Date: December 21st, 2023
To: Manu Asthana, Executive Director, Pennsylvania-New Jersey-Maryland Interconnection
From: Alexa Ringer
Subject: From Winds to Wires: Urgent Need for Regional Offshore Wind Transmission Planning

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Summary

If the US is to meet its clean energy goals, aggressive actions must be taken to tap more offshore wind (OSW), which has the potential to provide up to 25% of all US energy needs by 2050. OSW can be highly scalable[1] reducing carbon emissions by 99% compared to fossil fuels[2] and with minimal other environmental impacts on wildlife and ecological habitat.[3] However, international OSW growth has surpassed the US by a longshot,[4] leaving the US scrambling on its own clean energy goals. President Joseph Biden has established a national goal of deploying 30 gigawatts (GW) of OSW by 2030, but the US currently has just 30 megawatts (MW), which is equivalent to .03 GW or .1% of the way towards the national goal. Rising infrastructure costs, especially transmission, are a major barrier to wind developers and are cited as a reason for recent generators pulling out of projects.[5] Although projections conclude we are unlikely to meet this goal in the remaining six years,[6] Regional Transmission Organizations (RTOs), such as PJM, can reform & adopt new policies to facilitate faster renewable energy development. Specifically, the cost of installing transmission is a major barrier to wind developers who bear the cost of installing major infrastructure despite providing a public benefit. Current policy dictates that the developer pays for the transmission needed for its project, which is upwards of $3 billion, depending on the project.[7] Alternative cost allocation systems exist nationally and globally to help spur OSW especially, which PJM should adopt. This paper examines the current state of regional transmission planning for offshore wind and recommends how PJM can cost allocation changes to hasten OSW deployment.

I. Problem Statement

Background

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[1] Florian Kühn et al., "How to Succeed in the Expanding Global Offshore Wind Market," McKinsey & Company, April 20, 2022, https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/how-to-succeed-in-the-expanding-global-offshore-wind-market.

[2] "What Is the Carbon Footprint of Offshore Wind?," Ørsted, accessed December 21, 2023, https://us.orsted.com/renewable-energy-solutions/offshore-wind/seven-facts-about-offshore-wind/carbon-footprint#:~:text=99%25%20lower%20emissions%20than%20fossil%20fuels&text=When%20you%20divide%20the%20total,hour%20(kWh)%20of%20electricity.

[3] "Environmental Impacts of Wind Power," Union of Concerned Scientists, March 5, 2013, https://www.ucsusa.org/resources/environmental-impacts-wind-power.

[4] See Appendix, Figure 1.

[5] Miranda Willson, "FERC Aims to Fix the Grid's Renewable Energy Backlog. Can It?," E&E News, June 8, 2023, https://www.eenews.net/articles/ferc-aims-to-fix-the-grids-renewable-energy-backlog-can-it/.

[6] Jennifer McDermott et al., "Offshore Wind Project Cancellations Jeopardize Biden's Clean Energy Goals," PBS, November 4, 2023, https://www.pbs.org/newshour/nation/offshore-wind-project-cancellations-jeopardize-bidens-clean-energy-goals.

[7] Steve Ernst, "Studies See Wide Range of Transmission Costs for Offshore Oregon Wind," NewsData, LLC, July 22, 2022, https://www.newsdata.com/clearing_up/supply_and_demand/studies-see-wide-range-of-transmission-costs-for-offshore-oregon-wind/article_c99444e4-09f3-11ed-98f7-2f9198be3d53.html#:~:text=But%20an%20upcoming%20BPA%20transmission,at%20upwards%20of%20%243%20billion.

The northeast has the highest population density in the US. Yet the East Coast megalopolis is not close to abundant solar or onshore wind resources in the Mid & Southwest. Therefore, Atlantic OSW power projects present a major opportunity because they are one of the most scalable, efficient renewable closest to these major population centers.

However, this essential shift to renewable energy demand has been met with a major obstacle, even for shovel-ready projects: the grid is inadequately prepared to transport renewable energy. In the case of OSW, an entirely new sea-based grid must be developed to connect distant turbines to the land-based grid, and load centers. The northeast only has 2 operating OSW projects, meaning that grid build-out is in its early stages. When projects are built, they have limited points of interconnection (POIs) on land where they can connect the sea-based grid to the traditional grid.[8] The process of connecting to PJM's grid is a reactive approach to regional transmission planning; the most recent projects in the queue are responsible for all the grid upgrades that are necessary to accommodate their renewable energy project. This first-come-first-served and reactive approach to regional transmission planning has resulted in a backlog of thousands of renewable energy projects. Creating a diverse portfolio of renewable projects quickly is essential to ensure grid resiliency in the face of natural disasters.

