Challenge: The Generation Interconnection Process

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

2021 US capacity additions

![Chart showing capacity additions by RTO region]

By ISO/RTO region (MW)

- ERCOT: 2,425 MW
- Outside ISO/RTO: 4,629 MW
- MISO: 5,082 MW
- PJM: 4,629 MW
- SPP: 2,425 MW
- CAISO: 1,656 MW
- NYISO: 359 MW
- ISO-NE: 341 MW

RTO Size | Capacity in Queue
--- | ---
80 GW | 135 GW
200 GW | 330 GW
150 GW | 155 GW
180 GW | 245 GW
95 GW | 100 GW
52 GW | 160 GW
42 GW | 75 GW
32 GW | 30 GW

Excess Renewables

Estimated Renewables Development Gap

- Lawrence Berkeley National Lab

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)

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

**Local TO Reliability Projects**
Upgrades to meet local standards

**Generator Interconnection (GI) Projects**
Reliability upgrades for GI requests

**Long Term Transmission Service Projects**
Reliability upgrades for Tx Service Requests

**Regional Reliability Projects**
Addresses remaining reliability needs

**Regional Economic & Public Policy Projects**
Often addresses only a narrow set of remaining needs

**Joint RTO Interregional Planning Processes**
View of remaining needs is often narrow, resulting in few to no projects

---

**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 redispacht 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)

- 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)](https://www.gov.uk/guidance/electricity-network-delivery-and-access#connect-and-manage) [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

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
- **Toward More Effective Transmission Planning:** Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid
- **The Benefits of Electric Transmission:** Identifying and Analyzing the Value of Investments
- **Diversity Value:** The Value of Diversifying Uncertain Renewable Generation through the Transmission System
- **Brattle Grid Strategies:** Toward More Effective Transmission Planning

Summarizes proven approaches to quantifying various benefits.
Additional Reading on Transmission

Pfeifenberger, Transmission Planning and Benefit-Cost Analyses, presentation to FERC Staff, April 29, 2021.

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