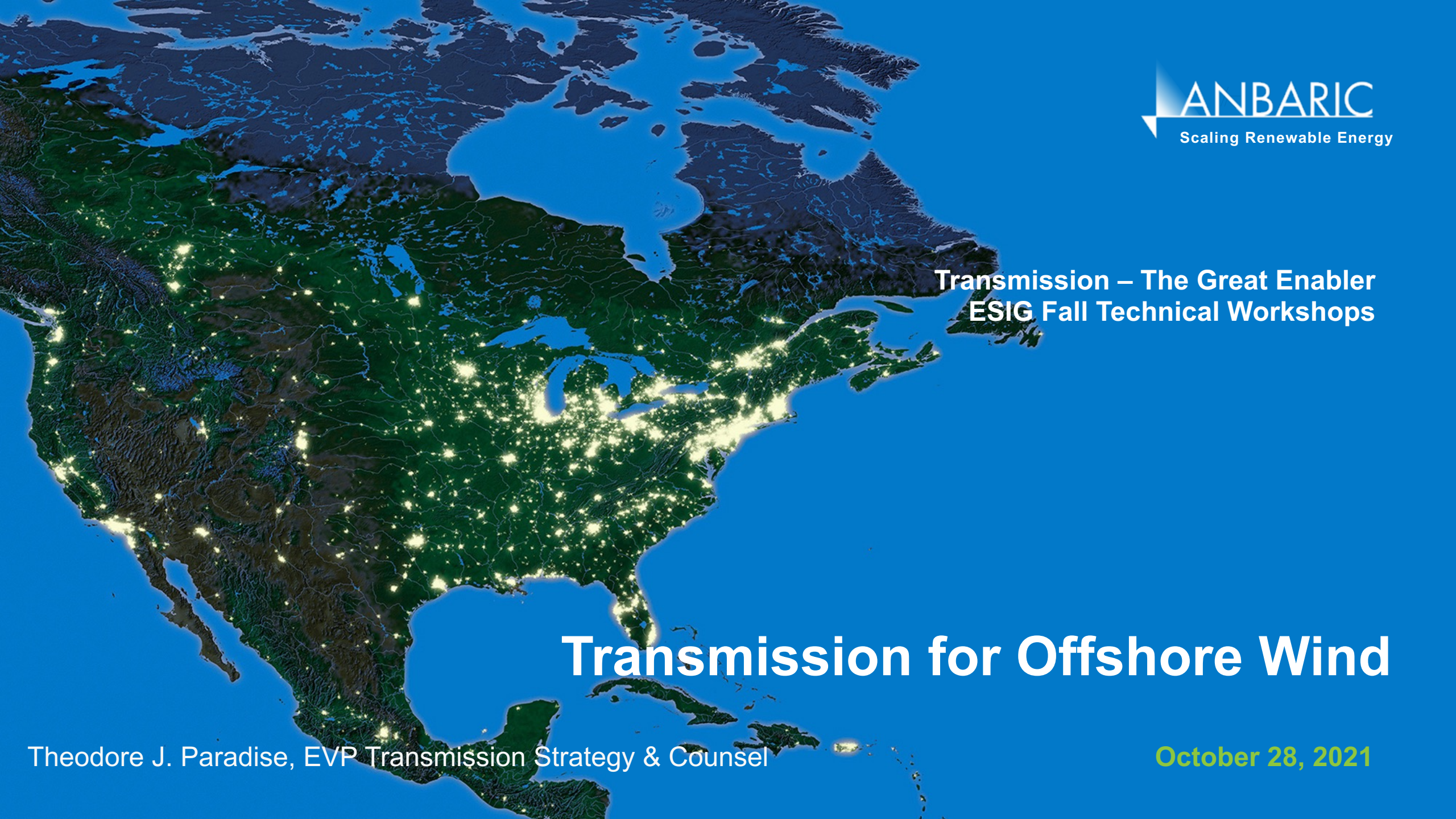


ANBARIC
Scaling Renewable Energy

Transmission – The Great Enabler
ESIG Fall Technical Workshops

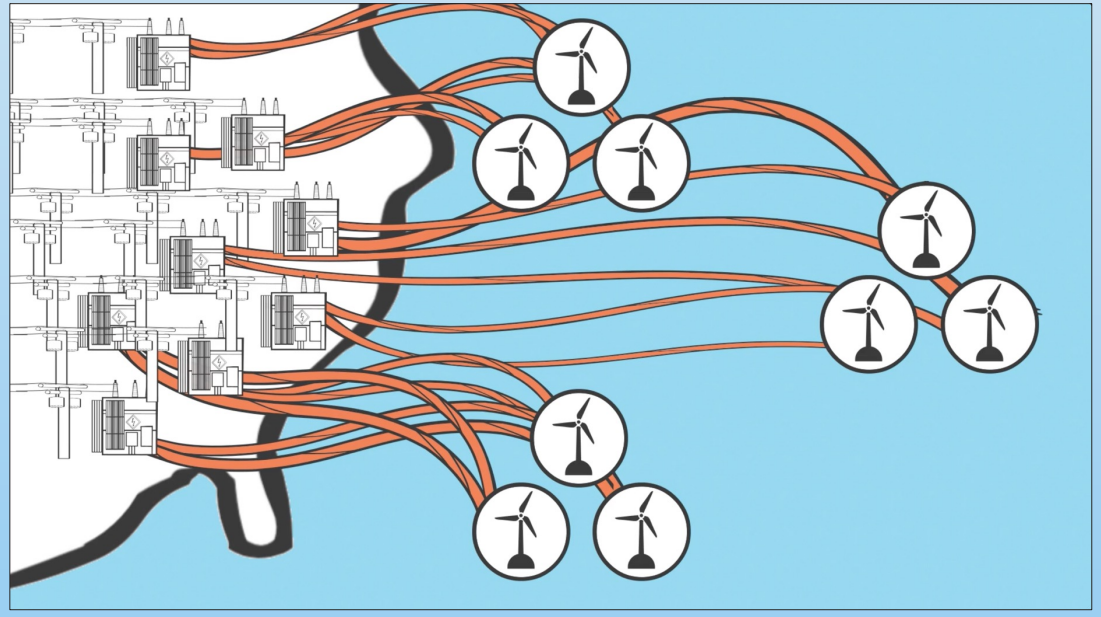
Transmission for Offshore Wind

Theodore J. Paradise, EVP Transmission Strategy & Counsel

