

# An Action Plan for Offshore Wind Transmission Development in the Atlantic Region

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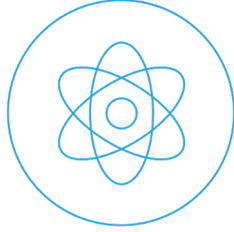
Mike Mullaley: April 29, 2024

Independent State Agencies Committee Meeting

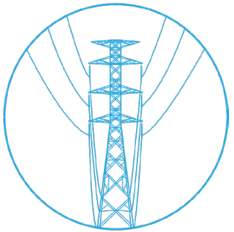


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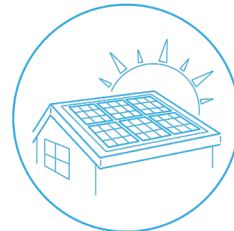
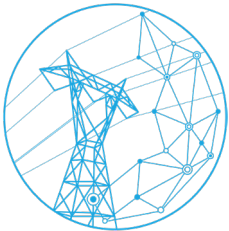
# GDO Mission and Goals



Ensure **resource adequacy** by supporting **critical generation sources** and expanding and enhancing **electricity markets**.

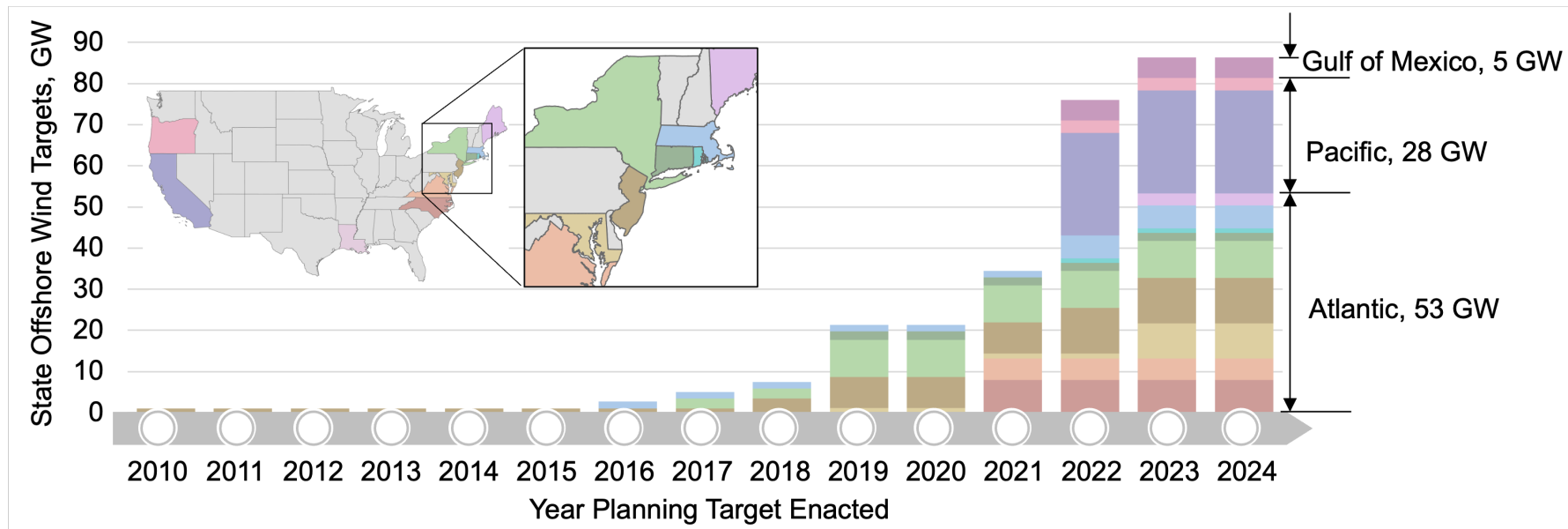


Catalyze the development of new and upgraded **high-capacity electric transmission lines** and an improved **distribution system** nationwide.



Prevent **outages** and enhance the **resilience** of the electric grid.

# National and State Offshore Wind Goals



In 2021, the Biden-Harris Administration set a national offshore wind deployment goal. It also tasked the DOE and U.S. Department of the Interior's (DOI) Bureau of Ocean Energy Management (BOEM) with jointly developing a plan to address transmission needed for that level of OSW deployment.

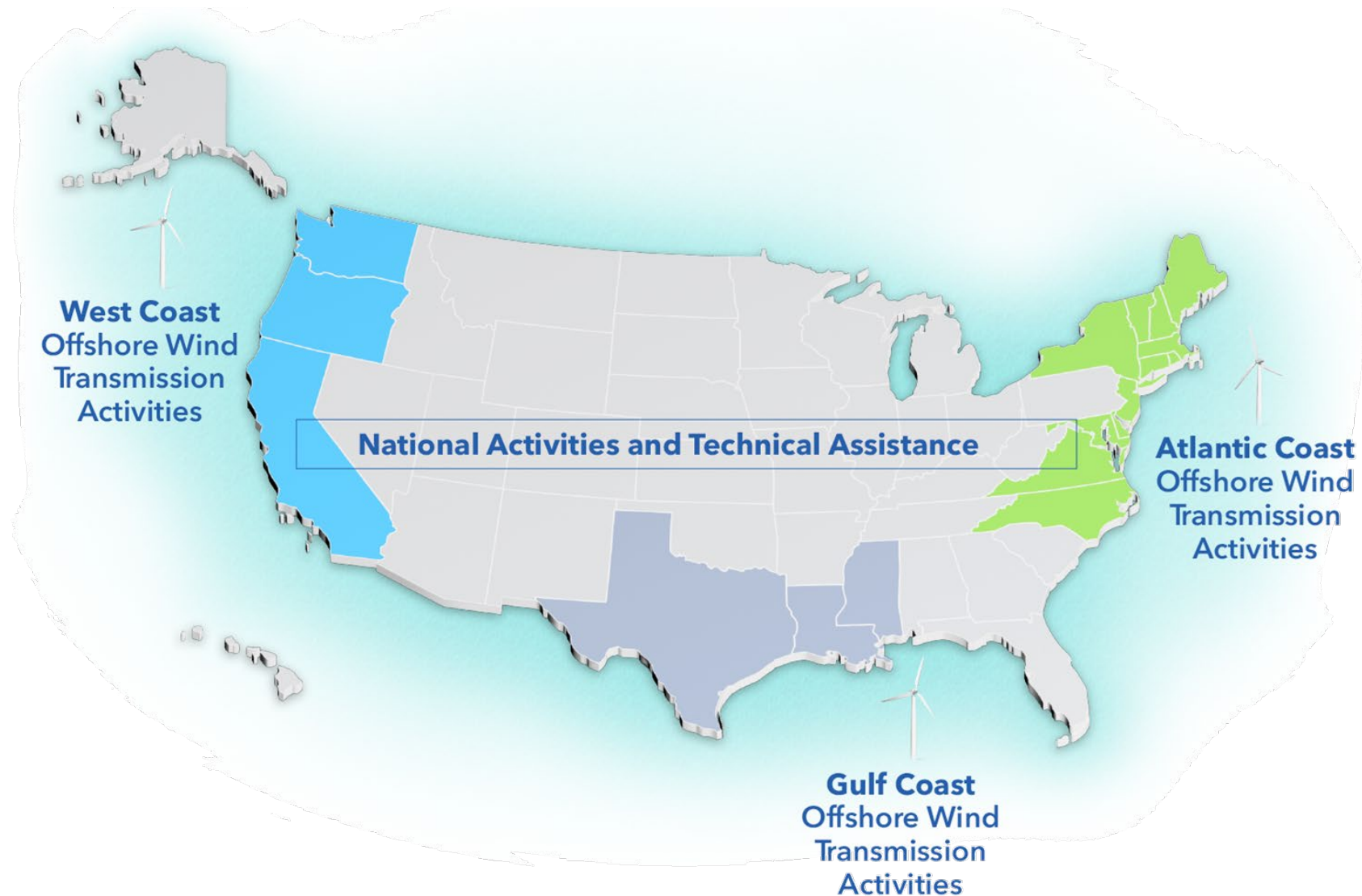
## National Offshore Wind Goals

- 30 GW by 2030
- Pathway to 110+ GW by 2050
- 15 GW floating by 2035

## State Offshore Wind Goals

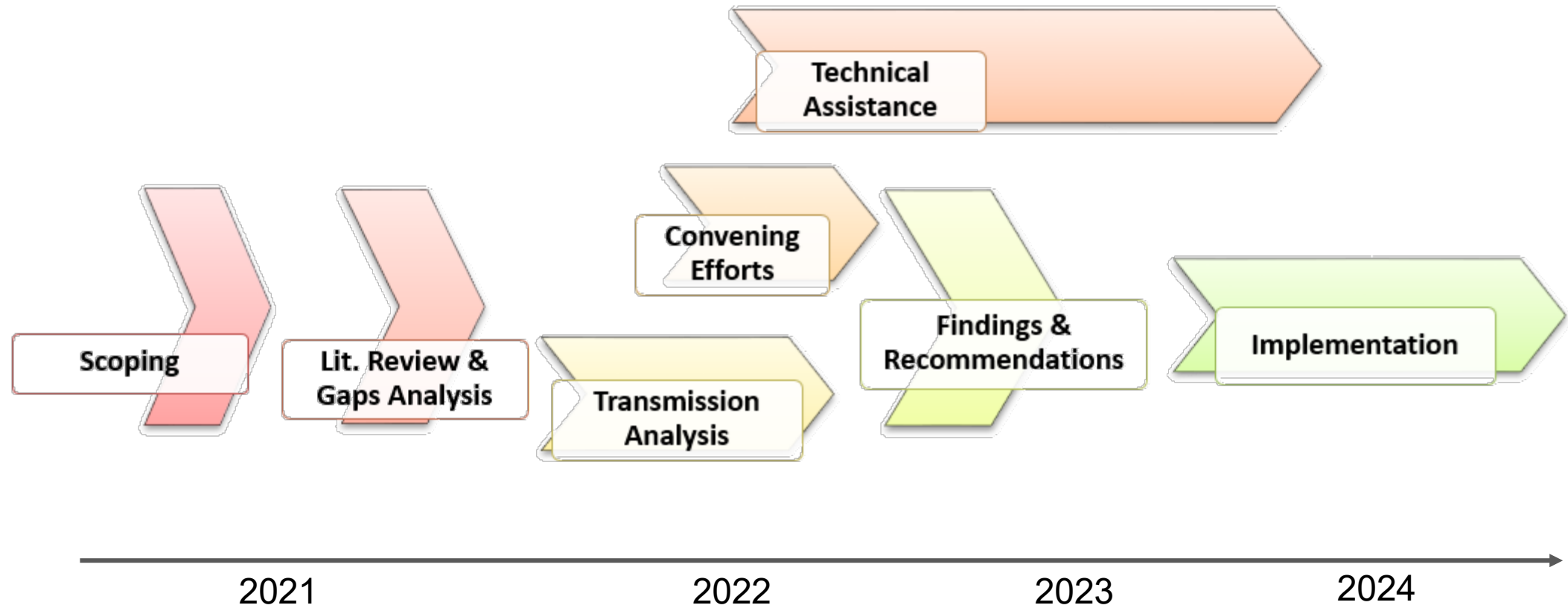
- States have policies to support over 80 GW