While it is much easier for developers to run electrical transmission underwater than through private property, once it reaches the mainland, it still reaches an adequate grid and costs more to develop than onshore wind projects. By developing OSW policies, RTOs on the East Coast like PJM can accelerate renewable deployment with cost-savings, minimal environmental impact, and high efficiency.

Technical Challenges of Transmission Planning

Transmission for OSW has a variety of technical challenges, including integration, transmission, PQ (power quality), and overall grid stability. For instance, inconsistency in cable-type usage means that AC transmission is most used, but regulators are trying to encourage HVDC because of AC's transmission voltage constraints.[9] Construction and maintenance can be far costlier and more technical because they are ocean-based. While there are other technical engineering challenges such as typologies of OSW structures, one of the most significant challenges is establishing an equitable funding mechanism. From a generator perspective, there are two ways to pay for transmission upgrades:

1) Super Shallow System – grid operators (RTOs) provide substation & offshore connection via onshore connection. Conventional transmission charges from customers cover remaining costs.
2) Shallow System – RTOs pay for the cost of grid reinforcement while project developers pay for the operational cost of transmission infrastructure.[10]

The shallow system places a significant cost burden on developers, while the super shallow system spreads the cost to customers who do not directly accrue cost-saving benefits from the new transmission, leading to a policy situation where no one wants to pay for transmission, even

[8] See appendix, Figure 2

[9] Syed Wajahat Ali et al., "Offshore Wind Farm-Grid Integration: A Review on Infrastructure, Challenges, and Grid Solutions," IEEE Access 9 (2021): 102811–27, https://doi.org/10.1109/access.2021.3098705.

[10] Rehana Perveen, Nand Kishor, and Soumya R. Mohanty, "Off-Shore Wind Farm Development: Present Status and Challenges," Renewable and Sustainable Energy Reviews 29 (2014): 780–92, https://doi.org/10.1016/j.rser.2013.08.108.

though it is essential. Identifying who must bear the cost of major grid infrastructure is essential to decarbonize the energy sector.

II. Analysis

RTO Role in Renewable Energy

RTOs and ISOs can help deploy renewable energy and related infrastructure components (transmission, substations, etc.). The growing impact of extreme weather events due to climate change is creating unpredictable energy needs while posing risks to grid stability. Reliability is one of the primary concerns of regional grid operators in the face of global climate change, but critics say that OSW will not solve the reliability needs because of wind variability. However, a 2020 paper discusses how infrastructure planning and regional transmission expansion planning can bolster and incorporate principles of grid resiliency into their planning mechanisms.[11] For instance, adding a resilience score for incoming energy projects – such as OSW, or OSW transmission – could speed track projects in queues to improve grid resiliency. Most transmission projects are pushed forward for local grid reliability concerns and are local, or within a single region. There is virtually no interregional transmission.[12]

PJM's specific role in OSW transmission planning is unique as the RTO covers the largest population area. PJM was created in 1927 when Philadelphia Electric Company, Pennsylvania Power & Light, and Public Service Gas & Electric Company of New Jersey consolidated their transmission system to be operated together.[13] Since the late 1990s, PJM has expanded considerably, now operating in 13 states, managing 56,250 miles of transmission, and serving 51 million people. In addition to coordinating the sale of wholesale electricity, PJM operates a market for financial transmission rights (FTRs), which "entitle the holder to a stream of revenues" and help reduce overcharging in areas with electricity congestion. Since PJM began more resiliency-focused regional planning efforts, it has begun to pursue smart grid technologies to help with demand management and overall reliability improvement, especially when it pertains to the variability of renewable resources like wind. However, there has been a slow adoption of transmission planning for OSW specifically.