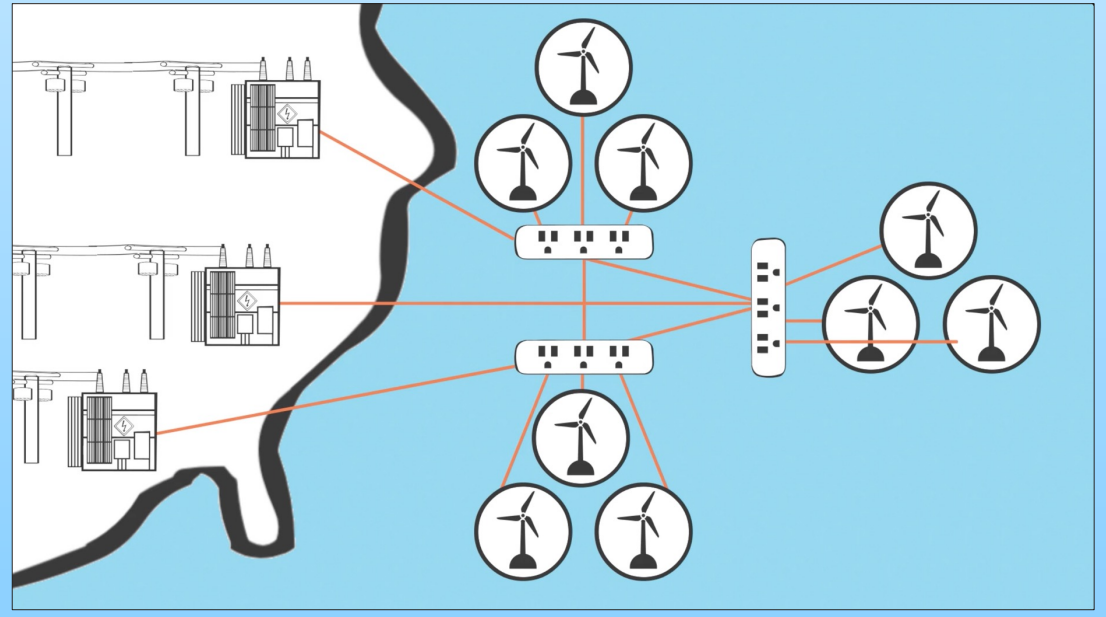
October 28, 2021

Importance of Planned Transmission

Transmission is critical to meeting the states' climate and energy policy goals, as permitting and related upgrades are often the most difficult part of projects. **TWO BASIC WAYS TO DO IT:**

