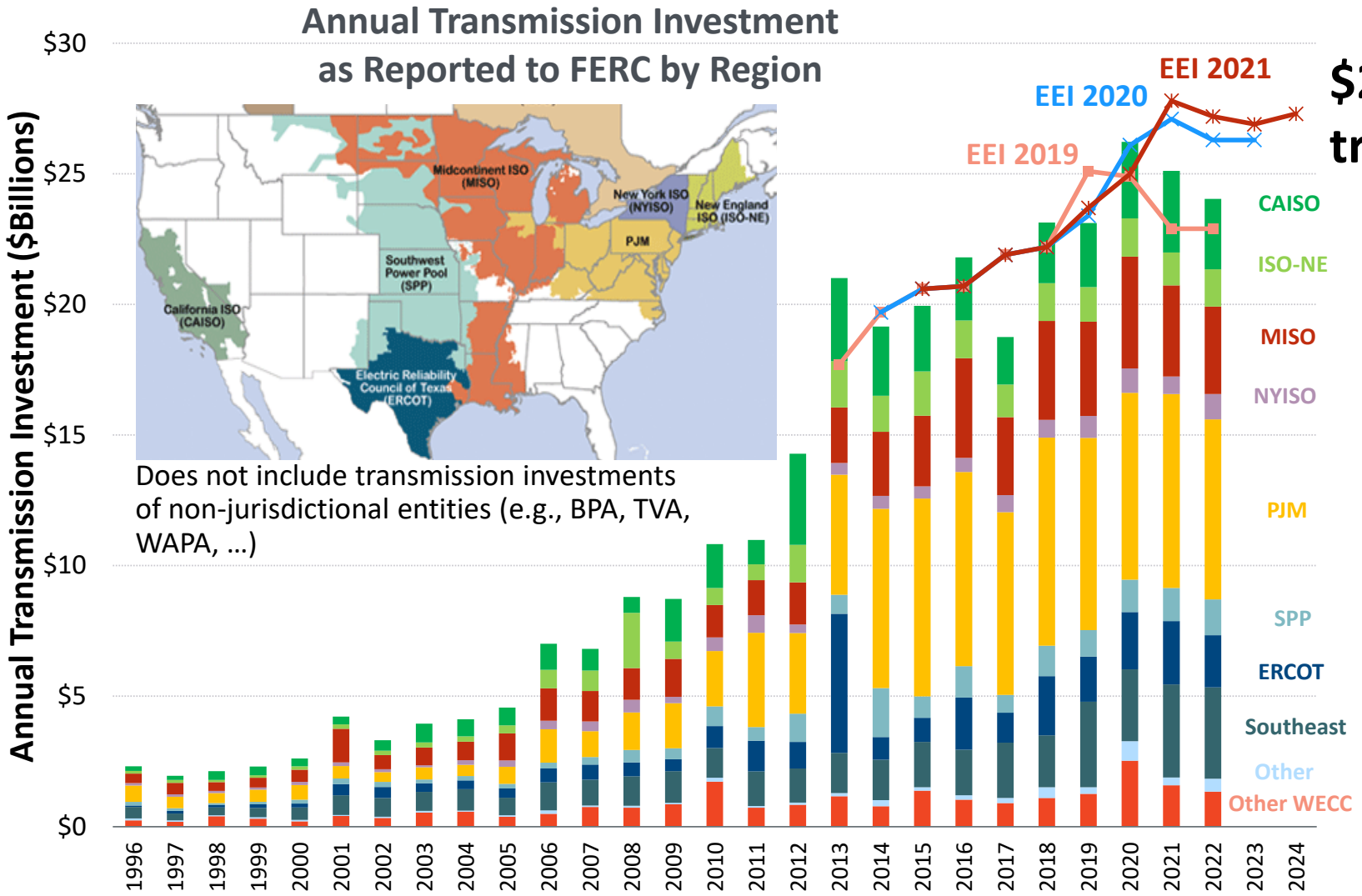
Annual U.S. Transmission Investments 1996-2022

