Renewable Capacity in Model for Achieving State RPS Targets

State	Year	Offshore Wind (MW)	Onshore Wind (MW)	Solar (MW)	Storage (MW)
NJ	2027	2,900	-	7,111	1,475
	2035	*7,648	-	11,322	2,875
MD	2027	768	210	5,002	-
	2035	1,568	210	5,602	-
DC	2027	-	-	343	-
	2035	-	-	462	-
DE	2027	-	-	468	-
	2035	-	-	595	-
VA	2027	2,600	130	6,270	280
	2035	5,200	130	16,570	3,100
NC	2027	-	600	1,117	-
	2035	-	600	1,153	-
PA	2035	-	1,585	2,185	58
IL		-	7,329	2,406	1,080
OH		-	1,742	3,938	24
MI		-	-	356	-
IN		-	2,325	275	-
Rest of PJM KY, TN, WV *(non-RPS states)*		-	609	713	54
2035 Total		14,416 MW	14,530 MW	45,577 MW	7,191 MW

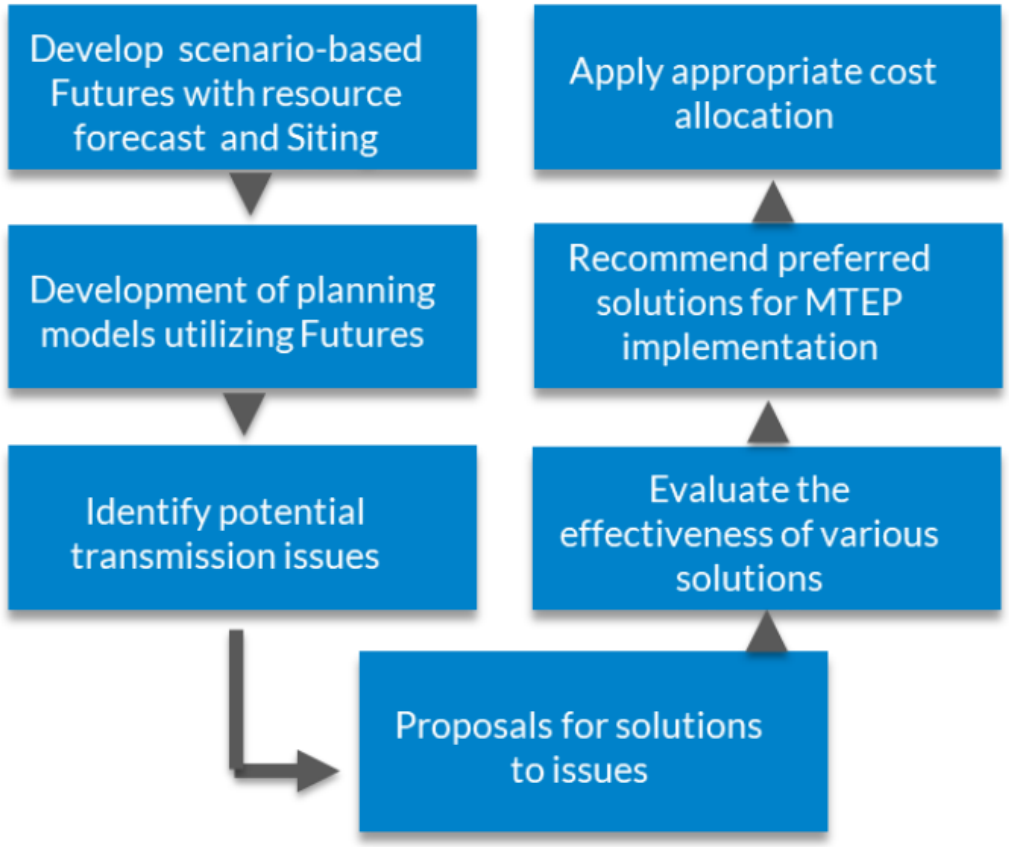
Table 7. Scenario 4 Results

	<230 kV	230 & 345 kV	500 kV	Transformer	Upgrade Cost ($M)
Atlantic City Electric	$11.30	$27.60		$11.34	$50.24
American Electric Power	$33.50			$9.00	$42.50
Allegheny Power Systems (FirstEnergy)	$37.20				$37.20
Baltimore Gas & Electric	$27.60	$27.25	$173.50		$228.35
ComEd	$15.10	$38.40			$53.50
Dominion	$135.00	$557.40	$995.30	$191.00	$1,878.70
Delmarva Power	$35.20	$18.50			$53.70
Jersey Central Power & Light	$13.80	$15.90			$29.70
Met-Ed	$9.20	$5.20			$14.40
PECO		$75.60	$303.50	$50.00	$429.10
Penelec				$50.00	$50.00
Pepco		$0.70			$0.70
PPL		$12.15			$12.15
PSE&G		$332.90			$332.90
Total ($M)	$317.80	$1,111.60	$1,472.30	$311.34	$3,213.14