Policy Challenges

Overall, there are several major policy challenges facing OSW, which are largely a consequence of inconsistency across regulating agencies. Federal, state, regional, and individual utilities all have different incentives and priorities for OSW wind developments creating backlogs and uncoordinated approval processes (see table below, derived from a report by the Brattle Group).[14] For instance, the Bureau of Ocean Energy Management is notorious for a slow leasing process because it includes an environmental review as required by NEPA which can take years

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[11] Hong Chen et al., "Toward Bulk Power System Resilience: Approaches for Regional Transmission Operators," IEEE Power and Energy Magazine 18, no. 4 (2020): 20–30, https://doi.org/10.1109/mpe.2020.2985437.

[12] Johannes Pfeifenberger, How resources can be added more quickly and effectively to PJM's grid, October 2023, https://www.brattle.com/wp-content/uploads/2023/10/How-Resources-Can-Be-Added-More-Quickly-and-Effectively-to-PJMs-Grid.pdf.

[13] Zhenyu Fan, Tim Horger, and Jeff Bastian, "Current and Emerging Challenges in PJM Energy Market," IEEE PES T&D 2010, 2010, https://doi.org/10.1109/tdc.2010.5484718.

[14] Johannes P. Pfeifenberger et al., "The Benefit and Urgency of Planned Offshore Transmission," The Brattle Group, January 24, 2023, https://www.brattle.com/wp-content/uploads/2023/01/EXECSUM_Brattle-OSW-Transmission-Report_Jan-24-2023.pdf.

to complete.[15] The IRS does not have expertise in renewable energy projects tax credits, leaving uncertainty as to how much wind developers can save through them. Regionally, RTOs are controlled by utilities across states that want to maximize rates by building assets but do not want independent generators to access their grid infrastructure because buying power from other generators is not profitable. The result is a siloed planning process for regional transmission even within RTOs.

Policy	**Challenge**	**Authority**
Grid Code	Inconsistencies across service providers	RTO
Regional Transmission Planning	Uncoordinated and siloed process with perverse cost-allocation incentive	RTO
Leasing	Slow & unclear leasing process	Bureau of Ocean Energy Management
Generator Interconnection process	Reactive & incremental process, adding generators one at a time	RTO
Tax Incentives	Uncertainty with Inflation Reduction Act tax incentives	Internal Revenue Service

However, not all of these are in PJM's sphere of influence. Strategizing policy improvements on regional organizations rather than federal entities like BOEM or the IRS is more feasible, faster, and can result in tangible increases in OSW deployment rate. Additionally, PJM faces mounting pressure from developers and state directives to plan transmission in line with state and local renewable energy goals. There are three major policy challenges hindering OSW transmission that PJM can address:

1) Cost Allocation System
2) Inconsistent Ocean Grid Layout & Standards
3) Siloed Inter-regional Planning

Cost Allocation System

Currently, the prevailing approach favors centralized management and financing by vertically integrated utilities, with little motivation to develop new transmission, despite renewables benefiting from a decentralized grid. FERC regulates rates but cannot overrule state veto power over a transmission line. Therefore, states can derail transmission projects and consequently the fates of all future renewable energy projects dependent on the new transmission. Transmission financing costs are mainly passed on to consumers, creating another regressive disincentive due to public opposition to rate hikes. A 2013 paper highlights how (at the time) energy deregulation, both on the state and federal levels, disincentivized transmission

[15] Offshore wind energy: Federal Leasing, permitting, deployment, and revenues, November 18, 2021, https://crsreports.congress.gov/product/pdf/R/R46970/1.

development for wind energy projects.[16] In interviews, stakeholders from Minnesota, Montana, and Texas underscored that transmission bottlenecks pose a significant obstacle to wind development. They emphasized the importance of cost-sharing in transmission development to enhance certainty, fairness, and feasibility for wind projects.

According to the Brattle Group, there are six basic cost allocation and recovery mechanisms for a utility to fund transmission.

1) License Plate - Each utility recovers its own transmission costs within their service area
2) Beneficiary Pays - Formulas that allocate transmission costs to individual transmission owners that benefit from a project even if the project is not owned by the beneficiaries. Transmission owners then recover allocated costs in their license plate tariffs from own customers
3) Postage stamp - Transmission costs recovered uniformly from all loads in a defined market area, RTO wide.
4) Direct assignment - Transmission costs associated with a new generation fully assigned to requesting entity
5) Merchant cost recovery - Project sponsors recover cost of investment outside regulated tariffs (e.g. negotiated rates with specific customers), largely applies to DC lines where transmission use can be controlled
6) Coownership - Benefiting transmission owners co-own the facility (each recovering costs through rate base treatment); one operator, shared transmission rights

While there are several options that an individual utility can take, the result is a piecemealed approach where a broader RTO may not receive the benefits while the entire customer base pays the cost.