# DOE Efforts on Offshore Wind Transmission



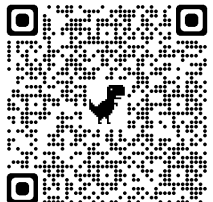
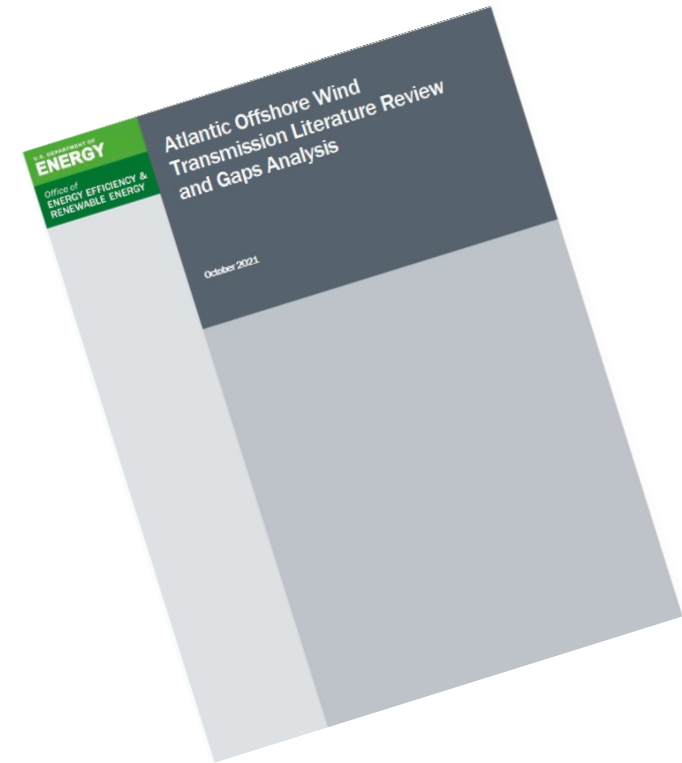


# Atlantic Engagement & Prior Work



# Literature Review and Gaps Analysis

- ▶ 20+ publicly available transmission analyses reviewed
- ▶ Key themes and knowledge gaps:
  - Isolated geographic and ocean planning
  - Lack of coordination between offshore wind generation and transmission
  - Limited study scope and breadth
  - Lack of reliability and resilience considerations
- ▶ To address these gaps:
  - Convene interested parties to evaluate offshore wind transmission options and system impacts
  - Identify collaborative pathways to achieve deployment goals
  - Conduct broader, more comprehensive interregional studies of potential offshore wind transmission options
  - Develop standards



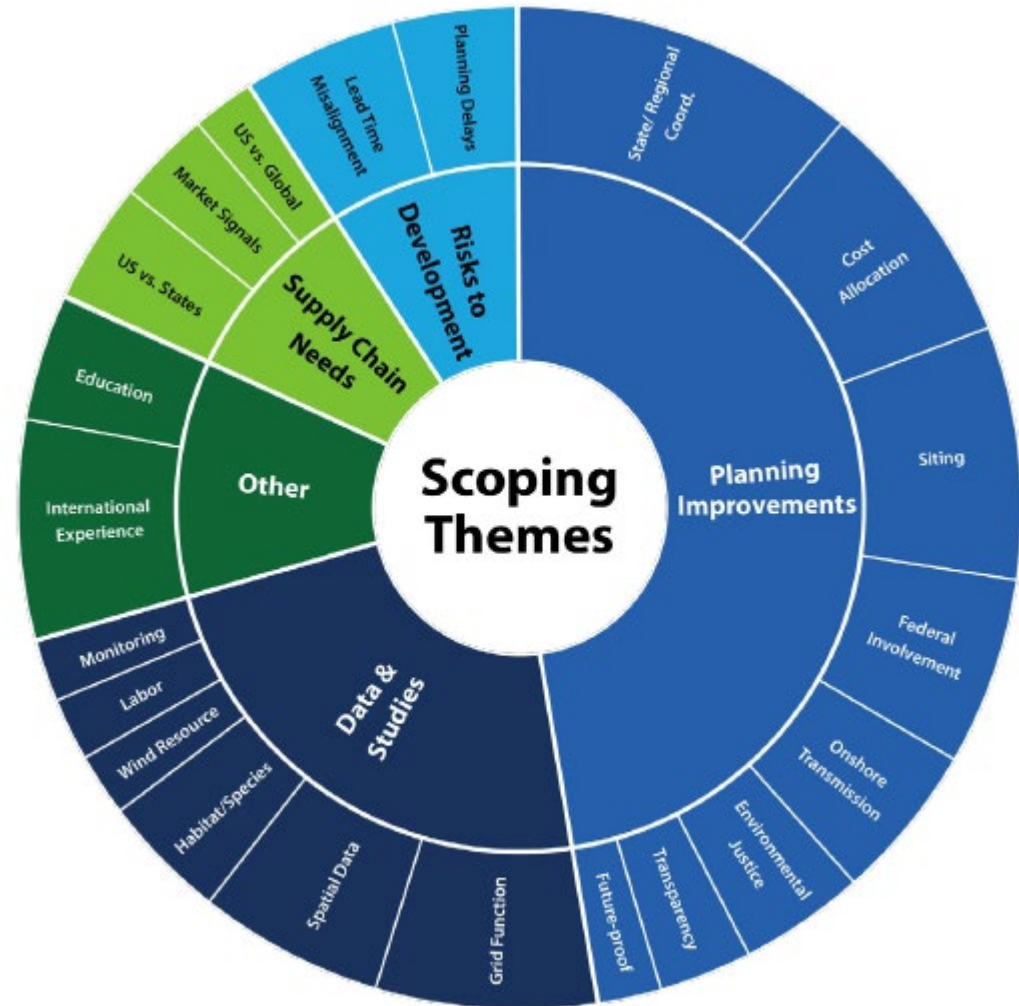
# Scoping Calls and Convening Workshops

## Scoping Calls (2021)

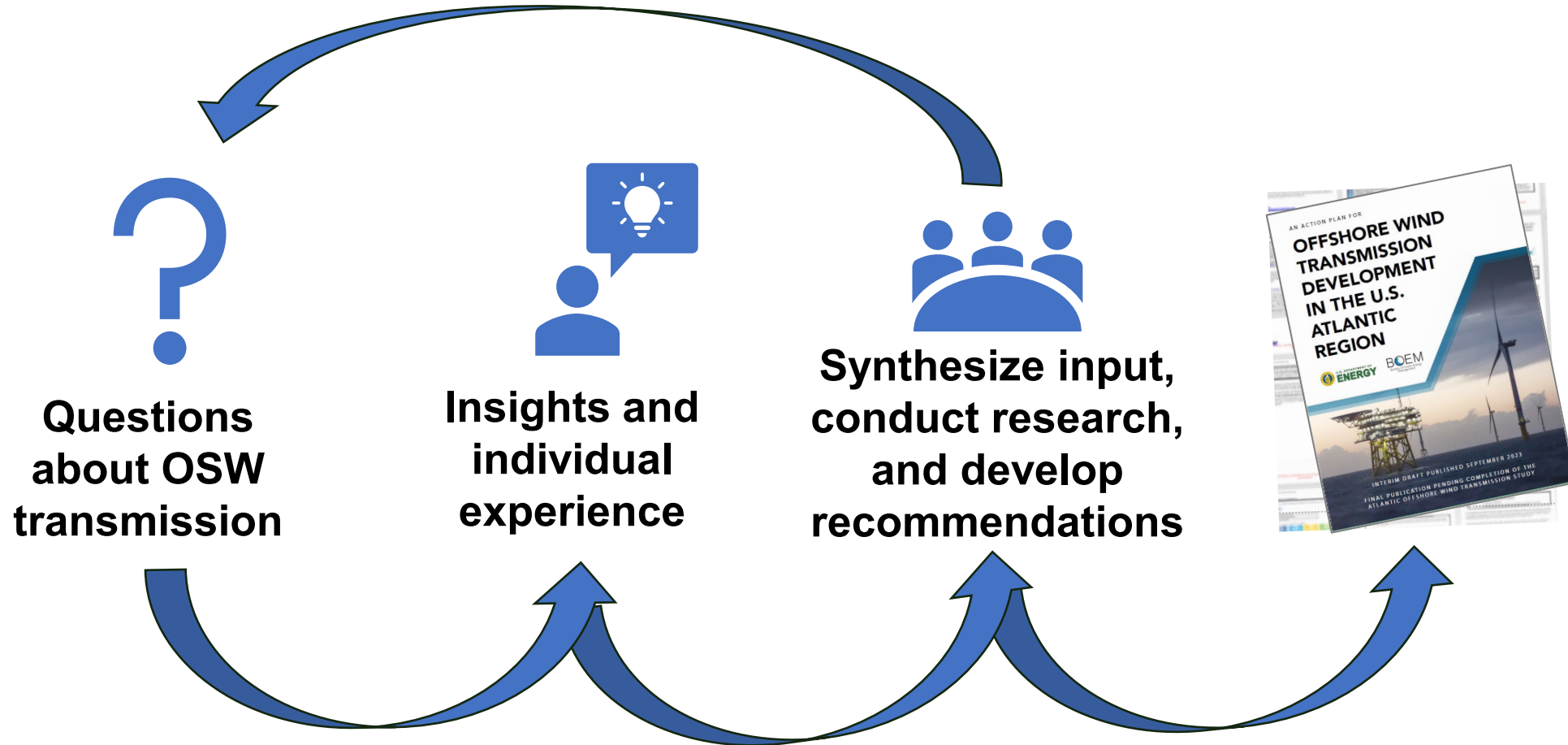
- ▶ DOE and BOEM hosted 21 listening sessions
- ▶ More than 100 entities participated

