The Benefit and Urgency of Planned Offshore Transmission:

Reducing the Costs of and Barriers to Achieving U.S. Clean Energy Goals

PRESENTED BY

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Contents

This presentation is based on the report, ***The Benefit and Urgency of Planned Offshore Transmission***, prepared with my colleagues at The Brattle Group, contributions from DNV, and input from an advisory panel of policy and industry experts. American Clean Power Association (ACP), the American Council on Renewable Energy (ACORE), the Clean Air Task Force (CATF), GridLab, and the Natural Resources Defense Council (NRDC) commissioned the analysis.

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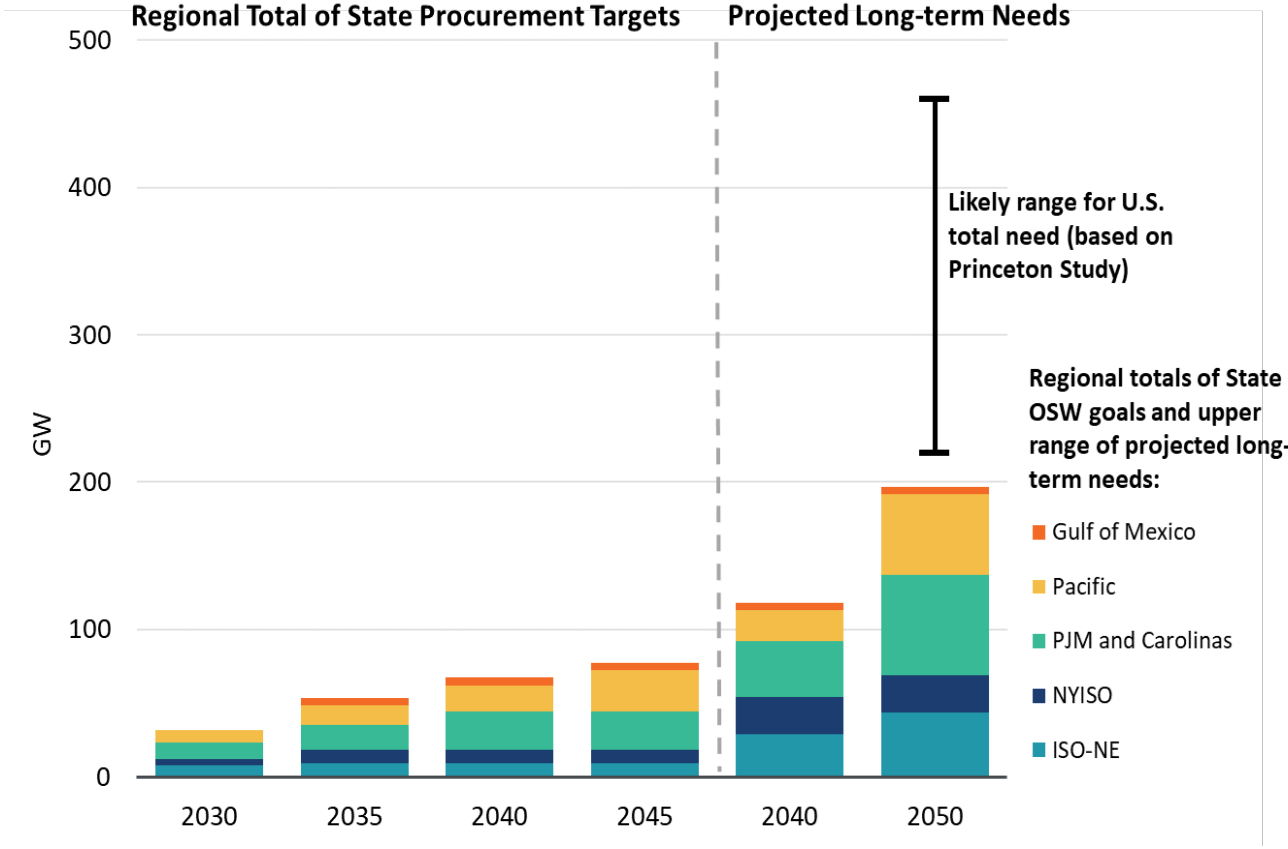
The Urgency of Starting to Plan for OSW Transmission Now