Inconsistent Ocean Grid Standards

Substations at ports where wind projects can interconnect are a major constraint to OSW development.[17] A major constraint of OSW development is limited Points of Interconnection (POIs) near coasts. It highlights the need for interregional land-based transmission planning and coordination with sea-based energy infrastructure to ensure projects can grow and scale. The report provides mapping analysis, transmission capacity analysis, and public interconnection queues to project future demand for transmission. This report summarized and analyzed interconnection queue data, revealing that developers prefer POI near shore and close to their proposed project to reduce the costs of subsea cable installation.

Siloed Inter-Regional Planning

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[16] Fischlein, Miriam, Elizabeth J. Wilson, Tarla R. Peterson, and Jennie C. Stephens. "States of Transmission: Moving Towards Large-scale Wind Power." Energy Policy 56 (May 2013): 101 – 113. https://doi.org/10.1016/j.enpol.2012.11.028

[17] Kelly Smith PE., Samuel Lenney, Oliver Marsden, Barbara Kates-Garnick, PhD., Aleksandar Stankovic, PhD., and Eric M. Hines, Phd., "Offshore Wind Transmission and Grid Interconnection across U.S. Northeast Markets", Offshore Power Research & Education Collective (2021), Tufts University, https://createsolutions.tufts.edu/wp-content/uploads/2021/08/OSW-Transmission-and-Grid-NE.pdf.

Beyond the scope of regional planning, RTOs are failing to consider and build transmission for interregional cooperation. Annually, the US invests between $20 – 25 billion in transmission, but more than 90% is justified for *local* reliability needs without performing a cost-benefit analysis.[18] Because the transmission upgrade process is locally implemented, it follows local utility criteria and does not undergo a regional planning process. As a result, there has been virtually no interregional transmission constructed in the last decade, which is one of the best ways to create systems-wide reliability with renewables due to the geographic diversity of renewable resources.

Because the "seams" of several RTOs converge at the ocean, experts are calling for interregional OSW transmission planning to avoid duplicating transmission costs and expedite the process.[19] Transmission should be established "in advance of generation procurement," which will require coordination between multiple RTOs, according to Brattle principal Johannes Preifenberger.[20] Following the report, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont announced a formal partnership to jointly apply for US DOE innovative transmission funding. This type of mega-regional transmission procurement will be critical to moving the needle on OSW transmission by pooling capital and political power. Grid operators need to similarly work together to develop "shared-use and open access facilities" if states are to meet renewable energy goals with limited POI and OSW infrastructure currently in place.[21]

Case Study – MISO Multi-Value Portfolios

The Midcontinent Independent System Operator (MISO) is the independent system operator of transmission infrastructure & the electric grid for 15 states spanning from Louisiana to Manitoba in Canada. MISO trailblazed an alternative policy for transmission cost allocation via Multi-Valued Projects (MVP) through subregional cost allocation. MVPs are regional transmission projects that are eligible for regional or subregional cost-sharing.[22] Through cost sharing, MISO is vertically divided into three subregions, MISO Central, North, and South. MISO

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[18] Johannes Pfeifenberger, How resources can be added more quickly and effectively to PJM's grid, October 2023, https://www.brattle.com/wp-content/uploads/2023/10/How-Resources-Can-Be-Added-More-Quickly-and-Effectively-to-PJMs-Grid.pdf.

[19] Diana DiGangi, "Proactive Transmission Planning for Offshore Wind Build-out Could Save up to $20b, Experts Say," Utility Dive, January 25, 2023, https://www.utilitydive.com/news/transmission-infrastructure-planning-2030-offshore-wind-urgency/641244/#:~:text=The%20researchers%20characterize%20the%20need,offshore%20wind%20can%20be%20built%2C.

[20] Diana DiGangi, "Proactive Transmission Planning for Offshore Wind Build-out Could Save up to $20b, Experts Say," Utility Dive, January 25, 2023, https://www.utilitydive.com/news/transmission-infrastructure-planning-2030-offshore-wind-urgency/641244/#:~:text=The%20researchers%20characterize%20the%20need,offshore%20wind%20can%20be%20built%2C.

