New York Power Grid Study: Results and Observations

PRESENTED BY

Johannes Pfeifenberger

PRESENTED AT

Independent Power Producers of New York

36th Annual Spring Conference

MAY 18, 2022

Brattle

Note

This presentation represents the view of the author and does not represent the opinion of NYSERDA, DPS, Pterra, or other Brattle Group staff or clients.

It is, in part, based on the Initial Report on the New York Power Grid Study, published in **Case 20-E-0197**, under the Title of Matter: **Proceeding on Motion of the Commission to Implement Transmission Planning Pursuant to the Accelerated Renewable Energy Growth and Community Benefit Act**, on January 19, 2021 at:

http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=259215&MatterSeq=62480

The published report was prepared by staff of The New York Department of Public Service (DPS) and New York State Energy Research and Development Authority (NYSERDA) with support and advice from the named authors of The Brattle Group and Pterra Consulting for the New York Public Service Commission under a contract with NYSERDA. It is intended to be read and used as a whole and not in parts.

Background

New York's Climate Leadership and Community Protection Act (CLCPA)requires:

- 70% renewable generation by 2030
- Zero-emission electricity by 2040
- 85% economy-wide reduction in greenhouse gas emissions by 2050

The CLCPA also specifies minimum amounts of certain types of resources including:

- 6,000 MW of distributed solar resources by 2025
- 3,000 MW of storage by 2030
- 9,000 MW of offshore wind (OSW) generation by 2035
- Much more renewable generation is necessary to achieve the 2040 and 2050 mandates

Meeting these milestones will require significant investments in:

- Renewable generation, storage, energy efficiency measures
- Electrification of the transportation and heating sectors
- Electric transmission and distribution (T&D) infrastructure

Overview of the Power Grid Study

To meet state policy directives, the PSC, through the Department of Public Service and in consultation with NYSERDA, initiated the **New York Power Grid Study (PGS),** which consists of **three component studies:**

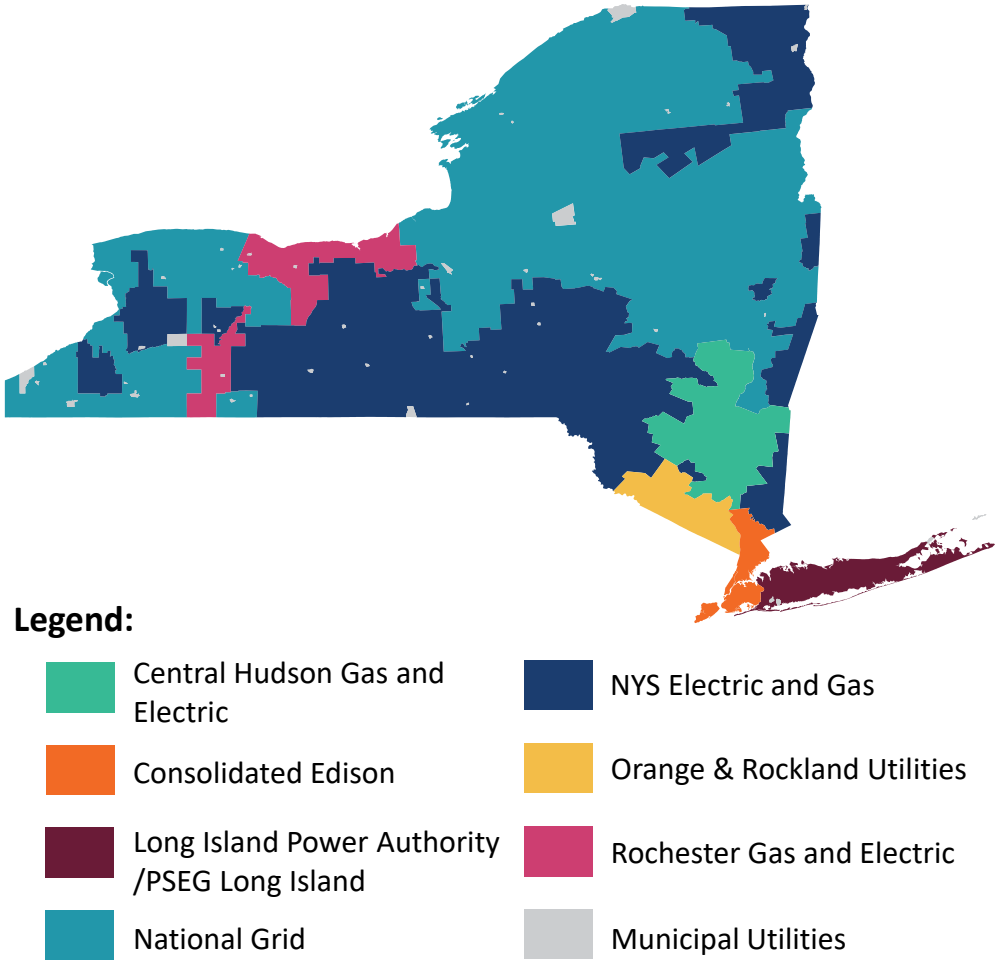
- **Utility Study**: Conducted by the Joint Utilities on local transmission and distribution (LT&D) needs;
- **Offshore Wind (OSW) Study**: Study of offshore and onshore bulk-power transmission scenarios to illustrate possible solutions to integrate the mandated 9,000 MW of offshore wind
  - Conducted by DNV-GL, PowerGem, and WSP for NYSERDA
- **Zero Emissions Study:** Scenario-based study to analyze transmission, generation, and storage options for achieving 70% renewable generation by 2030 and a zero emissions grid by 2040
  - Conducted by Siemens for NYSERDA