We need to urgently plan transmission (1) for 30-50 GW of OSW by 2030-35, while also considering (2) the much higher longer-term needs of 200-450 GW by 2050



Note: most of the OSW generation will need to be delivered to shore; some may be used to produce hydrogen

State	Already Procured (GW)	Current Goals (GW)	Current Goals Year	Projected 2050 Needs (GW)
ISO-NE	**5**	**8**		**42-44**
Massachusetts	3.2	5.6	2027	23
Connecticut	1.2	2	2030	9-11
Rhode Island	0.4	1-1.4	2035	5
Maine	0.01			5
NYISO	**4.4**	**9**		**14-25**
New York	4.4	9	2035	14-25
PJM	**8.4**	**18.2**		**33-58**
New Jersey	3.8	11	2040	11-26
Maryland	2	2	2030	2
Virginia	2.7	5.2	2034	20-30
SERC		**8**		**7-10**
North Carolina		8	2040	7-10
South Carolina				
MISO		**5**		**5**
Louisiana		5	2035	5
CAISO		**25**		**25**
California		25	2045	25
NWPP				**24-30**
Washington				4-10
Oregon		3	2030	20
State Total	**17.6**	**77**		**150-197**
U.S. Goal/Need		**110**	**2050**	**220-460**

Decisions Made Today Will Impact 2040-2050 OSW Development

It is urgent to start planning now transmission that can cost effectively integrate both near-term OSW goals and long-term clean energy needs

- Substantial transmission development (onshore or offshore) takes a decade or more to develop
- Coordinated transmission for OSW must be identified sufficiently in-advance of generation procurements, to mitigate project-on-project risk and enable generators to utilize the facilities
- Unless both near-term and long-term needs are addressed through holistic planning…
  - Using the best Points of Interconnection (POIs) and transmission corridors for early OSW projects (without considering long-term needs) can severely limit future options
  - Best transmission solutions for individual projects may foreclose the best options to address long-term needs
  - Technology choices made for individual OSW projects may not allow future interoperability and integration into an offshore network
  - Identifying the most attractive solutions requires proactive planning that holistically considers the full set of near- and long-term transmission needs (i.e., generation interconnection, reliability, congestion relief, public policy)

A five-year delay of Planning may cut benefits of coordinated planning in half

The Benefits of Proactively-Planned OSW Transmission

Numerous studies document the benefits of starting proactive planning efforts now.

Proactive planning for at least 100 GW of additional U.S. OSW generation needed by 2050 can:

- Reduce overall transmission costs by at least $20 billion
- Result in 60-70% fewer shore crossings and necessary onshore transmission upgrades
- Reduce marine transmission cable installations by 50% or approx. 2,000 miles
- Significantly accelerate achievement of OSW development timelines by:
  - Eliminating interconnection and transmission-related delays
  - Reducing project-development and cost-escalation risks
  - Reducing environmental and community impacts
  - Achieving more competitive procurement outcomes
  - Facilitating investments in the local clean energy economy

Studies: Benefits of Proactively-Planned Offshore Transmission

Cost-Savings, Regional Planning

- PJM's Offshore Wind Transmission Study for 75 GW of clean energy resources shows a nearly 90% interconnection cost reduction for public policy resources compared with previous cost analyses.
- PJM-New Jersey State Agreement Approach shows over $900 million in cost-savings for interconnecting an additional 6,400 MW of OSW, among other benefits.
- MISO-SPP's Joint Targeted Interconnection Queue Studies reduce interconnection costs by over 50% while reducing other customer costs by approximately $1 billion.
- MISO's Long-Range Transmission Planning effort enables 90 GW of new resource interconnections, offering customer savings with total benefits about 3x total costs.
- National Grid's study for the UK found that proactive planning OSW Transmission through 2050 reduces costs by 19%, along with other benefits. A delay of only 5 years, cuts these benefits in half.