[21] Diana DiGangi, "Proactive Transmission Planning for Offshore Wind Build-out Could Save up to $20b, Experts Say," Utility Dive, January 25, 2023, https://www.utilitydive.com/news/transmission-infrastructure-planning-2030-offshore-wind-urgency/641244/#:~:text=The%20researchers%20characterize%20the%20need,offshore%20wind%20can%20be%20built%2C.

[22] "Multi-Value Projects," Midcontinent Independent System Operator (MISO), accessed December 21, 2023, https://www.misoenergy.org/planning/multi-value-projects-mvps/#t=10&p=0&s=Updated&sd=desc.

allocated transmission costs to a subregional level rather than for the entire RTO, which is more equitable because the transmission capability and therefore savings & benefits accrue exclusively to that subregion. Even though the benefits accrue locally, there are broader regional market benefits across the RTO including more efficient electricity congestion management, cost-savings from participating in a single MISO-wide balancing authority, and more cost-effective integration, balancing, and diversification of high amounts of intermittent renewable generation resources.

The MVP transmission planning program was designed specifically to bring wind resources from south to north, and vice-versa since wind generation alternates between the two geographies.[23] MVP must meet one of three criteria, including increased reliability, economic value across pricing zones, addressing an RTO's transmission violation under NERC's standards. MISO identified renewable resource zones near existing transmission infrastructure and windy areas. The cost-allocation scheme has allowed long-range transmission planning projects to progress and is estimated to have:

- Reduced 150 voltage violations.
- Resolve 500 thermal overloads.
- Increased transfer capability from "wind-rich regions" by 960, totaling 1,841 MW.
- Enabled annual delivery of 41 MWh of renewable energy.
- Supports MISO state energy mandates through 2026.
- Provided between approximately $12.4 - $40 billion in present value benefits[24]
- Reduced energy loss on transmission

MISO's regional transmission has enabled cost-effective decarbonization, which "multiple studies have confirmed that expanding interregional transmission is essential for cost-effective decarbonization."[25]

Case Study – New York MV Public Policy Process

New York ISO (NYISO) has been a longtime advocate for improving transmission capacity for reliability, but constraints in building new transmission have made it difficult to improve the state's overall transmission capability. As recent climate change fueled events like superstorm Sandy have damaged the grid and highlighted the need for transmission that can move renewable energy from the wind and hydro rich upstate areas to downstate. As a result, in 2019 New York changed its public policy transmission planning process by mandating that a full

[23] Ethan Howland, "State Regulators, Utilities Back Miso Plan to Allocate Multi-Value Transmission Costs to Subregions," Utility Dive, March 9, 2022, https://www.utilitydive.com/news/state-regulators-utilities-support-miso-transmission-cost-allocatation/620086/.

[24] Multi Value Project Portfolio - Detailed Business Case, 2011, https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Detailed%20Business%20Case117056.pdf.

[25] Michael Goggin and Zach Zimmerman, Billions in Benefits: A path for expanding transmission between Miso and PJM, November 2023, https://acore.org/wp-content/uploads/2023/11/ACORE-Billions-in-Benefits-A-Path-for-Expanding-Transmission-Between-MISO-and-PJM.pdf.

set of benefits be considered when looking at new transmission, not just reliability. [26] As a result, two major upgrades have been approved for New York transmission infrastructure.[27]

Additionally, Governor Kathy Hochul launched a New York State Offshore Wind Master Plan in 2022 to aggressively scale up OSW.[28] Part of this plan includes identifying a procurement and configuration option for transmission. NYSERDA, who spearheaded the plan, identified that a "joint procurement of generating assets and transmission and interconnection structures presents the most easily implementable and feasible option" for bringing incoming OSW projects online. Joint ownership of transmission facilities can provide expedite the process of transmission construction, especially if there are many willing participants at the table.[29] The result has been New York spearheading a meshed generation tie-in approach for OSW transmission, which is network-ready, enabling scalability over time.[30]

III. Recommendations

Framework for Policy Improvement

Given these challenges threatening to stall renewable energy deployment as East Coast demand is expected to surge[31] PJM must quickly incorporate policy changes that reflect the urgency of climate change. These policy changes should include consideration for the following.