## Convening Workshops (2022-2023)

- ▶ DOE and BOEM hosted nine workshops
- ▶ Over 40 hours of expert presentations and facilitated roundtable discussions
- ▶ More than 875 individuals participated across 43 entities



# How was input used?



# Atlantic Offshore Wind Transmission Study

2-year study (November 2021 – October 2023) by NREL/PNNL  
Alignment with federal and state offshore wind goals

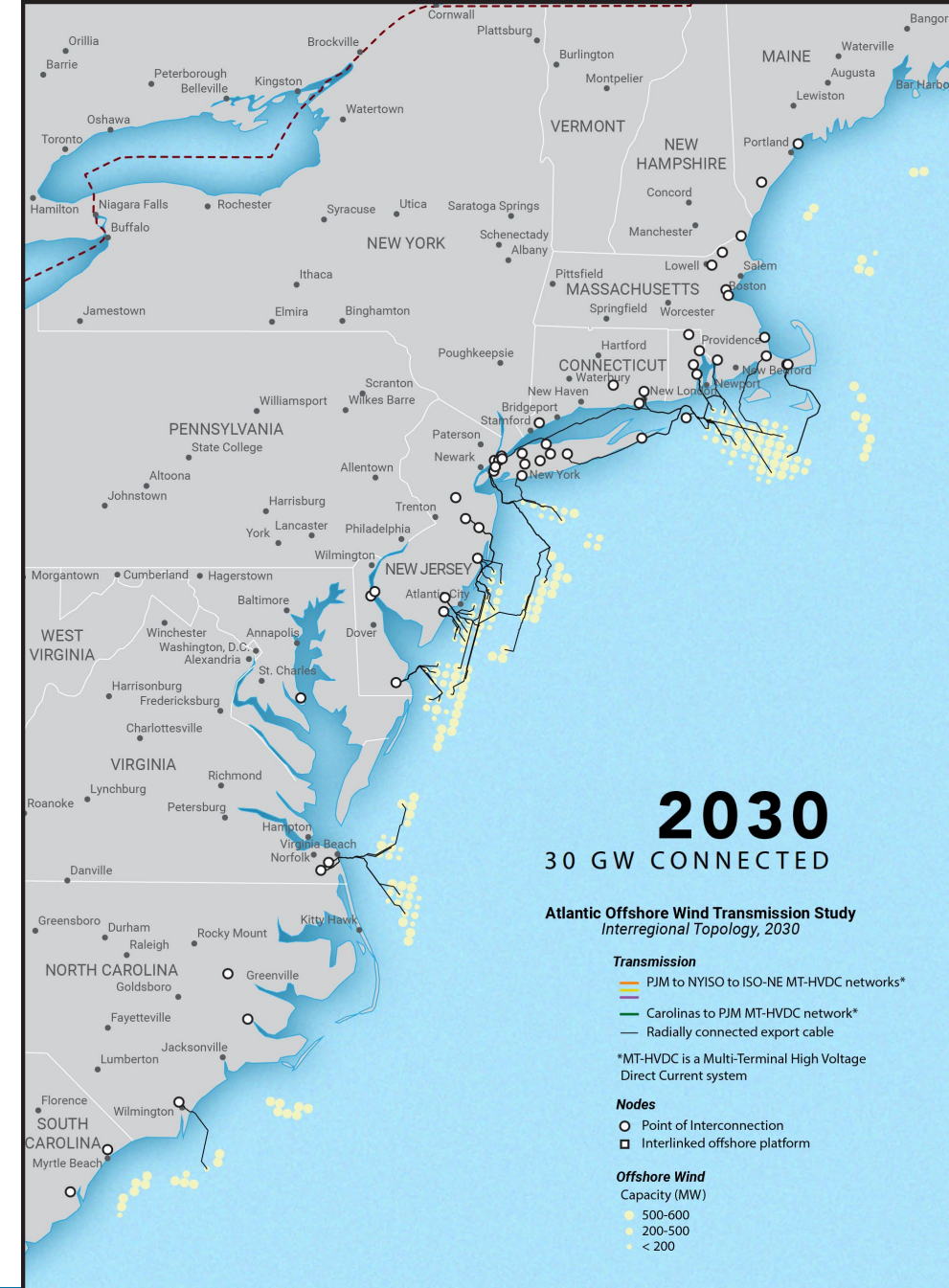
## Goals:

- Determine what the potential costs, benefits, and impacts of offshore transmission networks are
- Identify high-value coordinated transmission solutions through multi-scenario modeling & analysis
- Avoid known areas of co-use conflicts, exclusions
- Minimize overall cable distances

## Maps:

- Interregional networked topology
- 5-year increments (2035-2050)

NREL website: [www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html](http://www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html)

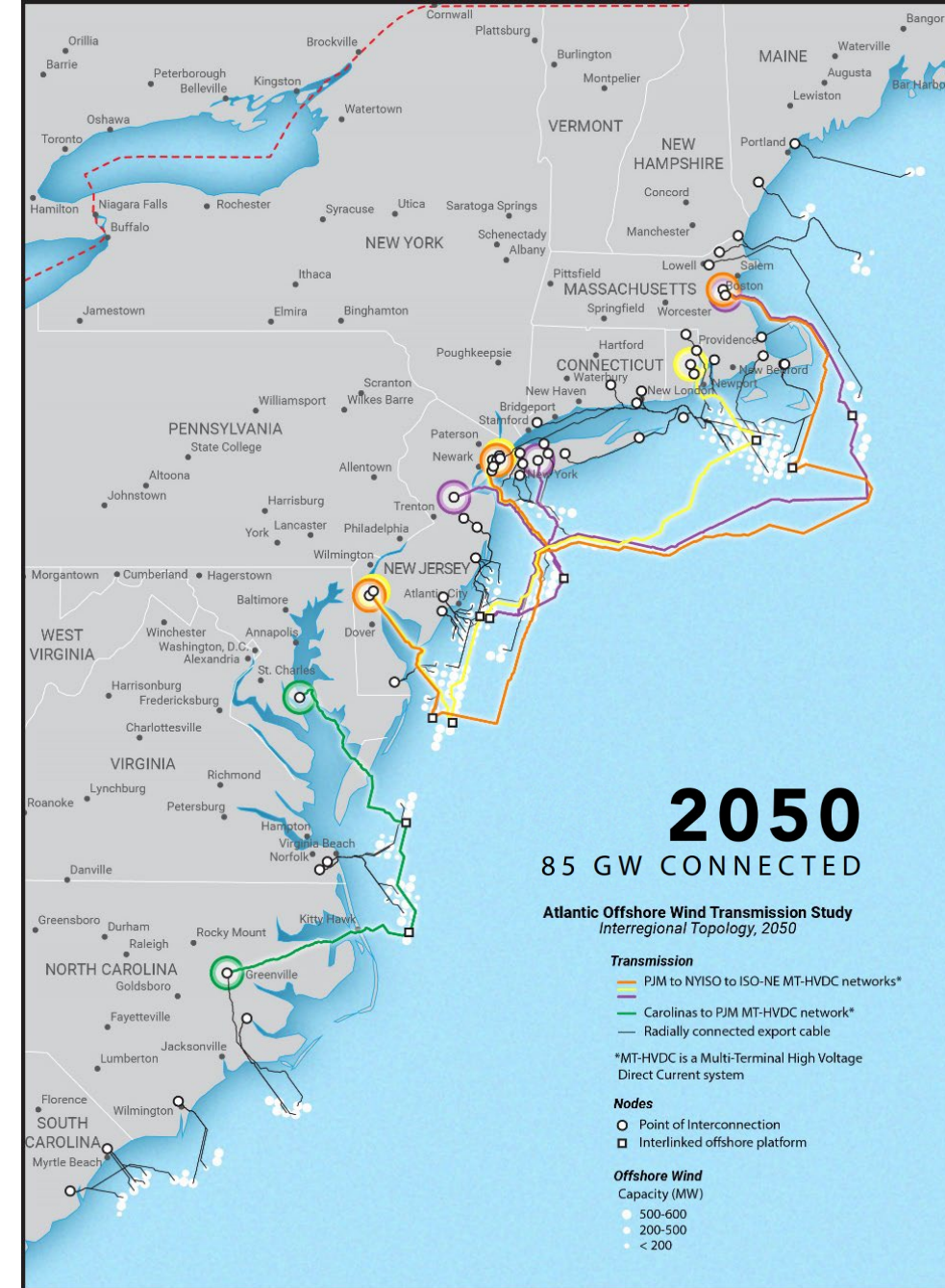




# Topologies Studied

The team studied five topologies (and sensitivities) of OSW and transmission deployment through 2050 with 85 GW in the Atlantic:

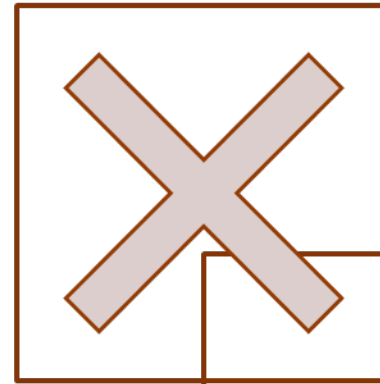
- **Radial:** Planned connections from offshore substations to onshore grid
- **Interregional:** Specifically designed to take advantage of opportunities to connect diverse regions by interlinking offshore platforms
- **Intraregional:** Within-region connections that could complement (and come before) interregional solutions
- **Inter-Intra:** Combination of interlinks from Interregional and Intraregional
- **Backbone:** Larger, longer version of interregional build