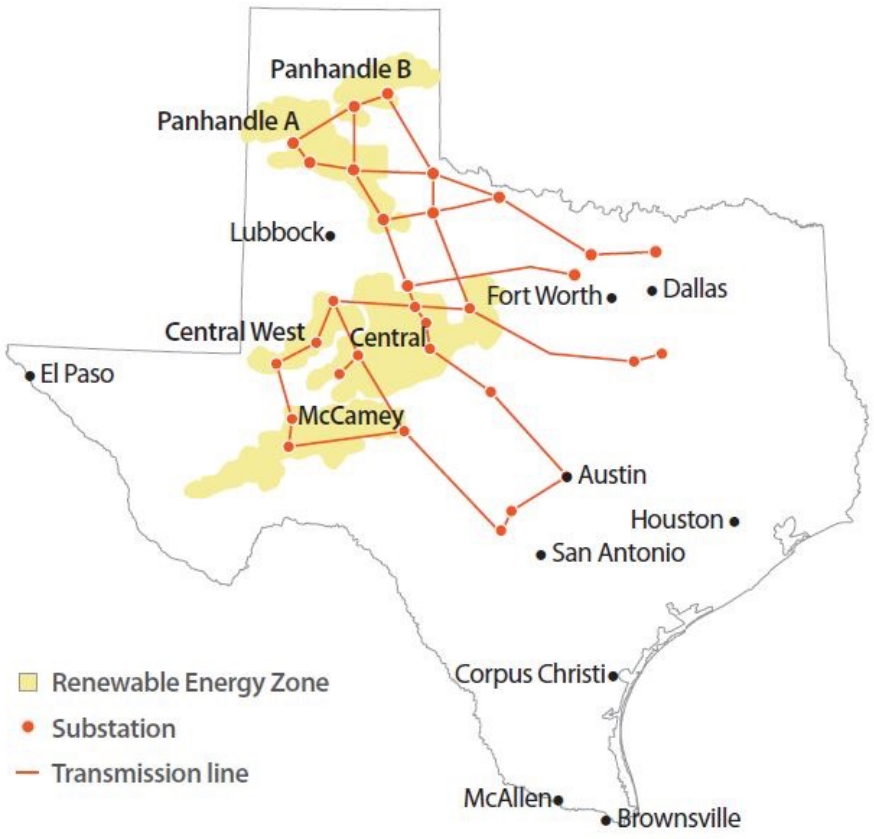


A SINGLE LINE TO EACH WIND FARM

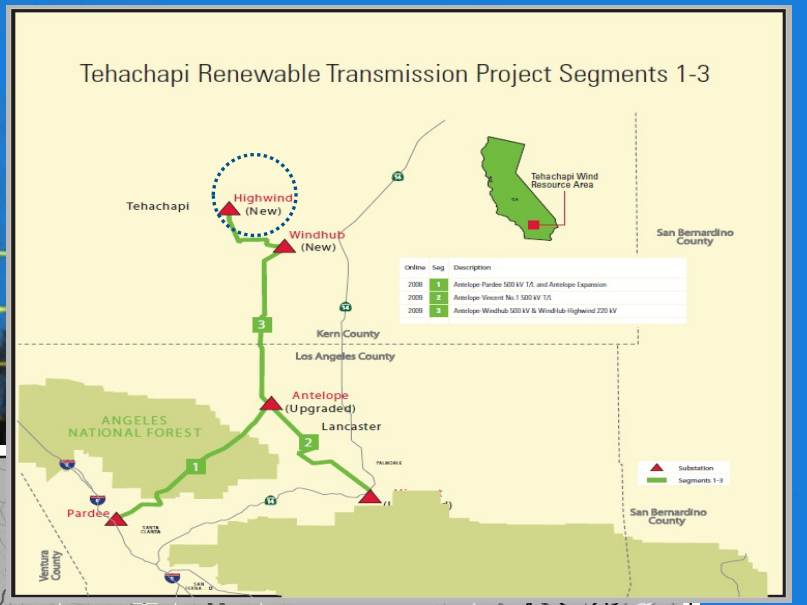


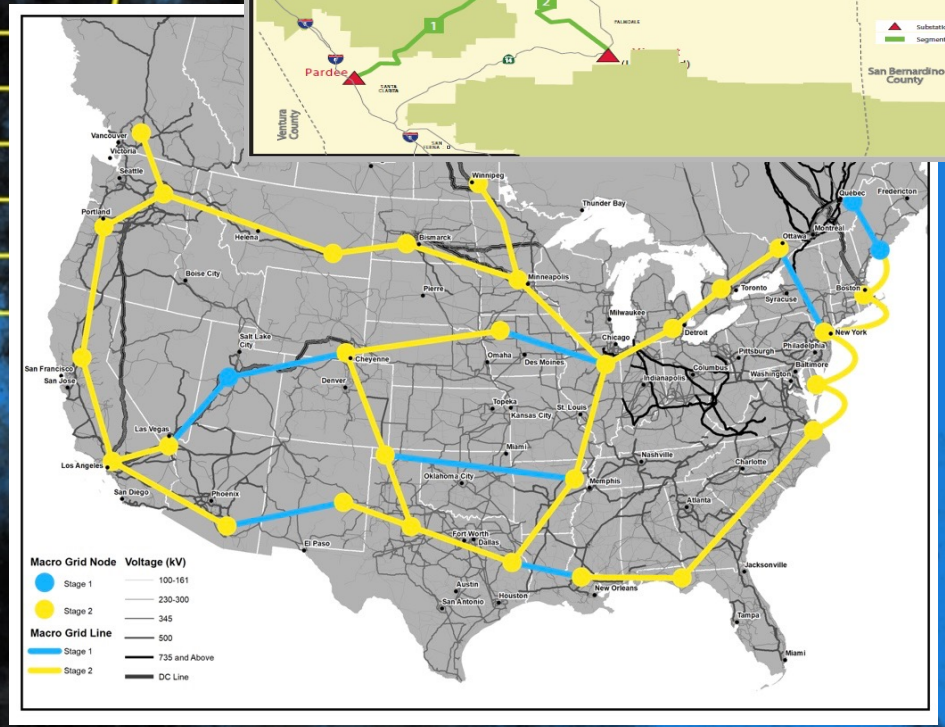
A PLANNED-OUT SYSTEM CONNECTING MULTIPLE WIND FARMS

The Grid is … The Grid



The understanding that large, planned and networked energy systems are more efficient, can save significant money to end users, and provide increased reliability is not new





Background Image: *The Atlantic,* "How a Plan to Save the Power System Disappeared" Peter Fairley August 20, 2020