- Provide equitable and cost-efficient cost allocation
- Accelerate grid decarbonization with the same urgency as climate change.
- Streamline policies to make generation development more efficient, reliable, and certainty.
- Coordinate planning across entities

Policy Interventions

There are three policy interventions PJM can adopt to accelerate OSW transmission construction, equitable cost allocation, and OSW generation development.

1) Establish a Multi-Value Project Portfolios

Development of portfolio-based – not project-specific – cost allocations are simpler to implement because benefits tend to be shared and more reliable with time. Similar to recommendations to reform interconnection queues by approving projects in clusters, a portfolio-based solution can group projects and help grid planners see system-wide benefits. Additionally, requiring cost-benefit analyses for a portfolio of projects will illuminate benefits beyond local reliability and underscore the economic value of adding large numbers of renewable wind projects to the grid. PJM should also identify "OSW zones" where it will funnel

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[26] AC Transmission Public Policy Transmission Plan, April 8, 2019, https://www.nyiso.com/documents/20142/5990681/AC-Transmission-Public-Policy-Transmission-Plan-2019-04-08.pdf/23cbba74-a65e-66c2-708e-eaa0afc9f789.

[27] Johannes Pfeifenberger and Joseph DeLosa, "Proactive, Scenario-Based, Multi-Value Transmission Planning," The Brattle Group, June 7, 2022, http://www.brattle.com/wp-content/uploads/2022/01/21st-Century-Transmission-Planning-Benefits-Quantification-and-Cost-Allocation.pdf.

[28] "Offshore Wind Master Plan 2023 - 2024," NYSERDA, 2019, https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/About-Offshore-Wind/Master-Plan.

[29] "Joint Ownership of Transmission," American Public Power Association, 2009, https://www.energy.gov/sites/prod/files/2015/03/f20/Paper%20Joint%20Transmission%202009%20update.pdf.

[30] See Appendix, Figure 3.

[31] Mala Kline, "EIA Projects U.S. Energy Consumption Will Grow through 2050, Driven by Economic Growth," U.S. Energy Information Administration, March 3, 2022, https://www.eia.gov/todayinenergy/detail.php?id=51478.

transmission, substation, and other POI infrastructure. Strategizing and concentrating OSW transmission infrastructure will provide certainty to developers that transmission infrastructure will exist and create a suite of energy projects to deconcentrate risk and tap into economies of scale for increased reliability.

2) Develop Ocean Grid Standards for more optimal grid deployment

The northeast's ocean grid is in its early stages and now is the time to optimize a grid configuration that is optimized for additional wind projects. PJM must develop a standardized, modular OSW transmission system that can be fed into a planned offshore transmission system and easily join onshore grid systems. These standards must include HVDC standards for OSW transmission, plans to construct new POIs in coordination with ports, and a grid structure that is easily scalable so that the grid can expand. The current tie-in approach is an inefficient use of transmission resources, and PJM must prioritize other layouts such as a backbone approach or collector systems that anticipate – rather than react to – future OSW projects.[32]

3) Lay policy groundwork to coordinate regional transmission planning processes

Finally, RTOs must embrace interregional transmission planning, especially on the coast where the "seams" of planning boundaries intersect at the ocean grid. Interregional transmission can provide "dependable capacity value by tapping into geographic diversity in the timing of peak demand, renewable output, and generator outages between regions."[33] The value of interregional coordination cannot be understated, especially in the East Coast where multiple RTO boundaries converge at high-load centers near high-potential wind generating sites. With more coordination, these RTOs could share wind resources and provide renewable reliable electricity to millions of households. This could manifest in several ways. For instance, the installation costs of POIs that could benefit multiple RTO regions could be shared by multiple RTOs. OSW grid technology standards should be coordinated not just within PJM, but with other RTOs to create a more efficient grid scheme. Establishing policies and agreements across RTOs to standardize regional transmission processes will help provide certainty to developers such as agreeing to the same methodologies for cost-benefit analyses.

IV. Conclusion

To conclude, RTOs such as PJM play a critical role in deploying offshore wind energy. Through financing mechanisms, efficient grid layouts, and interregional planning, PJM can accelerate the speed and reduce the cost of OSW projects in the northeast. If states aim to succeed in their renewable energy goals and stave off the worst impacts of climate change, interstate and interregional transmission coordination is critical to decarbonize the energy sector. Through these policy reforms, PJM can provide more certainty for OSW generation developers, increase system-wide efficiency & reliability, reduce unnecessary costs, and accelerate the energy transition.