## Study is...

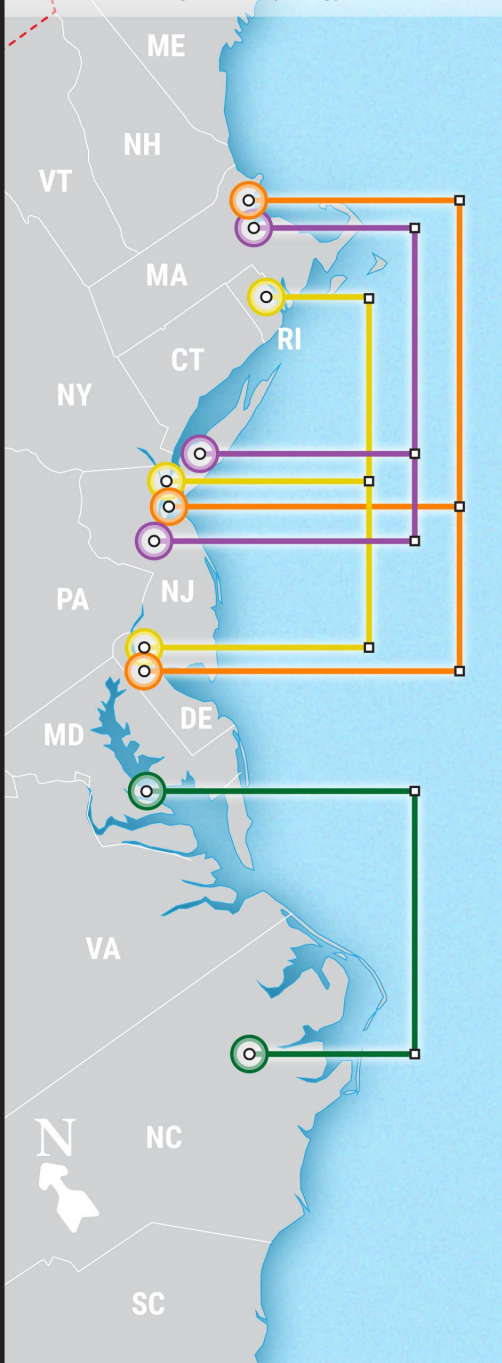
- An analysis of the operation, economics, and reliability implications of different types of offshore wind transmission networks
- A long-term planning analysis of the grid in 2050 in a low carbon scenario
- A focus area from Maine to South Carolina
- Cable routing analysis



## Study is *not*...

- An interconnection study level of detail for offshore wind injections
- An analysis of impacts of electrification (approximately doubling electricity demand) on the transmission system at all voltage levels (transmission elements below 230 kV are simplified in this study)
- A detailed siting or permitting analysis
- A prescription or suggestion for Points of Interconnection or exact interlinks





## Key Findings: Offshore wind development provides a *unique opportunity* to add transmission capacity offshore that provides value to the grid.

- Offshore wind will be a **key part** of a low carbon future for Atlantic states.
- Offshore wind development provides a unique opportunity to **expand transmission capacity** offshore with feasible cable routes that consider ocean co-users and environmental constraints.
- Production cost savings and resource adequacy benefits of proactive, coordinated interregional offshore transmission planning **outweigh costs**.
- Interconnecting offshore transmission lines contributes to **grid reliability** by enabling **resource adequacy** and helping manage the loss of onshore grid components (**contingencies**).
- Sequencing transmission infrastructure **reduces development risk** while positioning the states to receive benefits.

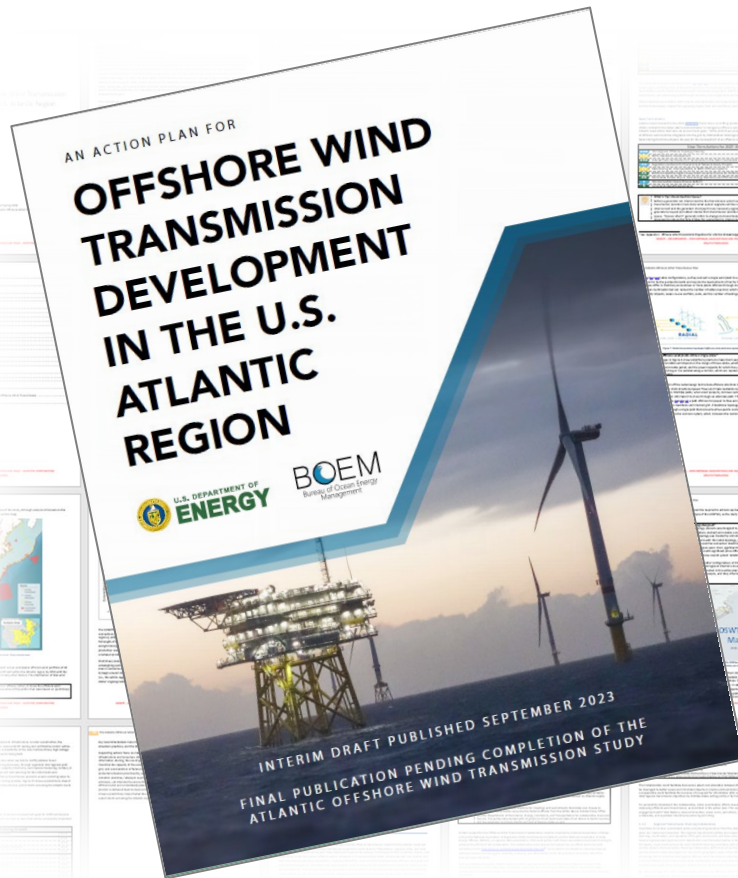
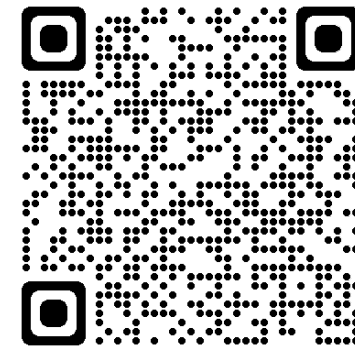
# Atlantic Offshore Wind Transmission Action Plan



- Co-authored by DOE and BOEM
- Published March 21, 2024

- 41 recommendations
- Spanning 2023-2050 timeframe
- 5 categories

- Read the plan at [energy.gov](https://energy.gov):



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# Immediate Recommendations



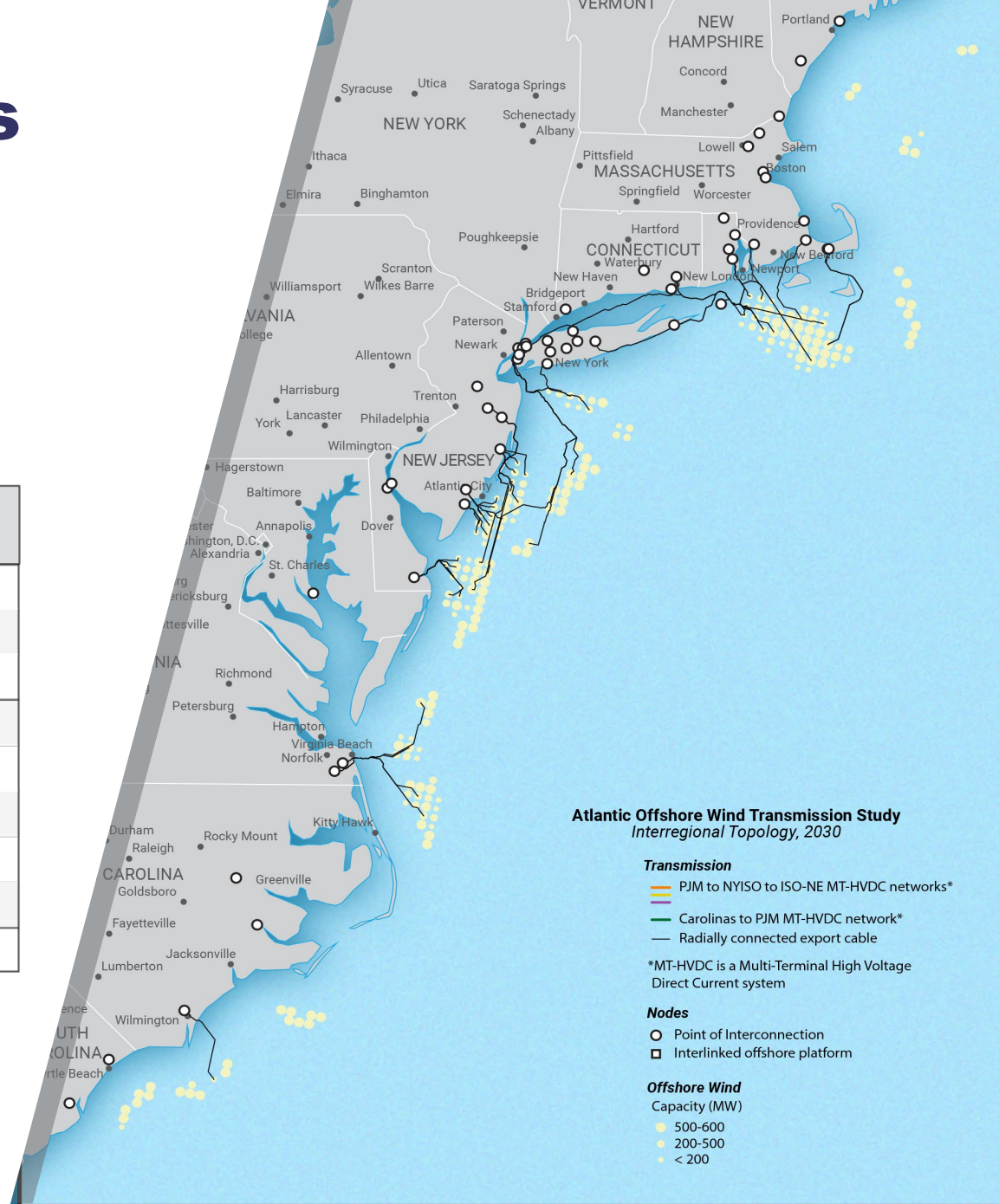
Immediate Actions Before 2025		Reference Section
★ ★ ★	Multi-State Offshore Wind Transmission Collaborative	1.1.1
★ ★ ★	Regional Transmission Planning Collaborative	1.1.2
★ ★ ★	Tribal Nation Engagement	1.1.3
★ ★ ★	Systematic Evaluation of POI Capacities	2.1.2
★ ★ ★	NERC Reliability Standards Around Offshore Transmission	2.3.1
★ ★ ★	Voluntary Cost Allocation Assignments	4.1.1
★ ★ ★	Offshore Transmission Investment Tax Credits	4.2.1
★ ★	“Network-Ready” Equipment Standards	3.1.1
★ ★	Equipment Rating Standardization for Transmission Components	3.1.2
★ ★	R&D for Offshore Transmission Technology Commercialization	3.3.1
★ ★	Expansion of Domestic Supply Chain and Manufacturing	3.4.2
★ ★	Skilled U.S. Workforce Development	3.4.2
★ ★	Federal-State Aligned Offshore Wind Transmission Siting	5.1.3
★ ★	Guidance for Federal Environmental Review and Permitting Requirements and Procedures	5.2.1
★ ★	Permitting Agency Resources and Staffing	5.2.3
★	Environmental R&D for Offshore Wind Transmission	3.3.2
★	Relevant Federal Funding, Financing, and Technical Support	4.2.2