Limits on Integrating OSW

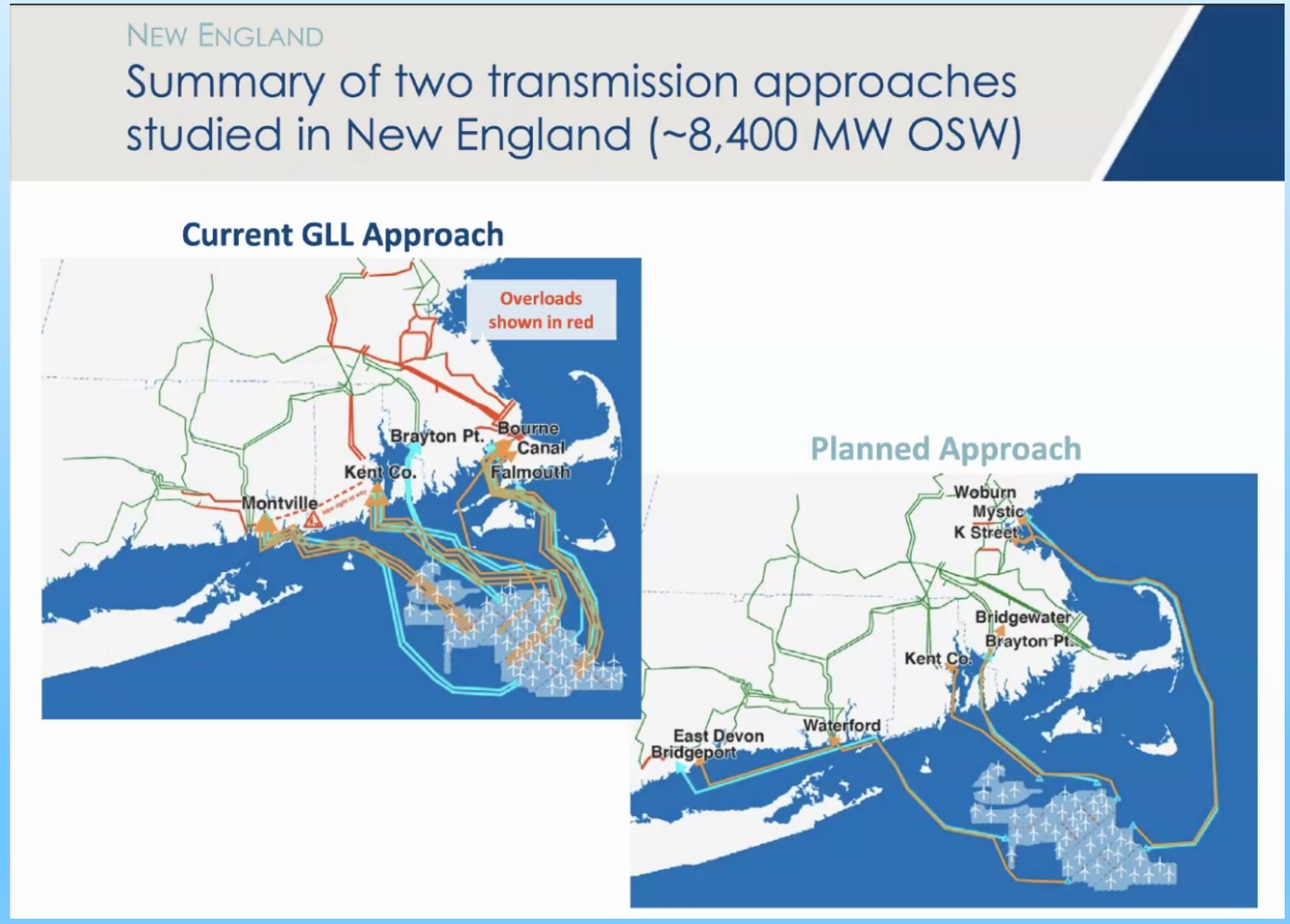
- Limits on integrating offshore wind into the existing grid come in a few flavors:
  - Limited substation space near the coasts and expansion, new stations can be challenging
  - Existing terrestrial grid thermal overloads, voltage, or stability issues depending on injection points, made worse when everyone wants to connect to the same, close-to lease area location
  - Limited water way approaches, ROW limitations
  - Need to network with fast fault switching – e.g. full bridge converters or HVDC breakers – for cable sizes to go even larger, e.g. 500+ kV, 2,000+ MW, and not cause single source loss issues

- Does transmission approach make a difference?

- Are current transmission planning processes helping or hurting the path forward?

New England Study

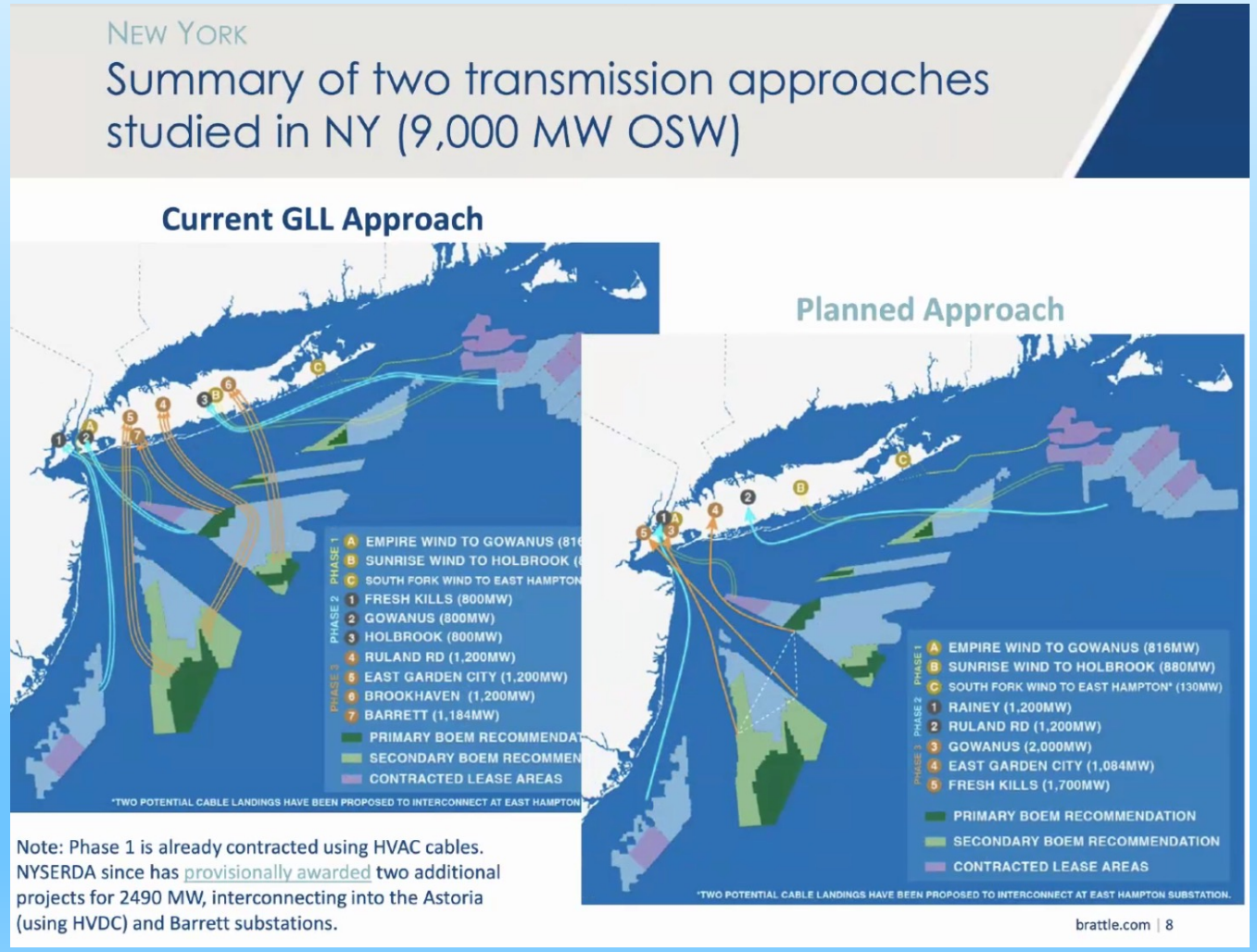
- Reduces transmission cabling by ~50%; far less ecological and fisheries impact
- Significant reduction in curtailments, ~$300M / yr.
- Twice the amount of offshore wind generation can be added before significant (several 345 kV lines in new ROWs) onshore transmission additions are needed