Cost-Savings, Inter-regional Planning

- LBNL's recent study found expanding transmission capability between any of the 3 northeastern ISOs by 1,000 MW would have saved $100-300 million per year in wholesale power purchases, expected to grow with time.
- LBNL also identified resilience benefits, based on a large amount of interregional transmission value occurring during difficult-to-forecast times of severe system stress.
- MIT's recent study of the Northeastern U.S. and Canada found that an additional 4 GW of transmission capacity to Quebec could lower costs of zero-emissions power systems by 17-28%.
- A recent national study by MIT found for deeply-decarbonized systems interregional transmission could reduce total generation and transmission costs by up to 20%.
- A recent General Electric Study for NRDC showed that expanding interregional transmission capacity by 87 GW between various regions would provide $83 billion in customer benefits.

Studies: Benefits of Proactively-Planned Offshore Transmission

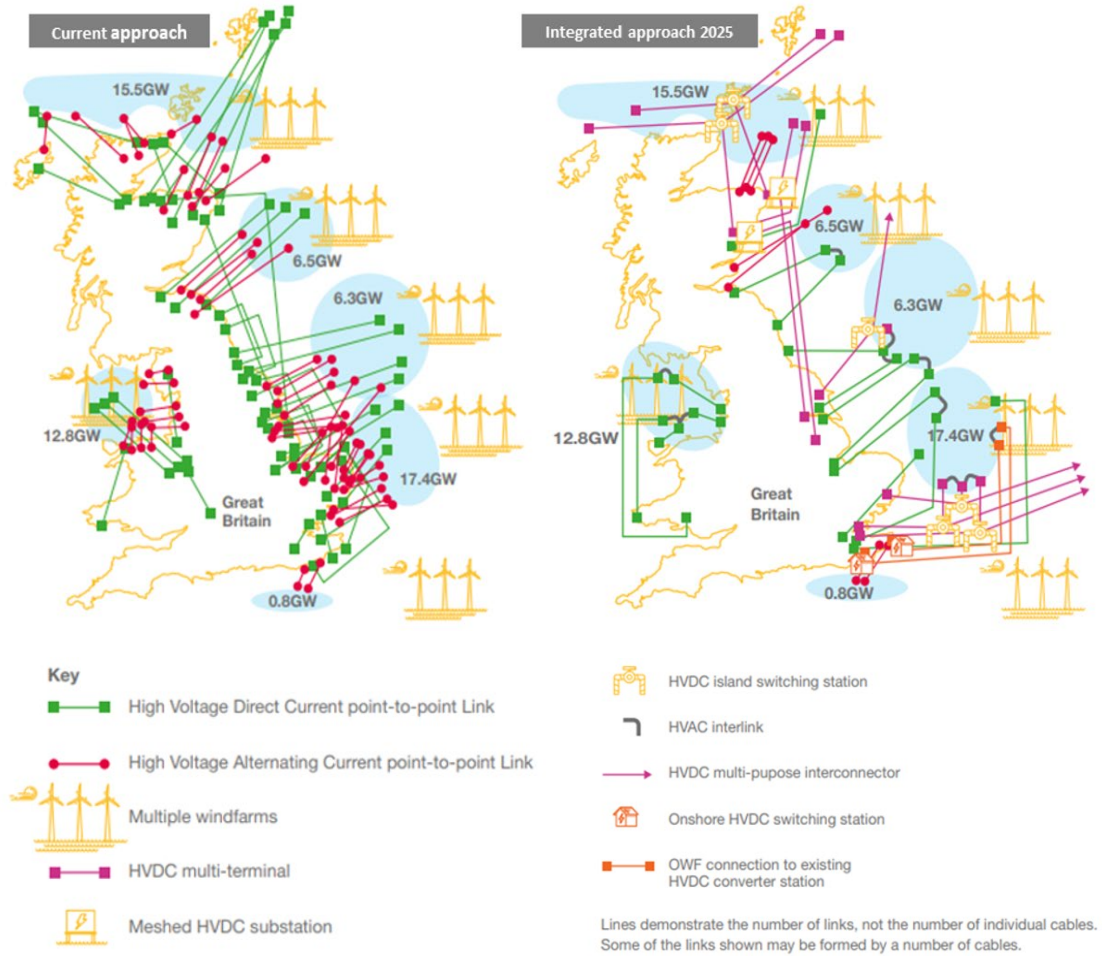
Environmental & Community Benefits

- National Grid found that proactive planning for U.K.'s 2050 OSW goal significantly reduced marine and shoreline impacts, with 70% fewer beach crossings, and 30% lower offshore line-miles. The study similarly found reduced onshore impacts, with proactive planning requiring 60% fewer onshore line miles, and 55% less land.
- Similar benefits have been demonstrated by Brattle and Anbaric for New England and NY
- The magnitude of these benefits is confirmed by New Jersey's experience with the State Agreement Approach, which allowed the consolidation of onshore grid access into a single transmission corridor, reducing onshore environmental and community impacts by two-thirds.