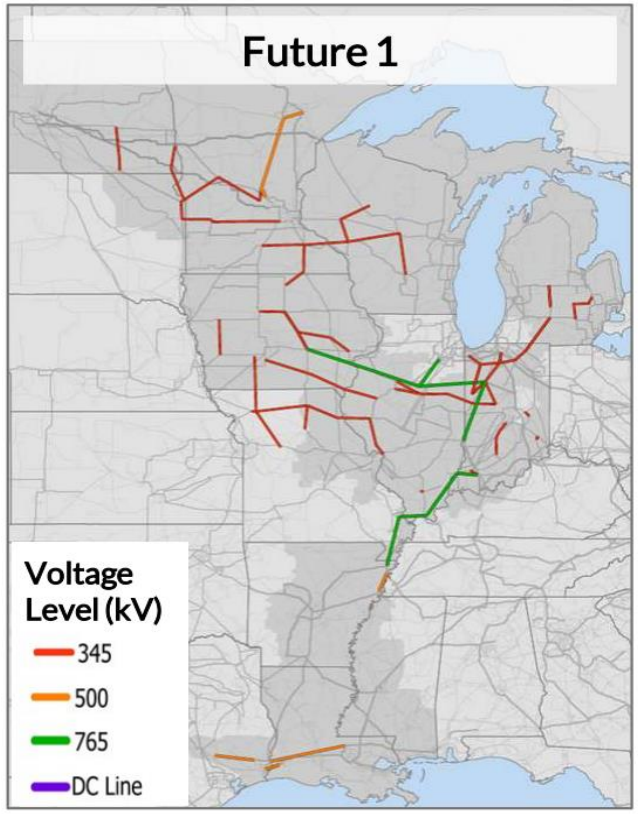
Example: MISO Long-Term Transmission Planning (LRTP)

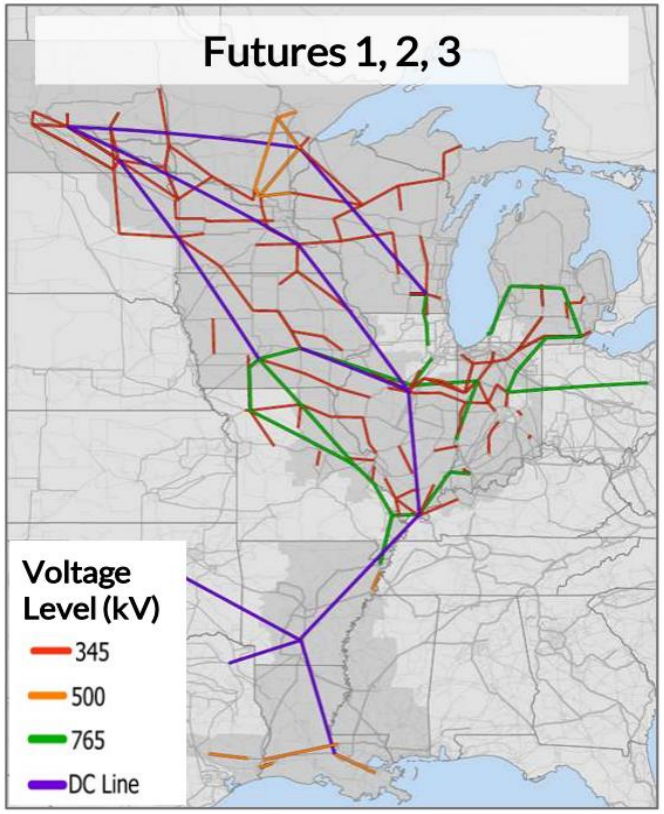
MISO's LRTP effort simultaneously evaluated 20-year reliability, economic, and public policy needs for a diverse set of plausible "Futures" (scenarios)