# 2025-2030 Recommendations



Near-Term Actions for 2025- 2023		Reference Section
★ ★ ★	Interregional Offshore Topology Planning	2.2.1
★ ★ ★	HVDC Standards Development	3.2.1
★ ★ ★	Federal Preferred Routes for Transmission in the Outer Continental Shelf	5.1.1
★ ★	Regulatory Guidance for Ownership of Network-Ready Projects	2.4.2
★ ★	Data Sharing for Interoperability of HVDC Offshore Systems	3.2.3
★ ★	BOEM Competitive Right-of-way Grant Issuance Process for Preferred Routes	5.1.3
★ ★	Multi-state Partnership on Clean Energy Standards and Offshore Wind Goals	5.1.4
★	Interconnection Queue Process Reform	2.4.1
★	Community Benefit Agreements	5.2.5

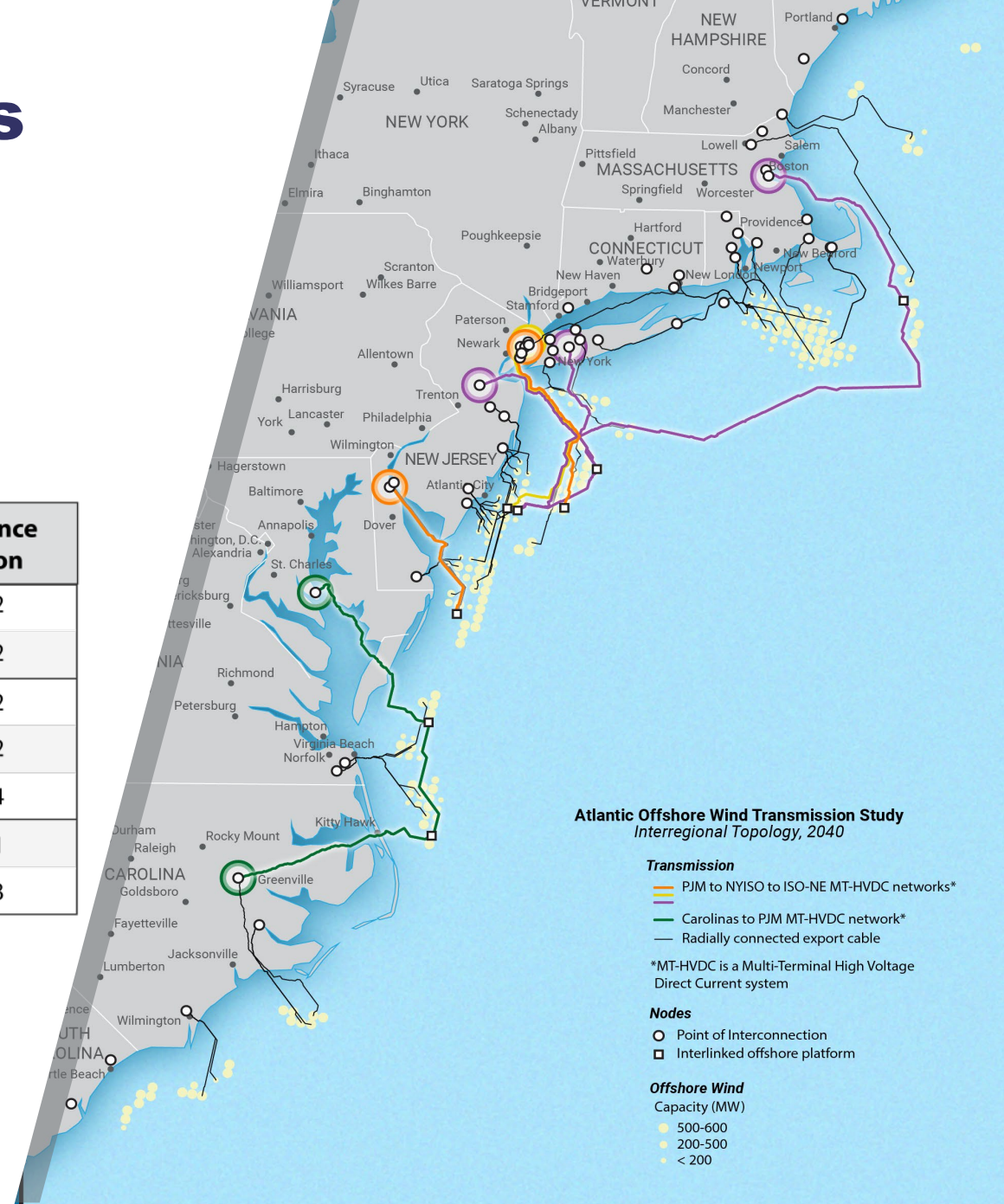




# 2030-2040 Recommendations



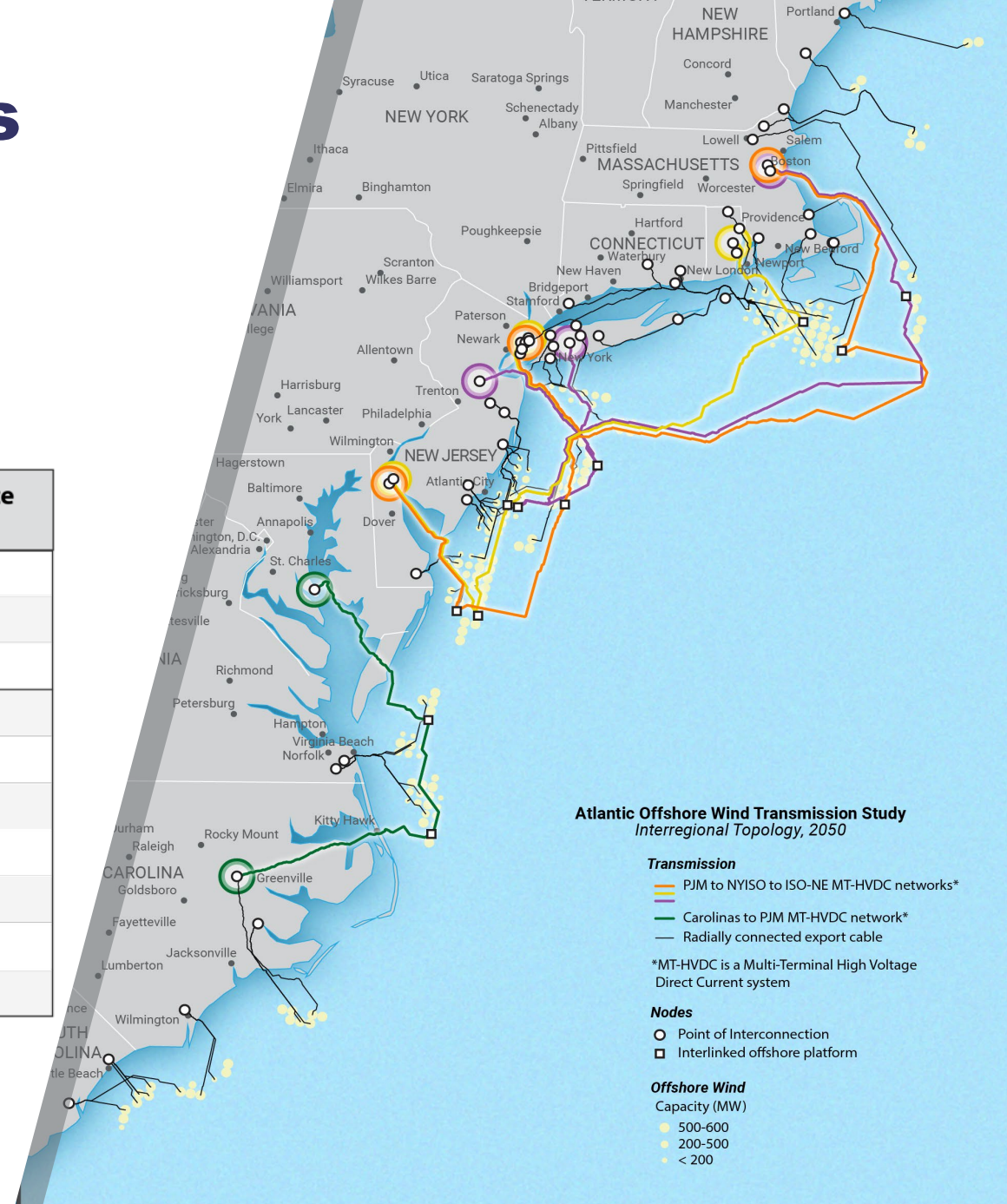
Mid-Term Actions for 2030–2040		Reference Section
★ ★ ★	Multi-Terminal HVDC Test and Certification Center	3.2.2
★ ★ ★	Environmental Review and Permitting Frameworks	5.2.2
★ ★ ★	Regulated Interregional Joint Planning Processes	2.2.2
★ ★	Interregional Transfer Capacity Minimums	2.3.2
★ ★	Assignment of Offshore Cables and Substations for Continued Use as Shared Infrastructure	5.2.4
★	Interconnection Queue Process Reform	2.4.1
★	Enhancement of Existing Market Monitoring Roles	2.4.3