Employment Benefits

- Extrapolating from Clean Energy State Alliance projections, onshoring supply-chains to meet current goals could provide 135,000 jobs.
- The American Wind Energy Association has forecasted 20-30 GW of OSW will support between 45,000-83,000 American jobs by 2030.
- Similar estimates from American Clean Power estimate 23-40 GW OSW will result in 73,000-128,000 direct jobs.

UNPLANNED VS. PLANNED TRANSMISSION FOR U.K. OFFSHORE WIND IN 2050
(Assuming planning efforts start to be effective by 2025)



Source: National Grid ESO, *Offshore Coordination Phase 1 Report*, December 2020.

Additional Benefits of Networked Offshore Transmission

Using standardized, modular offshore transmission facilities that can be networked into an offshore transmission system and integrated with the onshore grid offers important additional advantages:

- Improve the reliability and value of offshore wind generation deliveries
- Allow for the utilization of new, higher-capacity transmission cables (each able to deliver 2–2.6 GW of OSW), which further reduces costs and impacts to communities and the environment
- Improve the utilization and flexibility of the offshore transmission infrastructure
- Reinforce and avoid upgrades of existing onshore grids, which will improve grid-wide reliability and reduce future congestion costs
- Create unique, cost-effective opportunities to add valuable interregional transmission links (e.g., addressing constraints into New York City), that increase grid resilience and reduce system-wide costs