MISO's 2022 LRTP Process



MISO's Identified Long-Term Transmission Needs





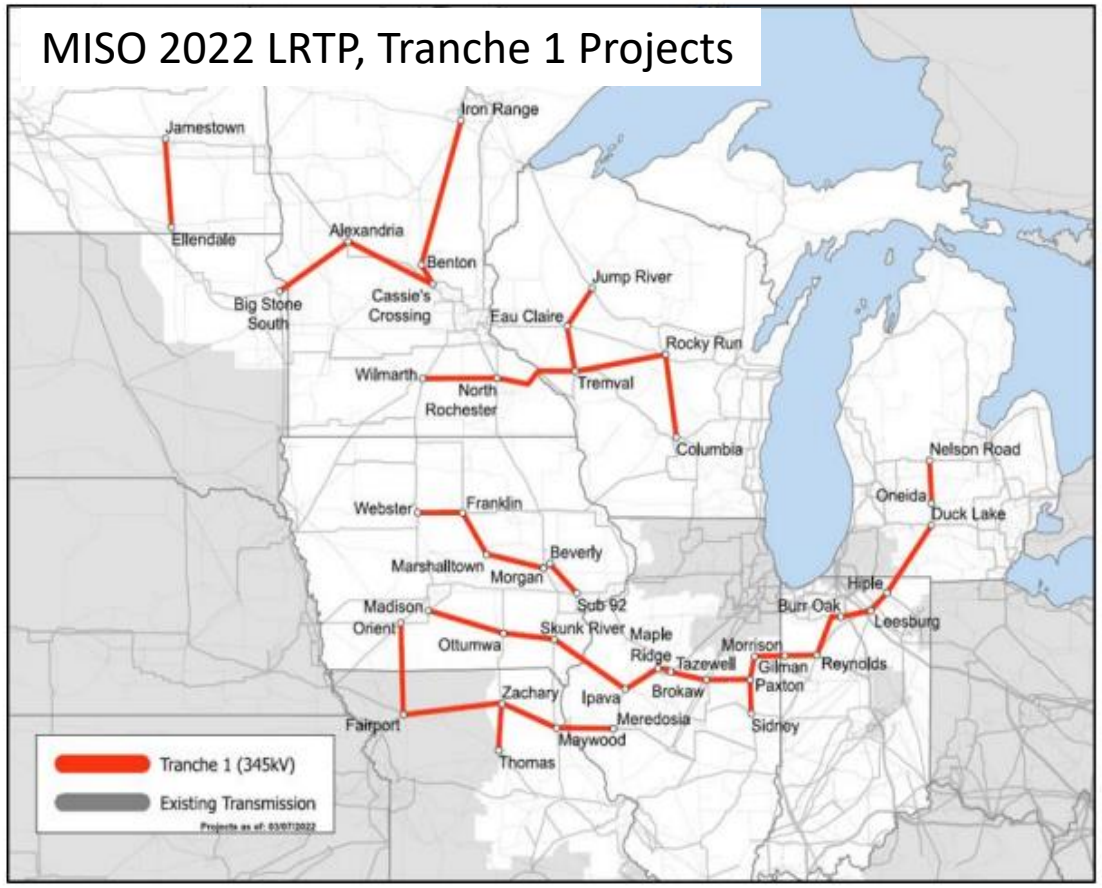
Source: MISO LRTP Roadmap March 2021

Example: MISO Long-Term Transmission Planning (LRTP)

Scenario-based LRTP ➔ First tranche of a new "least regrets" portfolio of multi-value transmission projects (MVPs)

MISO 2022 LRTP results

- Tranche 1: $10 billion portfolio of proposed new 345 kV projects for its Midwestern footprint
- **Supports interconnection of 53,000 MW of renewable resources**
- **Reduces other costs by $37-70 billion**
- Portfolio of beneficial projects designed to benefit each zone within MISO's Midwest Subregion
- Postage-stamp cost allocation within MISO's Midwest Subregion



Source: [3-29-22 LRTP Presentation (misoenergy.org)]

Risk Mitigation Through “Least-Regrets” Transmission Planning

Additional considerations regarding 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 costly in the long term
  - The industry needs to plan for both short- and long-term uncertainties more proactively – and develop "anticipatory planning" processes
- However **“least regrets” planning** too often only 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
- **Probabilistic weighting assumes risk neutrality** and does not distinguish between investment options with very different risk distributions

About the Speaker

Joe DeLosa III

MANAGER
WASHINGTON, D.C.

Joe.DeLosa@brattle.com

+1.845.612.9002

Joe DeLosa III is a Manager at The Brattle Group with comprehensive experience at the intersection of state clean energy policy and wholesale electricity markets. He has served as a subject matter expert for clients and senior policymakers across a wide range of power market issues, including cost-effective implementation of state clean energy policy, resource adequacy, transmission planning, energy and reserve markets, demand response, financial transmission rights, energy efficiency, and energy storage. Mr. DeLosa has offered expert guidance on major state policy initiatives, including PJM's inaugural State Agreement Approach for integrating offshore wind, integrated distribution planning, transmission cost allocation, and retail rate design.

Before joining Brattle, Mr. DeLosa was the Bureau Chief of Federal & Regional Policy at the New Jersey Board of Public Utilities, where he managed all RTO and federal affairs for the State. In his prior role, he also oversaw regulatory affairs for the Delaware Public Service Commission. He has also advised a wide range of PJM states as a long-time member of the Organization of PJM States (OPSI) staff.

Brattle Reports on Transmission Planning

Additional Reading on Transmission

Pfeifenberger, Promoting Efficient Investment in Offshore Wind Transmission, DOE-BOEM Atlantic Offshore Wind Transmission Economics & Policy Workshop, August 16, 2022.

Pfeifenberger, Generation Interconnection and Transmission Planning, ESIG Joint Generation Interconnection Workshop, August 9, 2022.

Pfeifenberger, Proactive, Scenario-Based, Multi-Value Transmission Planning, Presented at PJM Long-Term Transmission Planning Workshop, June 7, 2022.

Pfeifenberger, Planning for Generation Interconnection, Presented at ESIG Special Topic Webinar: Interconnection Study Criteria, May 31, 2022.

RENEW Northeast, A Transmission Blueprint for New England, Prepared with Borea and The Brattle Group, May 25, 2022.

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 et al., Initial Report on the New York Power Grid Study, prepared for NYPSC, January 19, 2021.

Van Horn, Pfeifenberger, Ruiz, "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


BOSTON


BRUSSELS


CHICAGO


LONDON


MADRID


NEW YORK


ROME


SAN FRANCISCO


SYDNEY


TORONTO


WASHINGTON, DC