# Long-term Recommendations



Long-Term Actions for Sustainable Growth		Reference Section
★ ★	State-Led Transmission Planning	2.1.1
★ ★	Cost Allocation Methodology	4.1.3
★ ★	Federally Designated National Interest Electric Transmission Corridors	4.2.3
★ ★	International Cooperation	1.2.1
★ ★	Communication Practices and Public Engagement	1.2.2
★ ★	Transmission Optimization with Grid-Enhancing Technologies	3.1.3
★ ★	Best Practices for Benefit Valuation	4.1.2
★	Equity in Ratemaking	4.1.4
★	Consumer Advocates	4.1.5
★	Utilization of Existing Federal Facilities Along the Coast	5.1.5





# Partnerships and Collaborations



Partnership &  
Collaborations

## 1.1.1. OFFSHORE WIND TRANSMISSION STATE COLLABORATIVE

States are driving offshore wind development through clean energy policies and are instrumental to achieving the national goal of 30 GW of offshore wind deployment by 2030. States are also diverse and bring their own unique experiences, perspectives, goals, policies, and transmission planning processes that are important to align.

## 1.1.2. REGIONAL TRANSMISSION PLANNING COLLABORATIVE

It will take more than coordinated policy and planning decisions from the states to ensure holistic plans are created and executed. The regional transmission entities are responsible for the actual planning, coordination, and operation of the grid, and as such, will have a key role in this transition.

## 1.1.3. TRIBAL NATION ENGAGEMENT

BOEM's Draft Guidelines and Instructions for Native American Tribes Communications Plan Development provides guidance to comply with the requirements and intent of the lease stipulation for a Native American Tribal Communications Plan and seeks to "ensure early and active information sharing, focus discussion on potential issues, and collaboratively identify solutions . . . to promote the sustainable development of offshore wind energy projects."



# Value of Interregional Transmission



Planning &  
Operations

## 2.2.1. INTERREGIONAL OFFSHORE TOPOLOGY PLANNING

When done well, holistic transmission planning that spans ISO/RTO and state boundaries can add tremendous value to local system reliability and reduce ratepayer costs. However, it requires transmission planners to look beyond their own jurisdiction and into neighboring regions where they may have limited data or understanding of the system.

## 2.2.2. REGULATED INTERREGIONAL JOINT PLANNING PROCESSES

FERC Order No. 1000 sets forth the current Federal requirements for considering potential interregional transmission. However, it requires only coordination between regions. Fully integrated interregional planning is allowed but not required, and to date, has not been successfully implemented for any large-scale infrastructure.

There is a definite need to enhance the current joint interregional transmission coordination process; take a broader view of interregional project needs and benefits; and provide pathways pursuant to which projects can be planned and paid for. We advocate for firmer regulation and support FERC's consideration of the issue.

# Lessons Learned from the Atlantic

## Addressing Reliability Standards

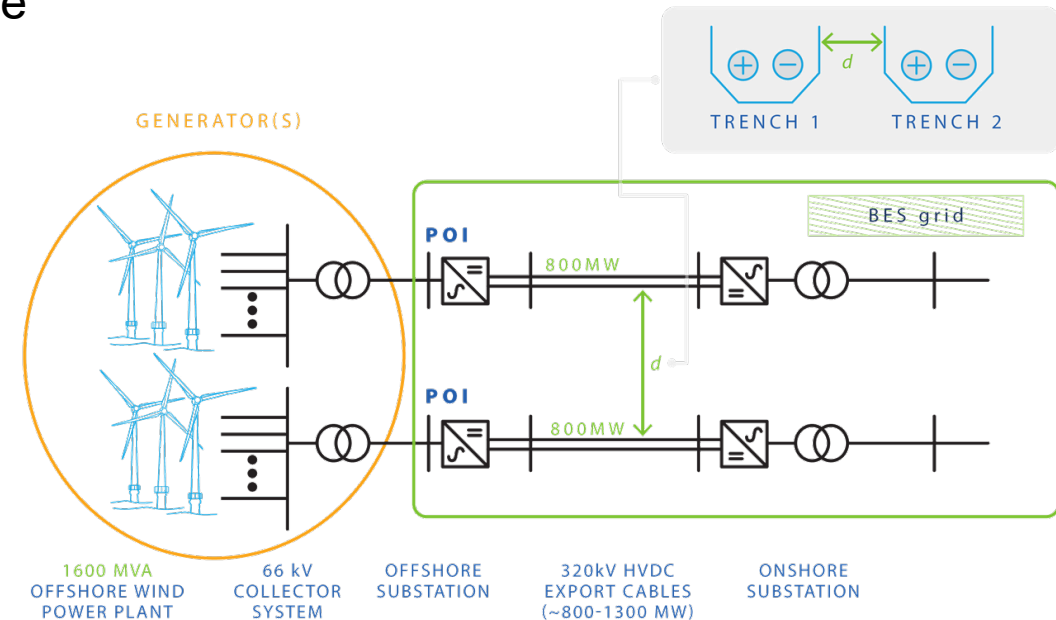


Planning &  
Operations

### 2.3.1. NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION (NERC) RELIABILITY STANDARDS AROUND OFFSHORE TRANSMISSION

Application of NERC transmission planning standards to offshore wind generation and transmission could benefit from further clarification and potential modification. Applicable requirements and the standards governing them may need updates to ensure applicability to ocean transmission infrastructure and offshore wind generation tie-lines. Technical clarity is needed in the following three topic areas:

1. Credible multiple contingencies of subsea cables within a common corridor
2. Credible multiple contingencies of HVDC bipole topologies with dedicated metallic return
3. Generator definitions for large distributed energy generation plants composed of many individual generators within planning contingency standards.



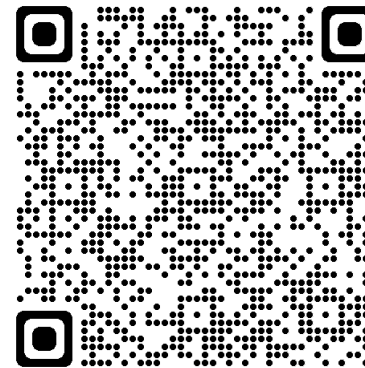
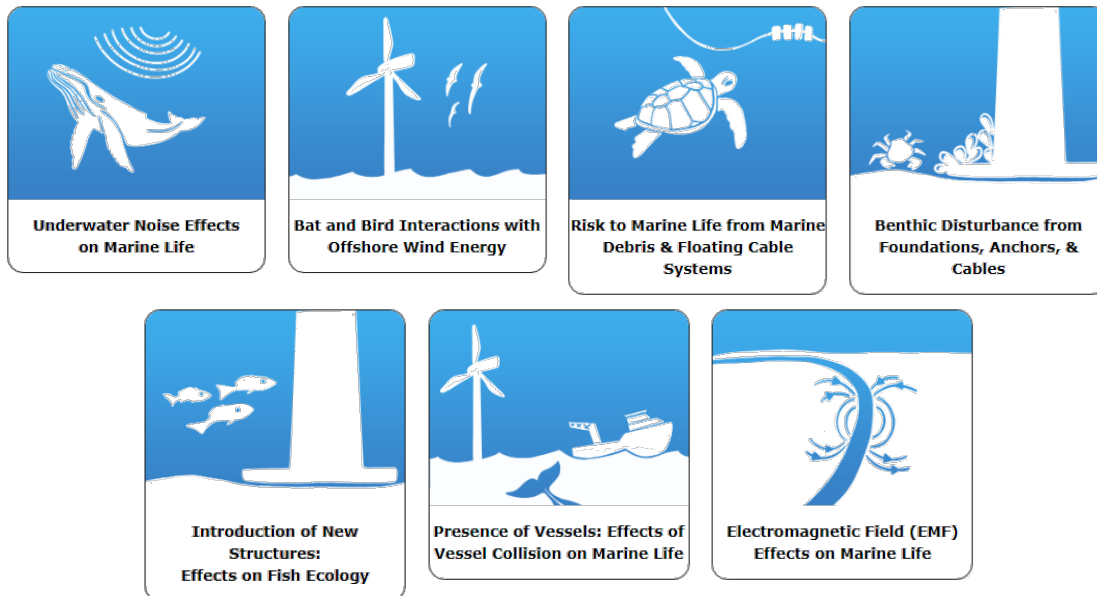
# Lessons Learned from the Atlantic Environmental Stewardship



Technologies & Standardization

## 3.3.2. ENVIRONMENTAL RESEARCH AND DEVELOPMENT FOR OFFSHORE WIND TRANSMISSION

Federal agencies and other institutions have invested in research on the environmental effects of offshore wind and transmission infrastructure. The current state of research is described by DOE-funded U.S. Offshore Wind Synthesis of Environmental Effects Research (SEER) project. Several research topics were identified during the Convening Workshops and through SEER, which are described in the Action Plan. We recommend continuing this research to address emerging issues and research gaps.



# Lessons Learned from the Atlantic Cost Allocation



Economics & Support  
Initiatives

## 4.1.3 COST ALLOCATION METHODOLOGY

In general, more work is needed on cost allocation, benefit valuation, ratemaking, and engagement with consumers.

There is an opportunity to consider and leverage international experience and paradigms.