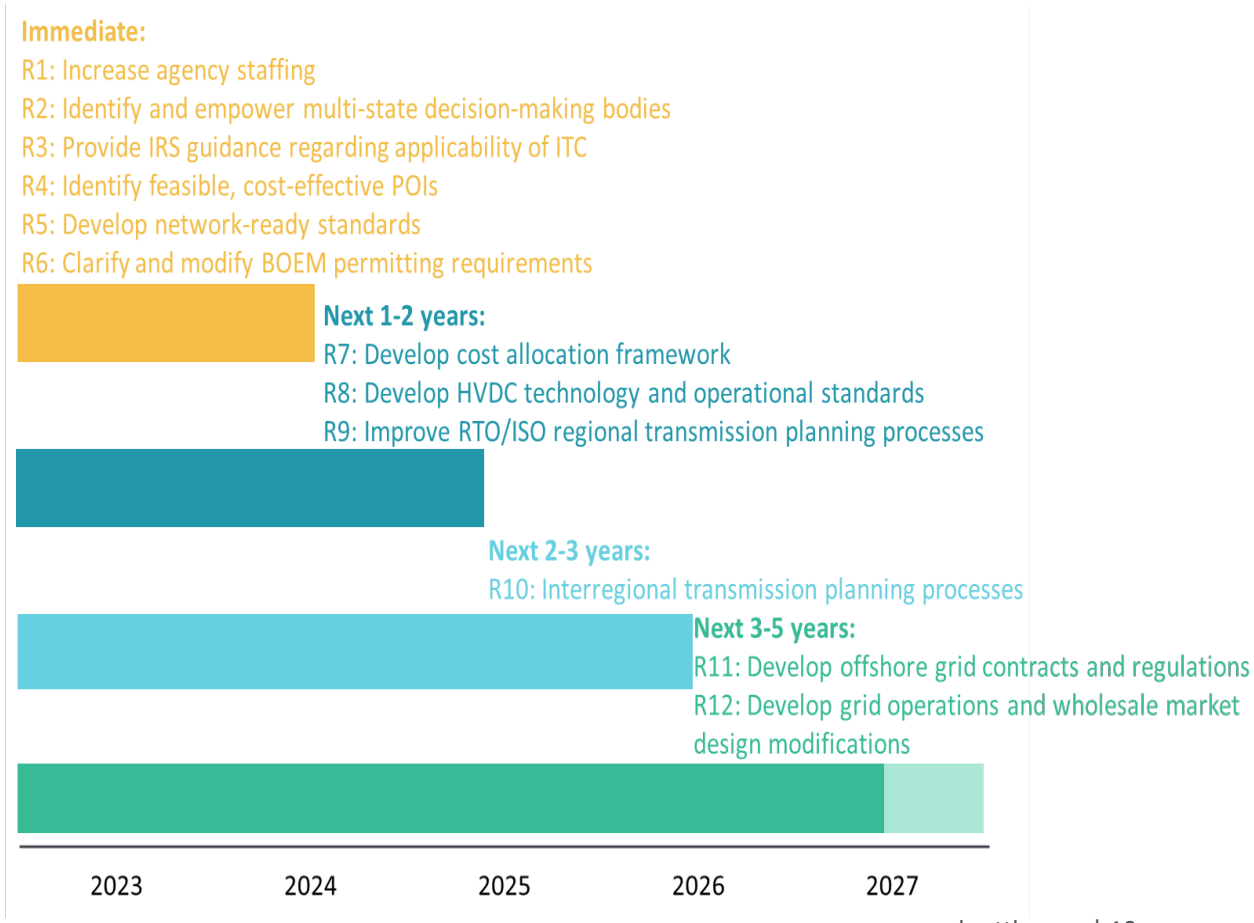
Challenges to Achieving Well-Planned Transmission Solutions

Grid Planning Processes	• Slow, costly, reactive, and incremental **generator interconnection processes** currently used by the regional grid operators create delays and increase the cost of integrating clean energy resources. • Siloed **regional grid planning** processes that fail to identify cost-effective solutions that can simultaneously address the full set of reliability, economic, and public policy transmission needs. • The absence of effective planning processes for **interregional transmission**.
Regulations, Contracts, & Operations	• Uncertainty over federal **investment tax credits** and other federal funding imposes substantial uncertainty on OSW planning efforts. • Undefined **regulatory and contractual frameworks** for the shared and networked operation and use of offshore transmission facilities. • Regional **grid operations** that are not yet equipped to optimize fully regional or interregional HVDC links. • An unclear and poorly understood **BOEM permitting** process for offshore transmission that is distinct from offshore wind generators' individual interconnection cables. • **Uncoordinated processes** for lease-area auctions, state procurement of OSW generation, and regional transmission planning.
Technology	• The lack of HVDC **technology standardization** (e.g., an HVDC grid code and vendor compatibility standards) and the slow adoption and operational integration of advanced HVDC technology in the U.S. • The lack of a compelling benefits case for specific **meshed offshore grid solutions** that can also reinforce the regional grid and provide interregional transmission capability.

Recommendations for Addressing the Identified Challenges

Twelve recommendations: prioritized into four categories, with progress on immediate actions critical to avoid foreclosing attractive solutions

- **Immediate (over the next year):** ensure that some of the identified challenges can be addressed expeditiously in states' OSW generation and transmission procurements
- **Near-term (over the next 1-2 years):** ensure that holistic planning of offshore transmission networks can start at the regional grid operator level
- **Mid-term (over the next 2-3 years):** enable effective interregional transmission planning processes between existing grid operators
- **Longer-term actions (over the next 3-5 years):** develop the necessary grid operations, wholesale market, regulatory, and contractual frameworks, which need to be in place before networked offshore facilities are placed into service