What's Currently Happening

- October 2020, ISO New England kicked off cluster study of offshore wind coming into Cape Cod
  - Issue: too much generation for the existing system
  - Identifies new circuits needed to get power off the Cape into southeastern, MA
  - Once power in SE MA, another new path needed to move power from SE MA to load, i.e. NE MA
  - Clusters aren't designed to integrate full amount of offshore wind (or any other type of generation) but to advance interconnection queue processing
    - Already interconnected wind can be dispatched down or off
    - Other balancing resources can be dispatched down or off
    - Results are undersized solutions that are designed for curtailment and no future additions
  - Costs can be large (over $1bn) and is on the interconnecting generators for transmission the whole system benefits from but may not even sized large enough for all resources to operate / avoid curtailment
    - Costs can be prohibitive to cluster transmission construction, see e.g., Maine cluster study outcome for onshore wind

New York Study



- Significant reduction in transmission cables:
  - 59% fewer marine cable-miles
  - 54% fewer cable shore landings
- Reduced curtailment
- Maximized POIs and constrained approaches
- $1.5 billion less in onshore upgrades needed
- Reduced impact to environment and fisheries

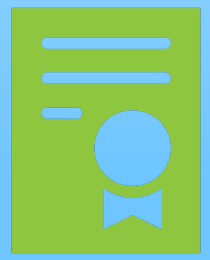
What's Currently Happening

- New York is one step behind New England
  - Limited paths into load are being utilized by radial AC connections, meaning that limited paths through areas like the Narrows (Anbaric study indicates 4 cables) are occupied by 400 MW AC circuits instead of much larger single HVDC bundles
  - Will eventually lead to significant upgrade costs sooner than needed, making the integration of more OSW more expensive, time intensive, and risky than need be

The Need For Planned Transmission In The US

- **In remarks made at the October 27, 2020 FERC technical conference,** former FERC Chair Wellinghoff strongly endorsed the planned transmission approach lines noting that it is "clearly superior in every single respect to the" radial generator lead line model.[1]

James Cotter of Shell stated at the October 27, 2020 technical conference "Our belief is that the current approach to transmission may limit offshore wind installation to 4-5GW and will likely be a barrier to significant offshore wind installations on the US West Coast. We believe a planned transmission backbone approach can be delivered faster and more efficiently than multiple, radial line interconnections, and presents a more realistic pathway to realize the states' significant ambitions. It is logical that planned routing to load centers could require less investment, less disruption, and deliver more benefits and studies already conducted are demonstrating this."



- **The National Association of Regulatory Utility Commissioners passed a resolution** in November of 2020 noting the benefits of planned offshore transmission for offshore wind.[2]
- **New Jersey BPU has put this consensus into action,** announcing in November of 2020 the first ever planned transmission procurement to enable the public policies of the state of New Jersey with an RFP to be conducted in 2021.

[1] https://cms.ferc.gov/sites/default/files/2020-10/Panel-3-JonWellinghoffGridPolicyInc.pdf
[2] https://pubs.naruc.org/pub/47ED8D6D-155D-0A36-311D-EE237765A6EB

Countries That Started With Radials Are Moving To Planned Systems

- The United Kingdom is a best cast for radial transmission development for offshore wind given it extensive coastline. But even here, Ofgem has determined that the nation will move to a planned “meshed” grid approach going forward.

> We do not consider that individual radial offshore transmission links for this amount of offshore generation are likely to be economical, sensible or acceptable for consumers and local communities.*

ofgem
Making a positive difference for energy consumers

- Working with government and industry, Ofgem will assess how a more "coordinated" offshore transmission system could reduce financial and environmental costs, the regulator said.

ForwardWorkProgramme
consultation 2020-2022

* https://www.reutersevents.com/renewables/wind-energy-update/windy-december-lifts-orsted-2019-profit-uk-develop-new-offshore-grid-networks

Shared Network Benefits are Significant and Even a Few Years Delay Can Impact

Significant savings and reduction in number of electrical assets are a key driver for the UK, but delay even to 2030 can reduce benefits by half.

Source: National Grid ESO February 2, 2021 presentation to New England states

https://newenglandenergyvision.files.wordpress.com/2021/02/bstojkovska-02-02-2021-draft.pptx

Offshore Network Coordination – Key Messages

£6 billion (18%) potential savings by **2050** if integration starts from 2025

The number of assets could be reduced by **50%** creating significant environmental & social benefits

Benefits are reduced the later integration begins – by half if integration starts in 2030.

Flexibility is needed to deliver projects in train without putting their delivery and the 2030 offshore wind target at risk

Support for commercial deployment is needed to deliver all of the required technology

Additional onshore infrastructure is required to connect wind, however integration can minimise the overall increase in infrastructure

nationalgridESO

So What Needs to Change?

Comments in AD20-18-000 highlight three areas, and key among these are rules around the regional planning process and the often-substituted grid expansion by interconnection. **These apply equally in the FERC ANOPR on transmission planning (RM21-17-000).** The recent FERC policy statement in Docket No. PL21-2-000 is a very helpful step in the right direction and provides clarity to states AND to RTOs that there are tools they may not have understood to be available to move transmission forward.