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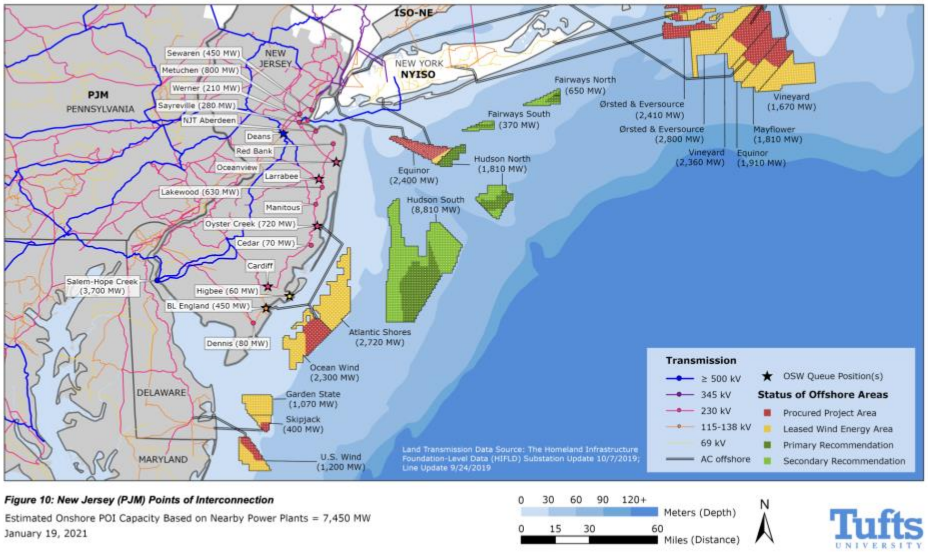
[32] See Appendix, Figure 4.

[33] Michael Goggin and Zach Zimmerman, Billions in Benefits: A path for expanding transmission between Miso and PJM, November 2023, https://acore.org/wp-content/uploads/2023/11/ACORE-Billions-in-Benefits-A-Path-for-Expanding-Transmission-Between-MISO-and-PJM.pdf.

V. Appendix

Figures

Figure 1[34]



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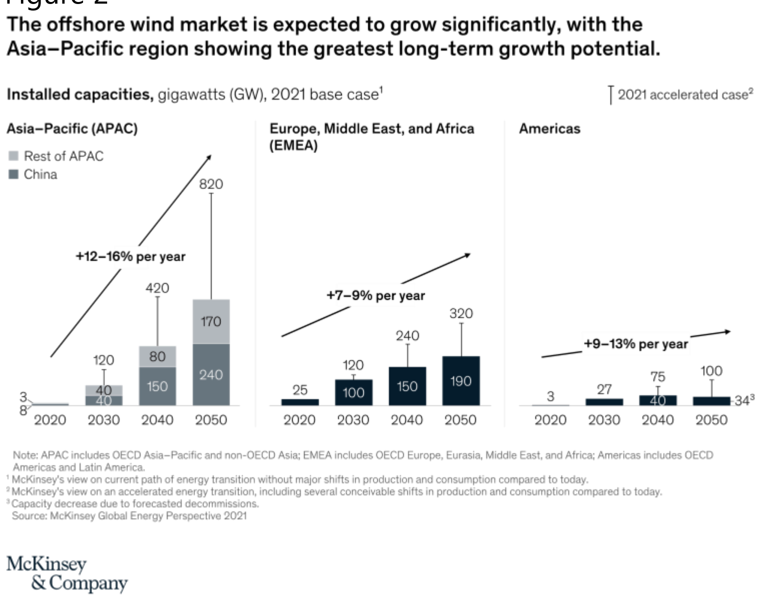
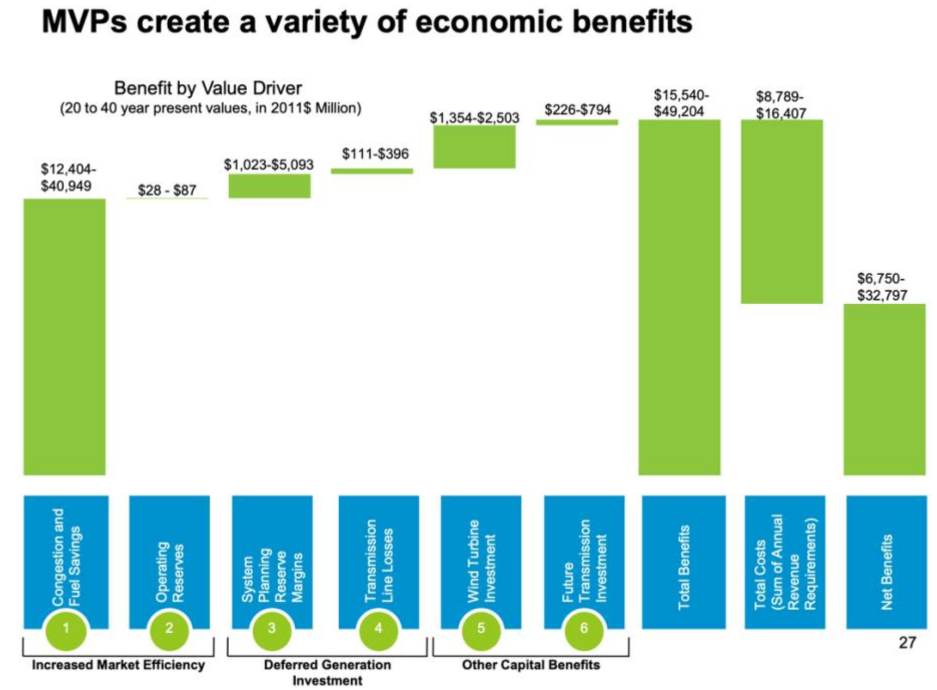