- ▶ Methodology to allocate interregional transmission costs among regions following the regional distribution of benefits associated with a project
- ▶ Novel mechanisms to finance and develop offshore interconnection facilities for near-term and long-term deployment
- ▶ FERC's consideration could provide a mechanism for:
  1. States to reach voluntarily determined cost allocation agreements, including states in two or more planning regions
  2. Interregional cost allocation principles inclusive of the unique characteristics of a networked offshore grid
  3. Default cost allocation methods for interregional transmission facilities in cases where a voluntary solution isn't reached

# Lessons Learned from the Atlantic

## Improving Processes



Siting &  
Permitting

### 5.2.1. IMPROVED ENVIRONMENTAL REVIEW AND PERMITTING FRAMEWORKS

The development of offshore wind infrastructure is regulated, permitted, and shaped by many different entities, including Federal agencies, Tribal Nations, state and local authorities, and grid operators. To efficiently and effectively allow transmission infrastructure to develop, all parties must coordinate and align their processes and expectations. This includes project review, NEPA analysis and associated consultations, grid connection studies, and state and local requirements. We recommend establishing clarity among Federal, Tribal Nation, state, and local jurisdictions on roles and responsibilities from the outset of the regulatory process.



# Lessons Learned from the Atlantic

## Supporting Local Communities



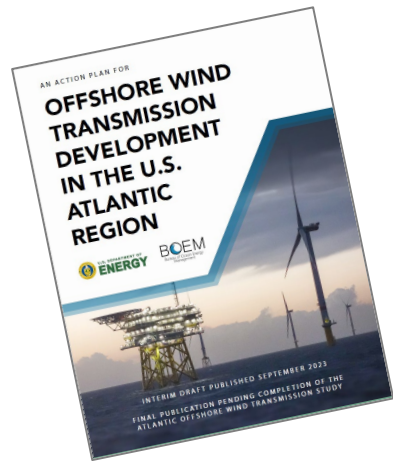
Siting & Permitting



### 5.2.5. COMMUNITY BENEFIT AGREEMENTS

Community benefit agreements (CBA) are one way to help bring local communities into sustained focus and ensure that communities impacted by infrastructure are net beneficiaries, which may positively impact the ability to site and permit transmission infrastructure within the community. CBAs between project developers and impacted communities—such as Tribal Nations, non-Tribal indigenous groups or coalitions, fishing, and other community groups or coalitions—can play a positive role in helping ensure that developers are affirmatively reaching out to communities and committing to provide benefits suited to each community’s unique needs.

# How is the Action Plan being utilized?



**Prioritization of recommendations and strategy development**



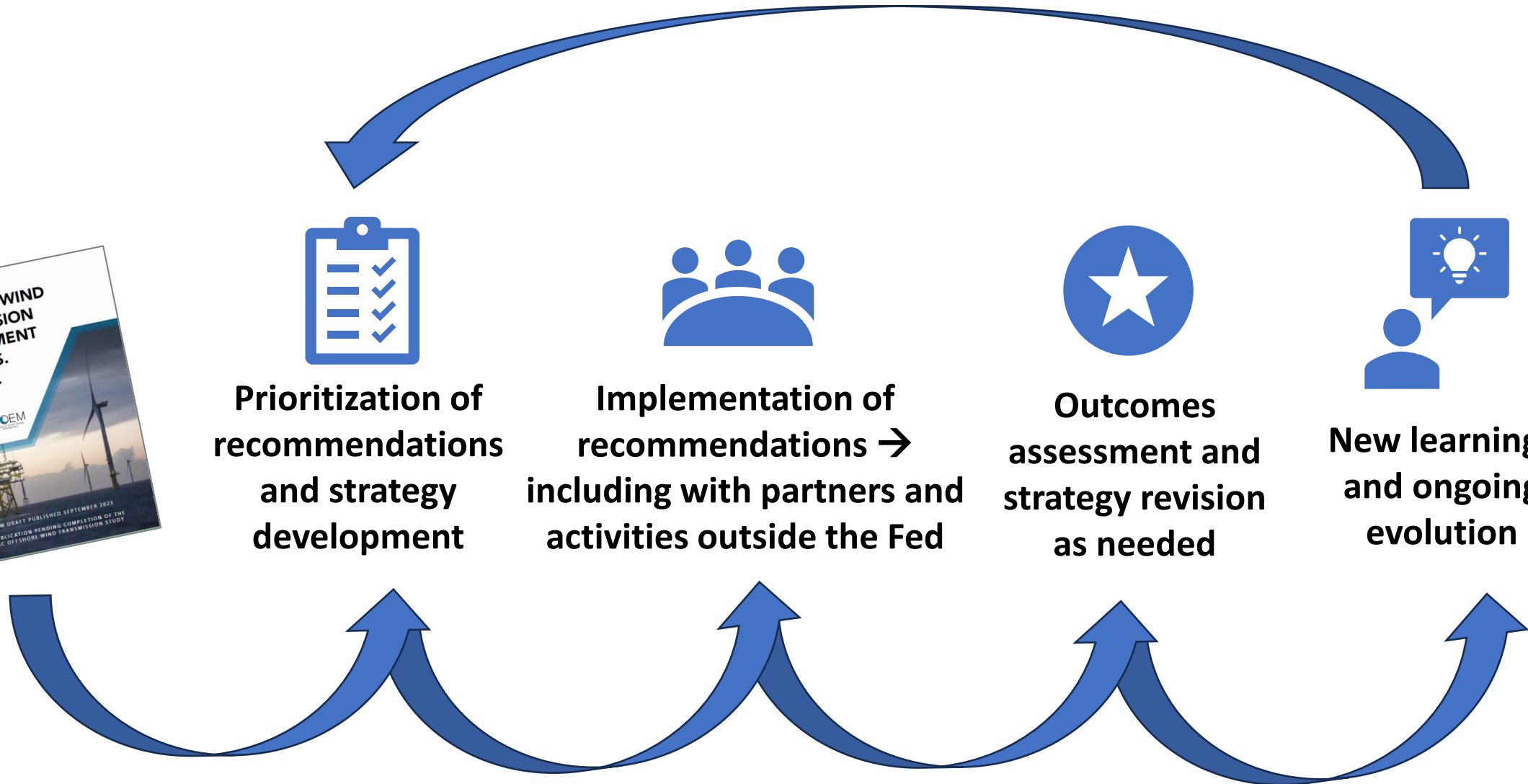
**Implementation of recommendations → including with partners and activities outside the Fed**



**Outcomes assessment and strategy revision as needed**



**New learnings and ongoing evolution**





# Tribal Nation Technical Assistance Program

## Action Plan Recommendation 1.1.3 Tribal Nation Engagement



Partnership &  
Collaborations

- ▶ New national program
- ▶ Technical assistance and trainings to support Federally Recognized Tribes to successfully engage in transmission planning and development for offshore wind
- ▶ The program was informed by conversations with Tribal Nations and is comprised of:

### Capacity Building (Educational Resources)

Educational events and webinars that may cover topics such as transmission topologies; available technologies and supply chain; siting and permitting; interconnection process; and environmental research. Webinar slides and recordings; virtual trainings; and presentations at national Tribal Nation forums will be made available.

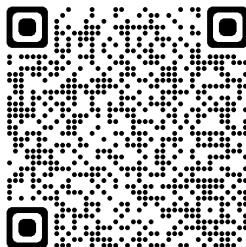
### Expert Match (Phone-an-Expert)

Consultation with national laboratory subject matter experts to leverage existing expertise and resources.

### Participation Support (Convening and Event Attendance)

Funding available to Tribal Nation members to participate in offshore wind transmission events.

Continued collaboration with Tribal Nations and integration of Indigenous Traditional Ecological Knowledge into new studies and decision-making.




# Supply Chain



Technologies &  
Standardization

## 3.4.1 Expansion of Domestic Supply Chain and Manufacturing

- ▶ Supply Chain Road Map for Offshore Wind Energy in the United States, published in two volumes: 2022 and 2023
- ▶ Critical materials database being developed
- ▶ Federal-State Offshore Wind Implementation Partnership: Supply Chain Working Group – ongoing collaboration between multiple Atlantic Coast states to develop a regional supply chain network.
- ▶ U.S. Department of Energy reducing the cost of investment through the Loan Programs Office’s initiatives throughout the supply chain




**The Demand for a Domestic Offshore Wind Energy Supply Chain**

Matt Shields,<sup>1</sup> Ruth Marsh,<sup>2</sup> Jeremy Stefek,<sup>1</sup> Frank Oteri,<sup>1</sup> Ross Gould,<sup>3</sup> Noé Rouxel,<sup>2</sup> Katherine Diaz,<sup>2</sup> Javier Molinero,<sup>2</sup> Abigayle Moser,<sup>1</sup> Courtney Malvik,<sup>3</sup> and Sam Tirone<sup>3</sup>

<sup>1</sup> National Renewable Energy Laboratory  
<sup>2</sup> DNV  
<sup>3</sup> The Business Network for Offshore Wind

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This report is available at no cost from the National Renewable Energy Laboratory (NREL) at [www.nrel.gov/publications](http://www.nrel.gov/publications).  
Contract No. DE-AC36-08G028308

Technical Report  
NREL/TP-5000-81602  
Revised June 2022



**A Supply Chain Road Map for Offshore Wind Energy in the United States**

Matt Shields,<sup>1</sup> Jeremy Stefek,<sup>1</sup> Frank Oteri,<sup>1</sup> Matilda Kreider,<sup>1</sup> Elizabeth Gill,<sup>1</sup> Sabina Maniak,<sup>1</sup> Ross Gould,<sup>2</sup> Courtney Malvik,<sup>2</sup> Sam Tirone,<sup>2</sup> and Eric Hines<sup>3</sup>

<sup>1</sup> National Renewable Energy Laboratory  
<sup>2</sup> Business Network for Offshore Wind  
<sup>3</sup> Tufts University

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Contract No. DE-AC36-08G028308

Technical Report  
NREL/TP-5000-94710  
January 2023

# Offshore Wind Transmission Standards



Technologies &  
Standardization

## Action Plan Recommendations: 3.1.1 Network-ready Equipment Standards

### 3.1.2 Equipment Rating Standardization for Transmission Components

- ▶ \$8.5 million awarded for 4 projects on HVDC standards and controls with the intention to enable the expandability of future meshed HVDC grid for offshore wind deployment at scale, addressing interoperability challenges. Three topic areas are:
  - ▶ HVDC standards and benchmark system development
  - ▶ Multi-terminal HVDC controls and functional requirements
  - ▶ HVDC curriculum development for education and workforce training

Wind Energy Technologies Office

**DOE Wind Energy Technologies Office  
Selects 15 Projects Totaling \$27 Million to  
Address Key Deployment Challenges for  
Offshore, Land-Based, and Distributed  
Wind**

SEPTEMBER 21, 2023

# How can states use the Action Plan and Atlantic Offshore Wind Transmission Study's recommendations to inform planning and implementation?