The Laws, Goals and the Planning are Not Aligned

Despite ~40GWs of offshore wind now in state statutes or executive orders (a down payment on the amounts needed), a federal goal of 30 GWs by 2030, and other federal objectives like a carbon-free electric sector by 2035, a 50% CO2 level below 2005 by 2030, and the commitments of the Paris Agreement, transmission for renewables is not being planned in most regional planning processes. Exceptions: NYISO has identified the first significant projects in ~28 years to provide overland transmission, and New Jersey has spurred PJM forward through single state procurement. Other states in PJM and the regional planning process are not planning for the regional expansion needed. ISO-NE is not currently doing any transmission planning that could build regionally funded projects outside of reliability. While NYISO has called for a meshed offshore network in 2019, it is not moving forward as of today in the planning process but this HAS been identified to NYISO as a needed public policy project.

Pathway No. 1 Interconnection Reform

- Existing ISO/RTO interconnection processes do not accommodate transmission platform project proposals—even where these resources are able to secure a spot in the interconnection queue, they are not awarded meaningful injection rights
- Interconnection proposals for each project are unlikely to make reasonably efficient use of the existing grid, as they are designed to be least expensive for a single project. This can lead to, for example, three wind farms using ten 400 MW AC lines (the maximum on a tri-core cable) where two larger 2,000 MW HVDC circuits could have been used
- Even cluster processes are inefficient and lead to undersized transmission that is still not in the best area:
    - existing wind is dispatched down to allow for interconnection of new wind, e.g., ISO-NE Cape Cod cluster study
    - routes are not looked at and problem solving starts with the impacts of proposed project-based interconnections; other system issues such as reliability and forward-looking (even one year ahead needs) are not considered

Interconnection Policy Fix

FERC should direct RTOs/ISOs to:

- (1) revise their interconnection processes to enable developers to propose “transmission first” projects that can be studied and developed with meaningful injection rights, and
- (2) require the conduct of a regional policy planning assessment where an interconnection study identifies significant upgrades beyond the gen-tie line needed to reach a substation and any directly related substation upgrades
  - Doing this means that transmission-first projects can be studied and developed using place-holder resources, and subsequently-interconnected generators can be afforded injection rights on par with bundled radial/generator interconnection requests
  - This will shift the evaluation and development of needed upgrades to the planning process, where they can be considered holistically in the broader context of overall system needs, be selected through competitive bidding, and be made subject to regional cost allocation methodologies—rather than having costs allocated solely to the interconnecting customers

PathwayNo. 2 – Regional Planning

- Pathway No. 1 is not sufficient
- In addition, modifications should be made to ISO and RTO planning processes; they are critical to the orderly development of OSW transmission
- There has been insufficient attention paid to transmission planning focused on meeting public policy objectives. Regional planning across the Eastern RTOs and ISOs has taken place in silos, narrowly focused on solving only “reliability,” “economic,” and (to a much lesser extent) public policy needs
- While state public policy planning has been absent in many areas, there is also no federal or municipal public policy planning

Regional Planning Fix

- Require proactive identification of state and federal policies driving OSW investment and include as part of planning processes an assessment of the sufficiency of the existing grid, and any needed expansion, in light of those policies
- Reliability needs, end-of-life/asset condition projects (to replace aging infrastructure at the end of its useful life), and other transmission system needs should be studied and planned for in the context of overall, immediate-, medium- and long-term state policies—including OSW targets—rather than "siloed" processes that simply solve for the need at hand
- Transmission needs identified through the planning process must be subject to competitive processes to the greatest degree practicable
- ISOs and RTOs must be directed to evaluate not just a project's capital costs, but whether it will reduce production costs, yield other costs savings (e.g., through construction cost caps or ROE commitments), solve for multiple needs or address multiple drivers, and reduce onshore upgrades, curtailment, and environmental impacts. ISO-NE's one and only RFP rejected 35 of 36 proposals and interconnection cluster has identified (only months later) the need to build a very similar project rejected as too expensive *IN ADDITION* to the reliability projected selected – a needlessly more expensive result for consumers

Regional Planning Fix Cont.

- State feedback matters. ISOs and RTOs should be directed to consult with state policymakers when evaluating competitive solutions to transmission needs. We note that this is a key point in the recent policy statement re: state input and control, but where an RTO-initiated process is used, states should have significant input into what projects best meet their stated policy needs
- Direct RTOs to plan for federal public polices. No entity currently filles the role of identifying federal public policies for RTOs FERC is best positioned to provide this guidance
- Planning processes should be looking at least fifteen to twenty years into the future so that the system is being expanded in the most efficient manner to meet anticipated needs, and that the projects built to address those needs are right-sized
  - Timeframe for state OSW goals: do not want to miss clear state requirements because of a too-short horizon, e.g., we see you want 4GW more but those additional MWs are outside the 10-year scope even though legislated. This could be an issue for example in designing a reliability solution that could ignore clear policy requirements missing the opportunity for a transmission solution to solve for both

State Voluntary Agreements: A Powerful Tool

- Despite existence of public policy tools, the requisite transmission is not being built. States have expressed a desire to use the RTO planning expertise *where the states can direct and choose* the transmission (scale and design) that they believe best meets the needs of their residents, and on a scale that they are willing to fund
- PJM formalized this add-on process in the State Agreement Approach. The recent Policy Statement (PL21-2-000, June 17, 2021) endorses that approach and observes that states have always had the ability to work with RTOs on agreements for direct procurement of transmission
- This is significant because the Policy Statement would allow one or more states to file a Study Agreement with FERC. This would allow, for example, ISO-NE to facilitate a state RFP for planned open access transmission to enable policies
- Several New England states have statutes allowing direct-state procurement of transmission (e.g., MA, CT, RI, ME)