[34] Kelly Smith PE., Samuel Lenney, Oliver Marsden, Barbara Kates-Garnick, PhD., Aleksandar Stankovic, PhD., and Eric M. Hines, Phd., "Offshore Wind Transmission and Grid Interconnection across U.S. Northeast Markets", Offshore Power Research & Education Collective (2021), Tufts University, https://createsolutions.tufts.edu/wp-content/uploads/2021/08/OSW-Transmission-and-Grid-NE.pdf

[35] Florian Kühn et al., "How to Succeed in the Expanding Global Offshore Wind Market," McKinsey & Company, April 20, 2022, https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/how-to-succeed-in-the-expanding-global-offshore-wind-market.

Figure 3[36]



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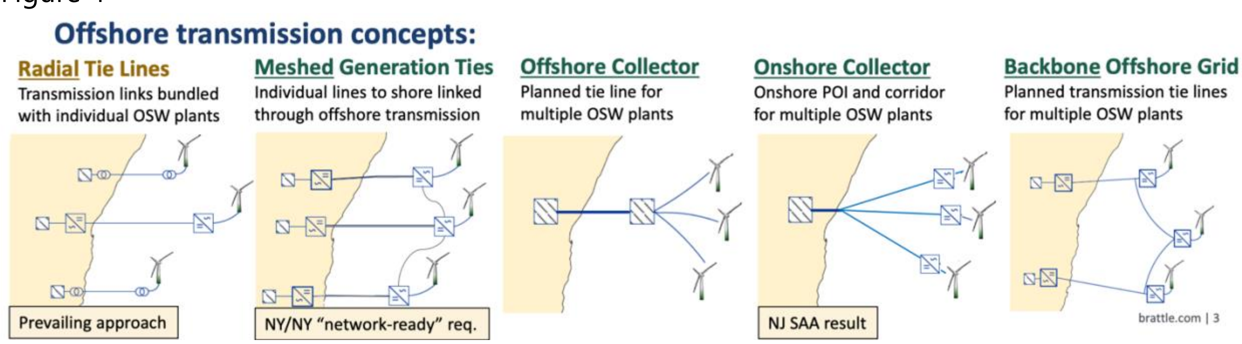

[36] Multi Value Project Portfolio - Detailed Business Case, 2011, https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Detailed%20Business%20Case117056.pdf.

[37] Johannes Pfeifenberger, "U.S. Offshore Wind Transmission: Holistic Planning and Challenges," The Brattle Group, September 22, 2023, https://www.brattle.com/wp-content/uploads/2023/09/US-Offshore-Wind-Transmission-Holistic-Planning-and-Challenges.pdf.

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