# State-led Rec's in Action Plan



Recommendation		Action (summarized)	Criticality	Timing
<b>Partnerships and Collaborations</b>				
1.1.1	Offshore Wind Transmission State Collaborative	Encourage the Atlantic states to collectively form an Offshore Wind Transmission State Collaborative to establish a shared vision on policy and approach to coordination for offshore transmission development.	☆☆☆	2023
<b>Planning and Operations</b>				
2.1.1	State-led Transmission Planning	State-led transmission planning be pursued in partnership with regional transmission operators.	☆☆	All
2.2.1	Interregional Offshore Topology Planning	State Collaborative communicate support for interregional HVDC transmission topology scenarios to respective transmission planning entities and JIPC conduct a collaborative study process between the ISOs/RTOs and planners in non-ISO/RTO neighboring regions.	☆☆☆	2025
<b>Technologies and Standardization</b>				
3.1.1	Network-ready Equipment Standards	Design and expand network-ready equipment standards for both HVAC and HVDC to enable future expansion. The multi-state collaborative take the lead to drive enforcement of standards within member states. Require projects to comply with specifications or through mandates in permits.	☆☆	2024
3.1.2	Equipment Rating Standardization for Transmission Components	State solicitations be prescriptive to match the small, medium, and large transmission designs. Establishing equipment standards for transmission cable voltage and current capacity, connectors, and collector stations.	☆☆	2023
<b>Economics and Support Initiatives</b>				
4.1.1	Voluntary Cost Allocation Assignments	States pursue, and ISOs/RTOs and other transmission providers to facilitate, voluntary cost allocation based on a mutually agreed-upon method.	☆☆☆	2023
4.1.4	Equity in Ratemaking	Public utility commissions adopt best practice standards to ensure that low-income and vulnerable populations do not continue to be disproportionately impacted by high energy burdens.	☆	All
4.2.1	Relevant Federal Funding, Financing, and Technical Support	Developers and states looking to develop offshore wind transmission projects carefully review and apply for existing and upcoming funding programs to access BIL and IRA funding.	☆	All
<b>Siting and Permitting</b>				
5.1.4	Multi-state Partnership on Clean Energy Standards and Offshore Wind Goals	State clean energy standards and/or offshore wind goals be amended to allow for full or partial credit of the installed capacity of an offshore wind plant toward state clean energy standards when an investment in offshore wind infrastructure helps a neighboring state achieve its goals.	☆☆	2028

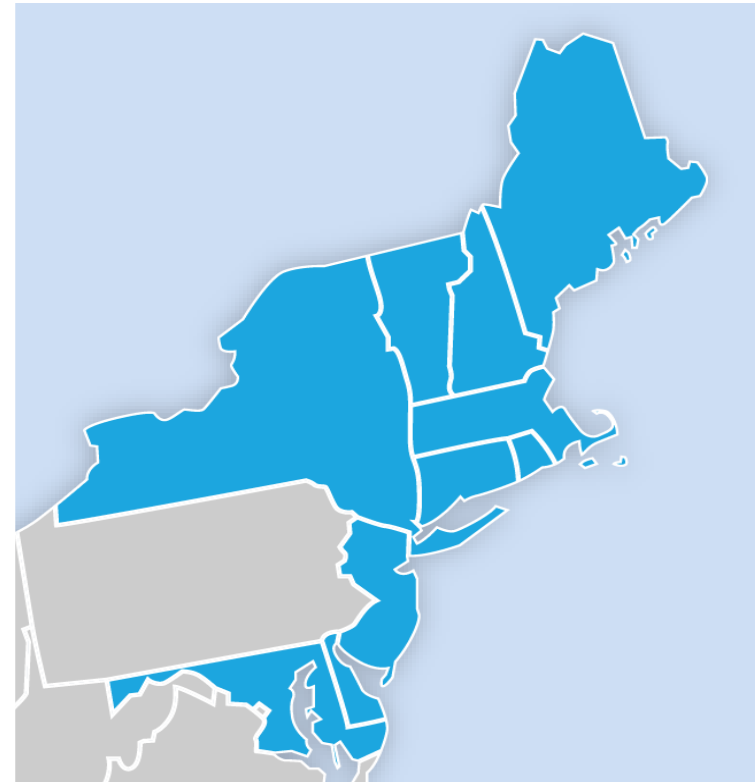
# Northeast States Collaborative on Interregional Transmission

## Action Plan Recommendation 1.1.1 Offshore Wind Transmission State Collaborative



Partnership & Collaborations

- ▶ Eight northeastern states sent a letter to DOE in June 2023 requesting support for interregional and offshore transmission planning efforts (2 more have joined since).
- ▶ Asked DOE to assist in forming a “Northeast States Collaborative on Interregional Transmission”
- ▶ The collaborative is working to:
  - identify barriers to economic planning and development of interregional transmission
  - identify potential multi-state projects that may be suitable for ISO/RTO study
  - develop a strategy for state cooperation on technical standards for OSW transmission equipment
- ▶ Also closely related to Action Plan Recommendation 1.1.2: Regional Transmission Planning Collaborative



MAINE  
NEW HAMPSHIRE  
VERMONT  
NEW YORK  
MASSACHUSETTS  
RHODE ISLAND  
CONNECTICUT  
NEW JERSEY  
DELAWARE  
MARYLAND

# Regional Transmission Planning and Procurement



Planning &  
Operations

## Action Plan Recommendation 2.1.1 State-led Transmission Planning

- ▶ We recommend state-led transmission planning should be pursued in partnership with local transmission operators. Tasks states may find helpful to support their transmission planning work:
  - ▶ Pursue state-driven transmission procurement and interconnection processes through, for example, PJM's State Agreement Process or ISO-NE's Elective Transmission Upgrade process.
  - ▶ Identify and name preferable Points of Interconnection to better align solutions submitted by developers with state interests
  - ▶ Make solicitations modular, similar to the approach taken in New Jersey, to allow companies to prioritize where they feel best positions to compete.
  - ▶ Develop and include incremental targets in their solicitations in addition to final capacity goals to ensure the construction schedules proposed by transmission developers align with generation investment schedules
  - ▶ Recommend modifications to state offshore wind solicitation processes to be implemented by each individual state



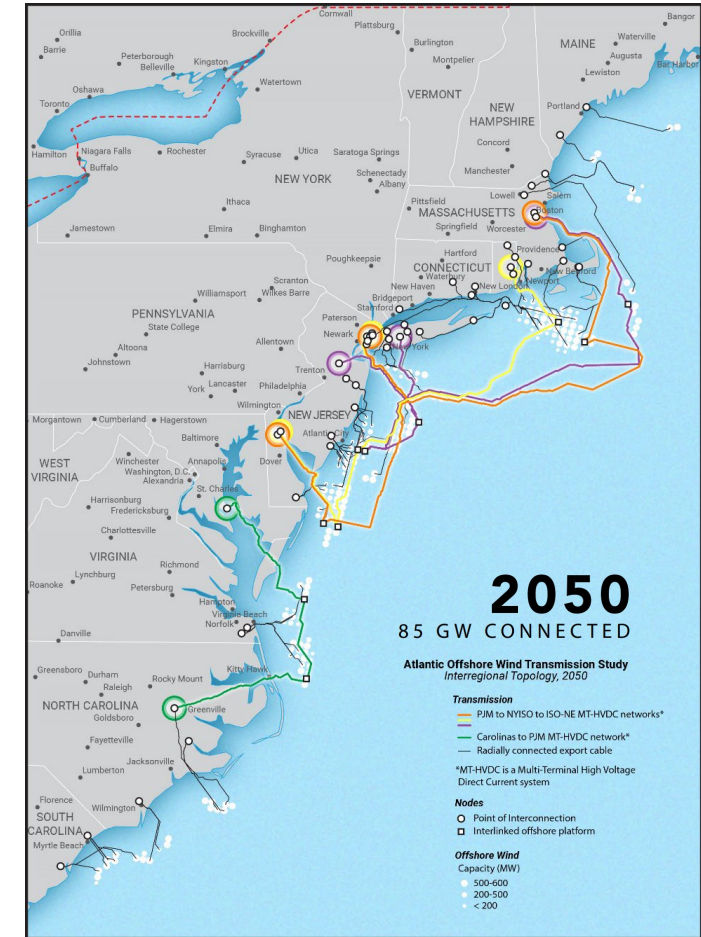
# Interregional Transmission Planning



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## Action Plan Recommendation 2.2.1 Interregional Offshore Topology Planning

- ▶ We recommend the Offshore Wind Transmission State Collaborative communicate support for interregional HVDC transmission topology scenarios (such as those identified by the AOSWTS) to their respective transmission planning entities and participate in conversations about benefits evaluation and cost allocation for identified interregional projects.
- ▶ We recommend that the JIPC conduct a collaborative study process between the ISOs/RTOs and planners in non-ISO/RTO neighboring regions, based on direction of the Offshore Wind Transmission State Collaborative, to include these interregional interlinks in their regional plans.



# Offshore Wind Transmission Standardization Guidance

Action Plan Recommendations: 3.1.1 Network-ready Equipment Standards  
3.1.2 Equipment Rating Standardization for Transmission Components



Technologies &  
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- ▶ Standardization needs identified and guidance developed  
    ➡ More coming soon!

Photo Credits: Melissa Pauley and Cynthia Bothwell, DOE  
Vineyard Wind Tour, New Bedford, MA



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# Thank You

[www.energy.gov/gdo/offshore-wind-transmission-federal-planning-support](http://www.energy.gov/gdo/offshore-wind-transmission-federal-planning-support)

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