State Agreement in NJ

- November 2020, NJ BPU issues order to move forward with transmission-first planning under the PJM State Agreement Approach:
  - PJM runs RFP process
  - NJ BPU has final say to select any projects
- Transmission to integrate state's goal of 7,500 MW of OSW
- Bids were due September 17, 2021

Green:

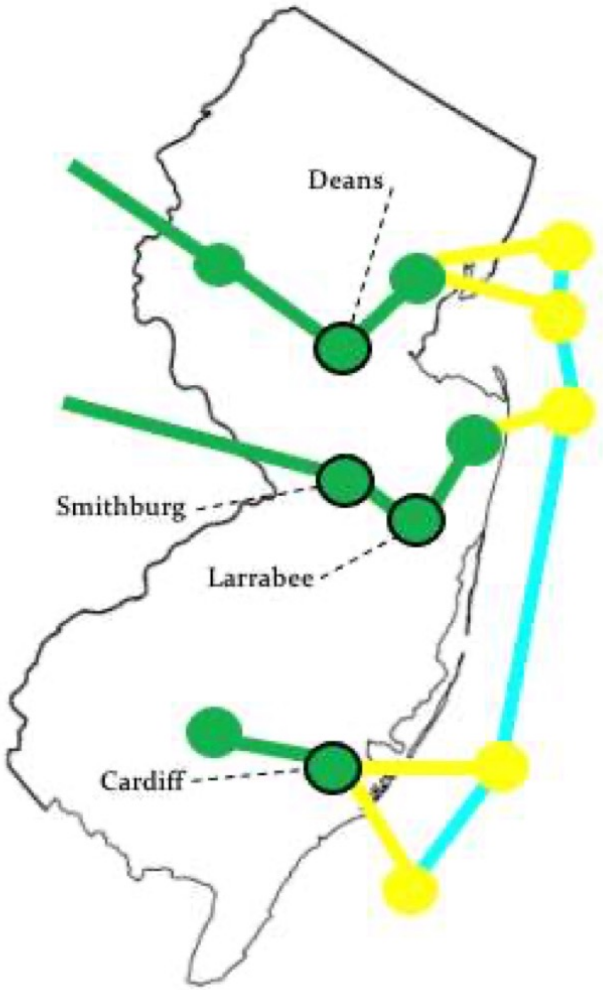
- Option 1 – Upgrade PJM Transmission system to Shore substations
- Black Outline indicates substations targeted for injections as described below.

Yellow:

- Option 2 – From Upgraded Shore Substations over Beach crossing to New (wet) collector Stations.

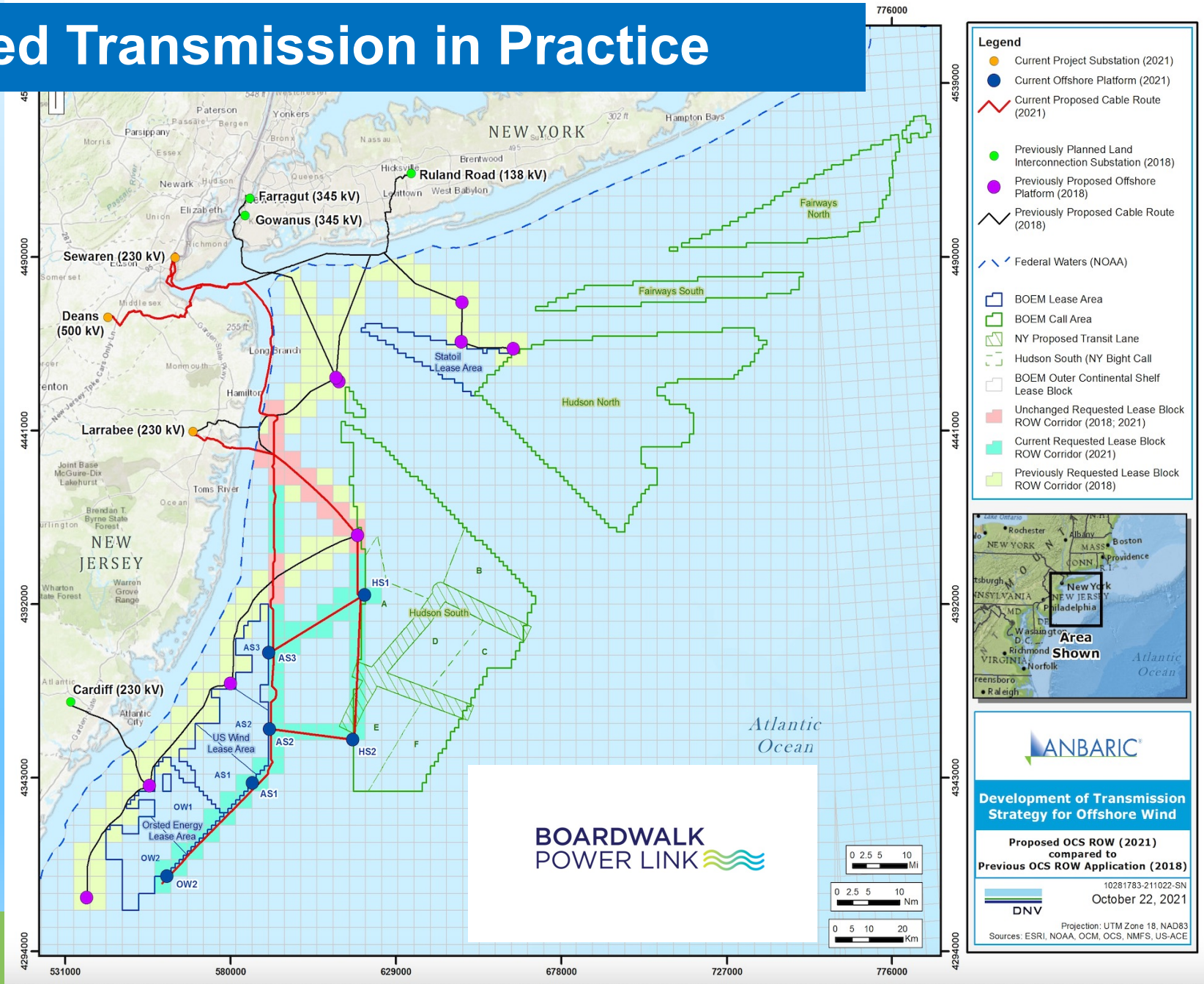
Blue:

- Option 3 – Interconnecting collector stations in a "network" or "backbone" to facilitate network delivery of Offshore Wind.