Recommendations for 2023

Immediate Actions

1. **Increase staffing at state and federal regulatory agencies involved in OSW planning**
   - *Relevant entities: state governors or senior policymakers, federal policymakers*
2. **Create and empower multi-state decision-making entities**
   - *Relevant entities: state governors or senior policymakers and state regulatory agencies with support of grid operators, DOE, FERC, BOEM, industry stakeholders, possibly in collaboration with federal PMAs*
3. **Provide IRS guidance regarding applicability of ITC to offshore interconnection facilities**
   - *Relevant entities: IRS*
4. **Identify feasible POIs to cost-effectively accommodate identified OSW needs over time**
   - *Relevant entities: states, multi-state entities, DOE, grid operators, FERC*
5. **Develop network-ready standards for offshore facilities that can be linked to create offshore grid**
   - *Relevant entities: DOE, states, grid operators with input from OSW generation and transmission developers*
6. **Clarify and modify BOEM transmission permitting and lease-process coordination**
   - *Relevant entities: BOEM, DOE, OSW transmission developers*

Recommendations for the Next 5 Years

Near-Term Actions (1-2 years)

7. **Develop multi-state cost-allocation framework**
   - *Relevant entities: state regulatory agencies, grid operators, FERC*
8. **Develop HVDC-technology and operational standards**
   - *Relevant entities: DOE, grid operators, states*
9. **Improve regional transmission planning processes (ongoing)**
   - *Relevant entities: FERC, grid operators*

Mid-Term Actions (2-3 years)

10. **Create effective interregional transmission planning processes**
    - *Relevant entities: FERC, grid operators, multi-state entities with input from market participants*

Longer-Term Actions (3-5 years)

11. **Develop offshore grid contracts and regulations for shared-use and open-access facilities**
    - *Relevant entities: DOE, FERC, states, multi-state entities, grid operators, with input from OSW generation and transmission developers*
12. **Develop grid operations and wholesale market design modifications**
    - *Relevant entities: DOE, FERC, grid operators, transmission owners*

Newly Available Federal Support

Substantial federal support is available now, but should continue to evolve to more fully meet the funding needs of regional & interregional OSW transmission development

1. Inflation Reduction Act:

- ***Section 50153****: up to $100 million is available for funding for planning, modeling, analysis, and convening stakeholders;*
- ***Section 50152****: up to $760 million to facilitate the siting of certain interstate and offshore transmission lines;*
- ***Section 50151****: up to $2 billion in facility financing, including loan guarantees, to certain transmission facilities designated by Secretary of Energy to be in the national interest;*
- ***Section 1706****: up to $250 billion in energy infrastructure reinvestment loan financing, to retool, repower, or repurpose energy infrastructure, including transmission to avoid or reduce greenhouse gases;*
- ***Section 13502****: includes additional tax credits for domestic manufacturing of offshore wind facilities and vessels.*

2. Infrastructure Investment and Jobs Act:

- ***Section 40101****: up to $5 billion for resilience grants, including $2.5 billion for Grid Resilience utility Grants (40101 (d)) for states, tribes, and territories, and $2.5 billion for Grid Resilience Industry Grants (40101(c)) through competitive grants;*
- ***Section 40103(b)****: up to $5 billion for the Grid Innovation Program, funding innovative approaches to transmission, storage, and distribution infrastructure;*
- ***Section 40107****: up to $3 billion for Smart Grid Grants, enabling deployment of technologies that enhance grid flexibility;*
- ***Section 40106****: up to $2.5 billion on a revolving basis for the Transmission Facilitation Program, which allows DOE to engage in various ways (including capacity contracts) to assist in the design, construction, operation of qualifying facilities.*

Thank You!

Comments and Questions?