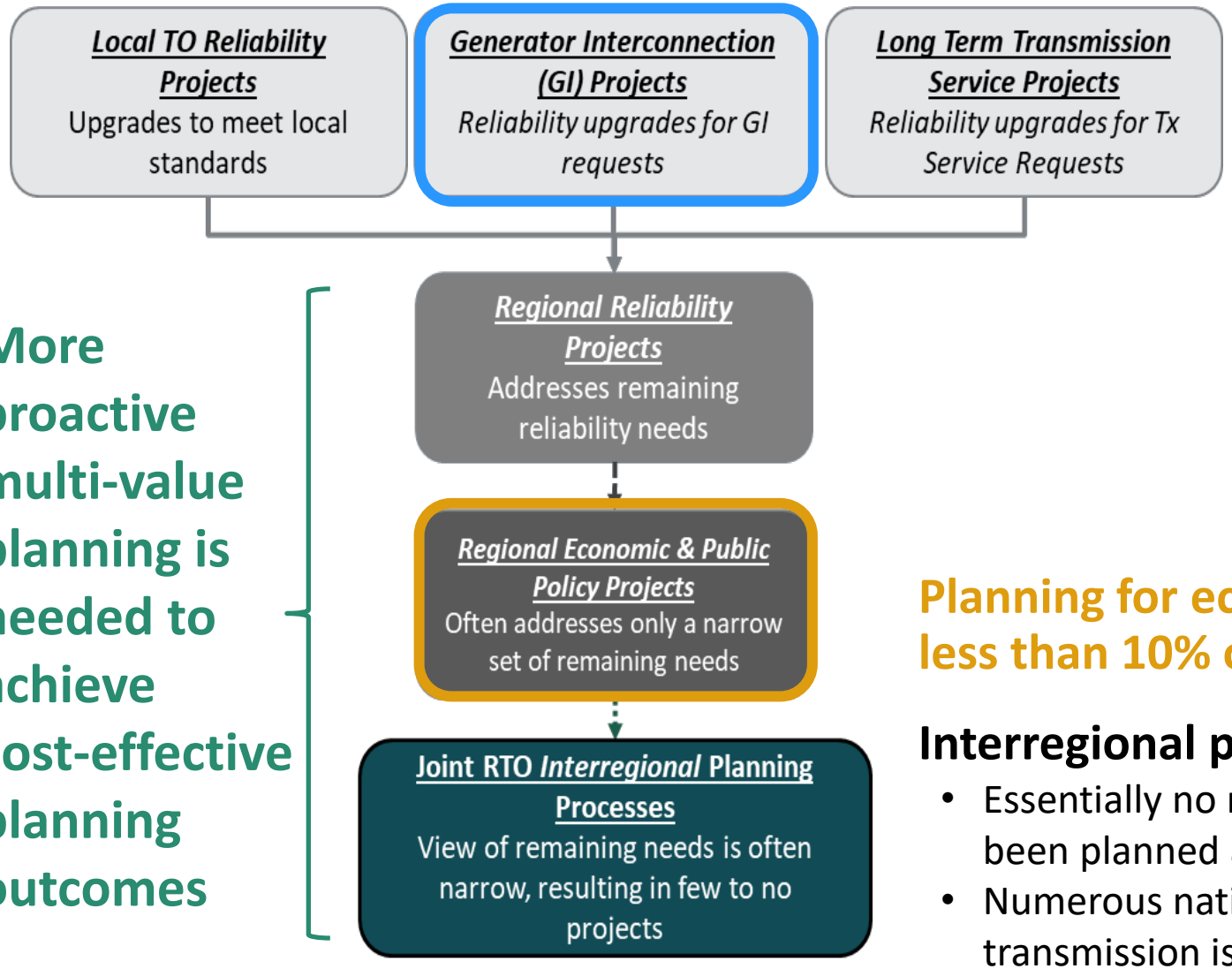


$20-25 billion in annual U.S. transmission investment, but:

- 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 to yield overall cost savings

Sources: The Brattle Group analysis of 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

Siloed, Reliability-focused U.S. Transmission Planning Cannot Identify the Most Cost-Effective Solutions



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)

Incremental generation interconnection has become the primary tool (and efficiency barrier) to support public policy goals

More proactive multi-value planning is needed to achieve cost-effective planning outcomes

Planning for economic & public-policy needs 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

Needed: Transmission Planning for the 21st Century*

FERC NOPR efforts and available experience point to proven planning practices that can reduce total system costs and risks, but are rarely used today:

1. **Proactively plan for future generation and load** by incorporating realistic projections of the anticipated generation mix, public policy mandates, load levels, and load profiles over the lifespan of the transmission investment
2. **Account for the full range of transmission projects' benefits** and **use multi-value planning** to comprehensively identify investments that cost-effectively address all categories of needs and benefits
3. **Address uncertainties and high-stress grid conditions explicitly through scenario-based planning** that takes into account a broad range of plausible long-term futures as well as real-world system conditions, including challenging and extreme events
4. **Use comprehensive transmission network portfolios** to address system needs and **cost allocation** more efficiently and less contentiously than a project-by-project approach
5. **Jointly plan inter-regionally across neighboring systems** to recognize regional interdependence, increase system resilience, and take full advantage of interregional scale economics and geographic diversification benefits

* Brattle & Grid Strategies Report: Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs, October 2021.

Proactive Planning Can Also Streamline 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

Additional Reading on Transmission

Pfeifenberger, DeLosa, et al., The Benefit and Urgency of Planned Offshore Transmission, for ACORE, ACP, CATF, GridLab, and NRDC, January 24, 2023.
Brattle and ICC Staff, Illinois Renewable Energy Access Plan: Enabling an Equitable, Reliable, and Affordable Transition to 100% Clean Electricity for Illinois, December 2022.
Pfeifenberger et al., New Jersey State Agreement Approach for Offshore Wind Transmission: Evaluation Report, October 26, 2022.
Pfeifenberger, DeLosa III, Transmission Planning for a Changing Generation Mix, OPSI 2022 Annual Meeting, October 18, 2022.
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 and DeLosa, 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, for 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.
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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.
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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 and "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, Pfeifenberger, "Well-Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning is Key to the Transition to a Carbon-Constrained Future," WIRES&Brattle, 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 Brattle, April 2015.
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