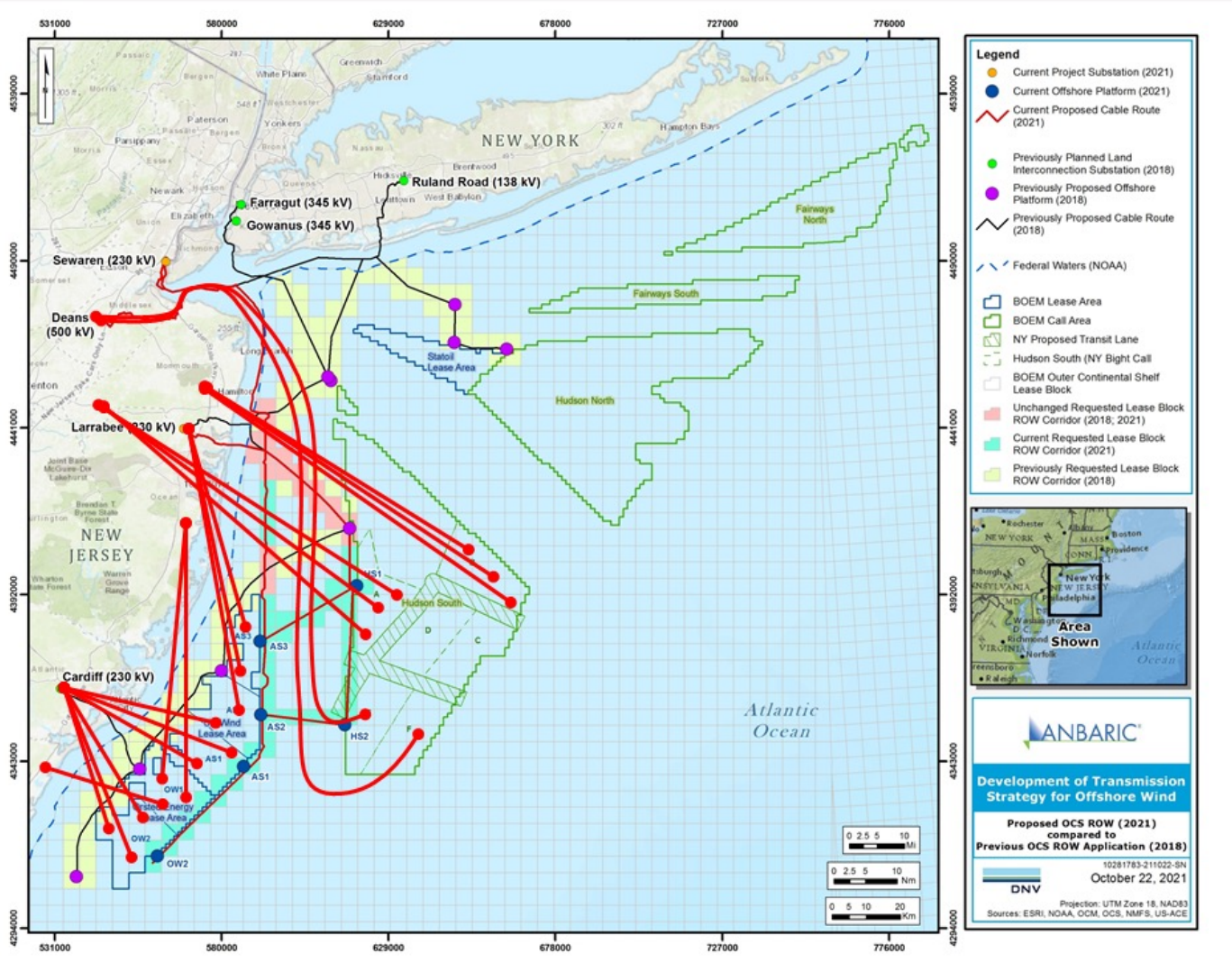


Graphic: NJ BPU

Planned Transmission in Practice



Radial Alternative



OW1 1100 MW = 3 AC cables
OW2 1200 MW = 3-4 AC cables
AS1 1500 MW = 4 AC cables
AS 2 1200 MW = 3 AC cables
HS1 1400 MW = 4 AC cables
HS2 1400 MW = 1 DC cable
HS3 1400 MW = 1 DC cable

Total = 19 - 20 cables in radial approach

OW1 3 AC cables
OW2 1 DC cable
AS1 1 DC cable
AS2 1 DC cable
HS1 1 DC cable
HS2 1 DC cable
HS3 1 DC cable

Total = 9 cables in coordinated approach

How to Move Voluntary Agreements Forward

Layout the path forward for other areas outside of PJM:

- While PJM included a cookbook for how to file a study agreement with FERC in its Tariff, other areas may be wondering about how to work with an RTO to help facilitate a state transmission procurement
- States identify goals and discuss collaboration or single state procurement
    1. Where one or more states decide to enlist the assistance of an RTO, the state(s) enter into a proposed study agreement with an RTO to help facilitate an RFP
    2. The agreement is filed with FERC for transparency and approval

    There need not be a 12+ month long stakeholder process and the follow-on tariff change filings to revise the RTO planning process before significant planning and procurement processes for offshore transmission systems occur

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THANK YOU