About the Speaker

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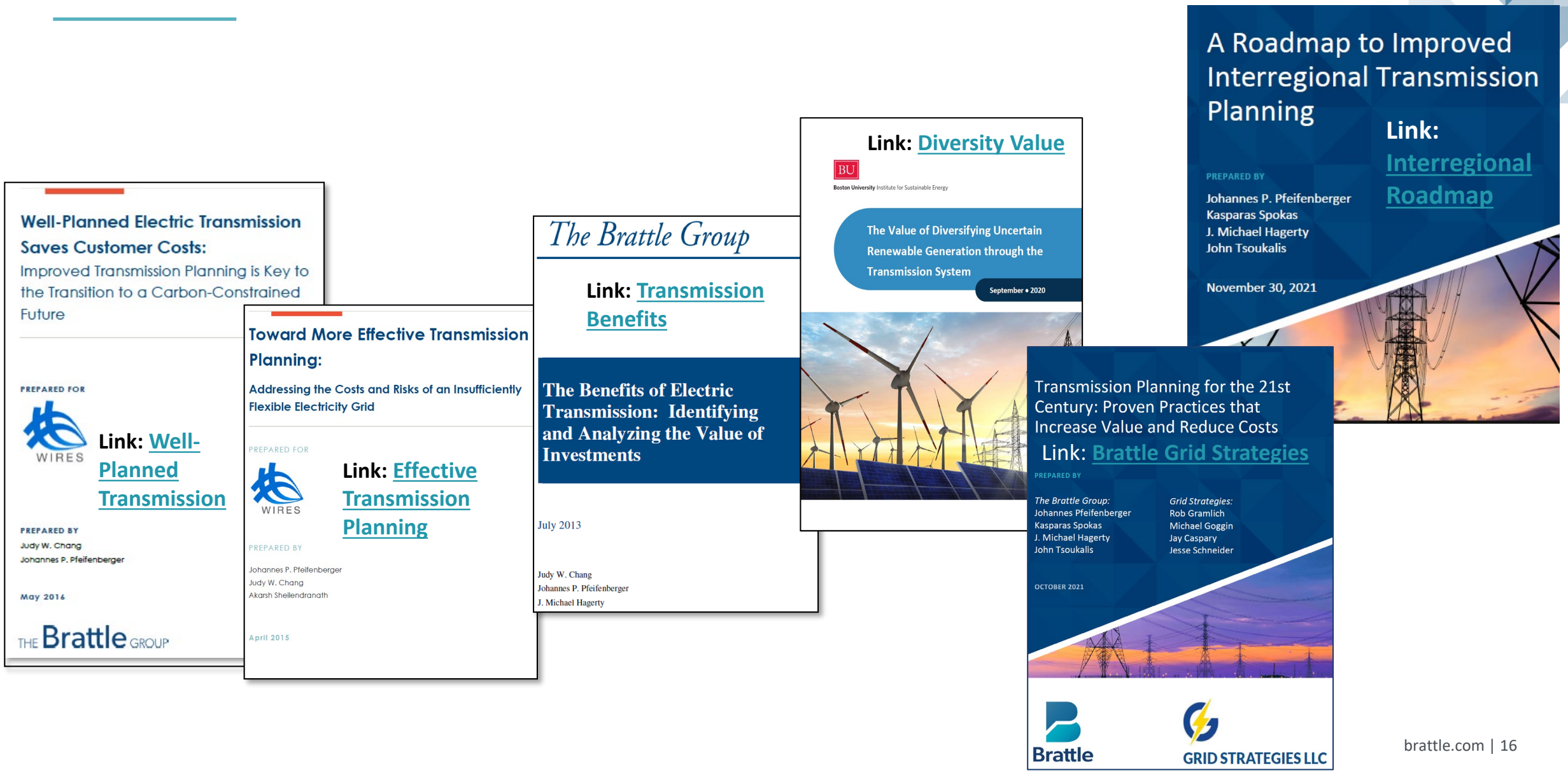
Johannes (Hannes) Pfeifenberger, a Principal at The Brattle Group, is an economist with a background in electrical engineering and over twenty-five years of experience in wholesale power market design, renewable energy, electricity storage, and transmission. He also is a Visiting Scholar at MIT's Center 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 renewable generation interconnection 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 and has analyzed offshore-wind transmission challenges in New York, New England, and New Jersey.

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 Regional and Interregional Transmission Planning and Benefit-Cost Analyses



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Brattle Group Practices and Industries

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