Utility Study

New York's utilities undertook a joint study, filed in November 2020, to identify local transmission and distribution (LT&D) upgrades necessary to achieve 70% renewable generation by 2030

- **Phase 1** LT&D projects for PSC approval to address existing reliability needs also provide CLCPA benefits
  - Local transmission projects to unbottle **6.6 GW** of renewable generation
  - Distribution projects to unbottle **2.0 GW** of renewables
- **Phase 2** LT&D proposals for further evaluation, including with new CLCPA benefit-cost analysis (BCA)
  - Local transmission projects would provide **12.7 GW** of additional renewable-integration headroom benefits
  - Distribution projects would support **2.8-4.3 GW** of additional renewable integration headroom benefits

New York State Electric Utility Territories



Utility Study: Local Transmission Takeaways

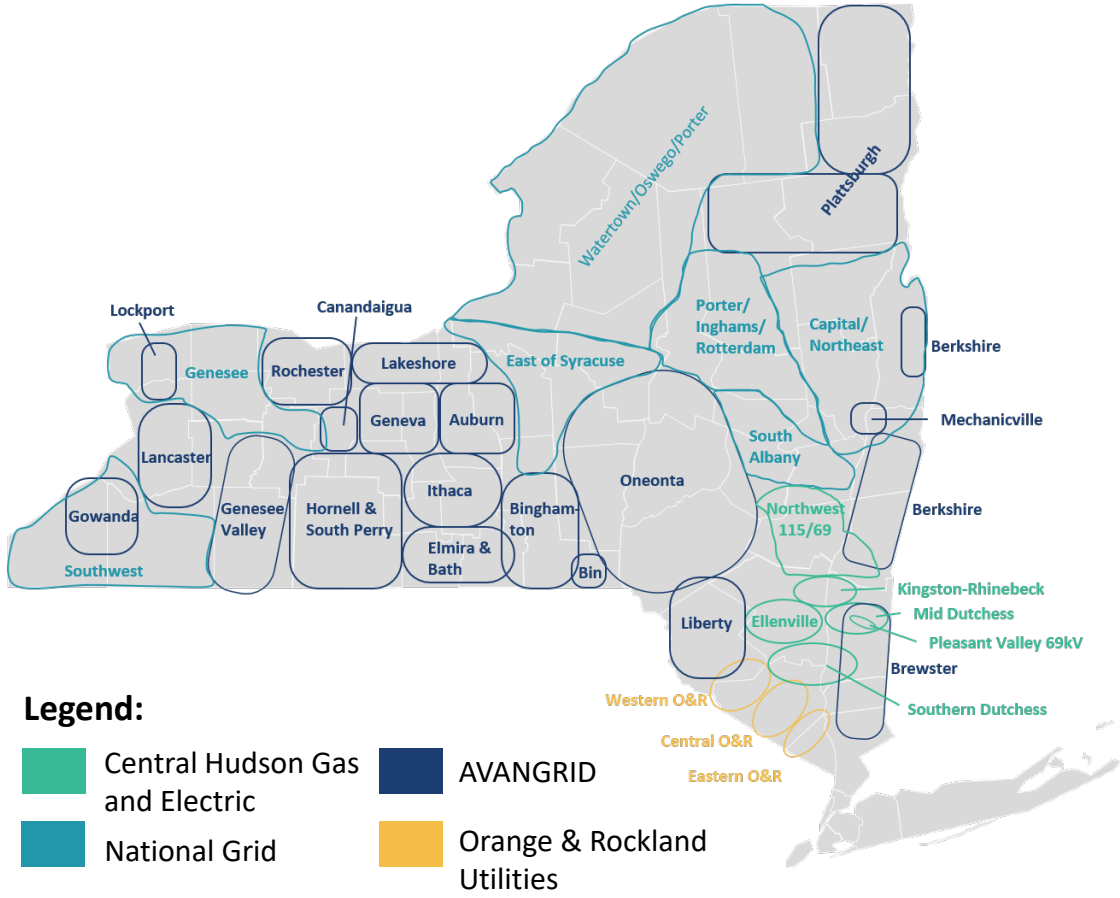
The total LT&D headroom created by the proposed Phase 1 projects appears sufficient to support the integration of land-based renewable resources needed to meet the State's 2030 objective. However:

- The headroom created by Phase 1 projects <u>does not</u> adequately address specific local transmission needs in certain attractive renewable development areas

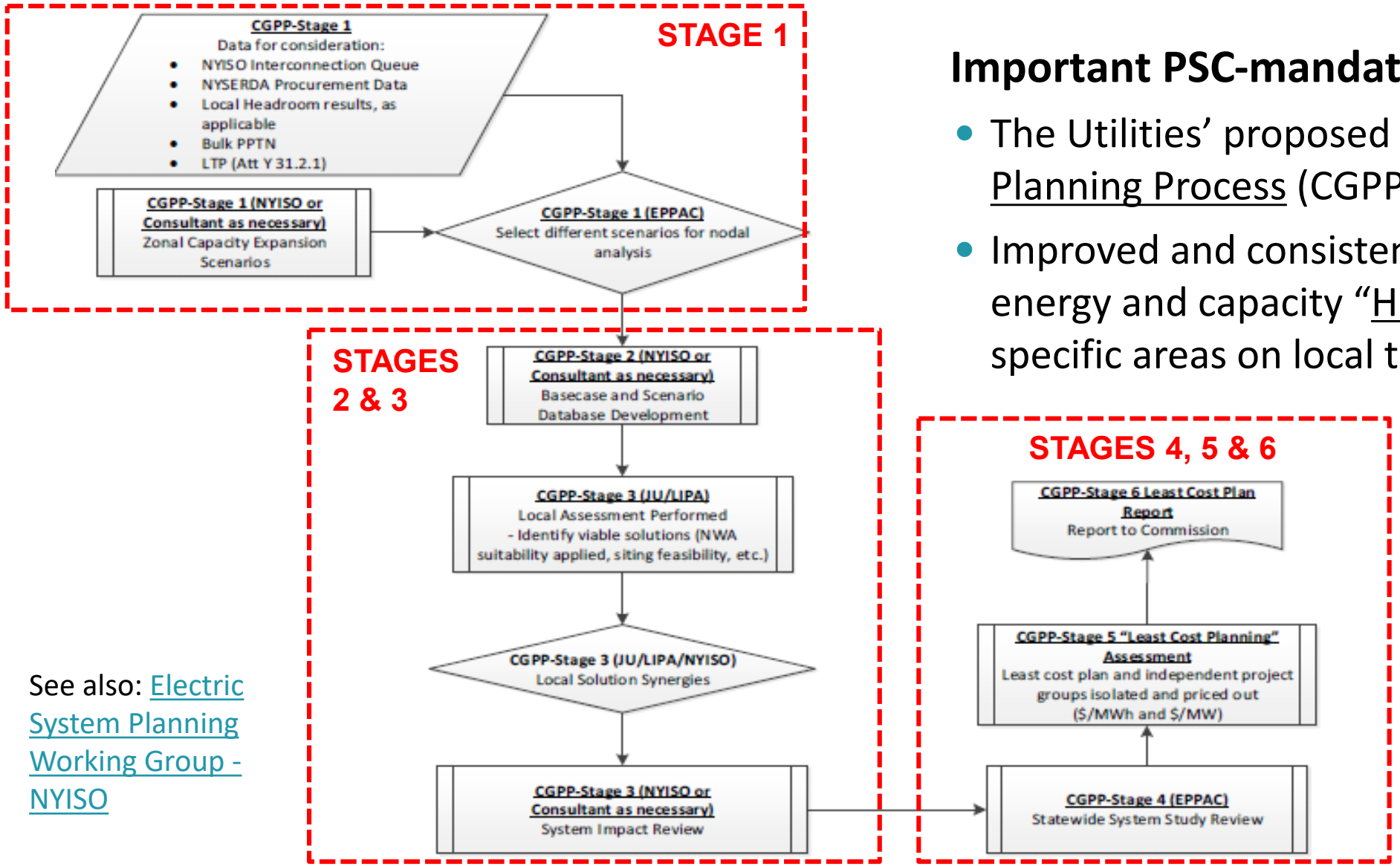
PGS Study recommendations:

- Consider approval of Phase 1 projects
- Accelerate some Phase 1 projects and develop priority Phase 2 projects for attractive renewable locations (**Hornell, Watertown/Oswego/Porter, Genese/Lockport/Lancaster, Central Hudson**)
- Consider developing local **<u>renewable energy zones</u>** (REZs)
- Accelerate implementation of **<u>advanced technologies</u>**
- **<u>Improve planning framework</u>** for Phase 2 projects

Local Transmission Areas in Upstate Utilities' Service Territories



PSC Initiatives: Headroom Determination and Coordinated Planning



Important PSC-mandated initiatives:

- The Utilities' proposed Coordinated Grid Planning Process (CGPP) (as shown)
- Improved and consistent determination of energy and capacity "Headroom" for specific areas on local transmission grid

See also: Electric System Planning Working Group - NYISO

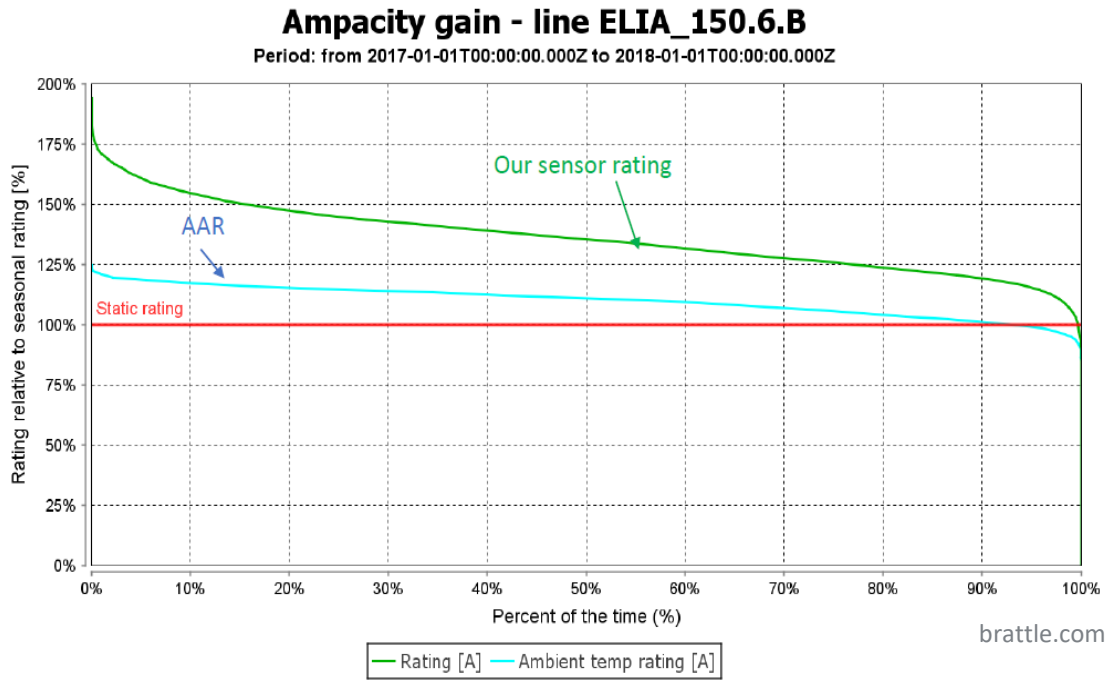
Advanced Grid Technologies

The Utility Study recommendations on advanced technologies do not go far enough

- The State should encourage the Utilities and transmission owners to more expeditiously evaluate and deploy well-tested advanced transmission technologies that could quickly provide CLCPA benefits and reduce costs
- Both Utility and NYISO transmission planning processes should be improved to recognize the unique advantages that advanced technologies can provide
- Cost recovery mechanisms will need to be clarified for storage facilities that address T&D needs but also participate in wholesale power market

Example: Dynamic Line Ratings (DLR)

- DLR can increase transmission ratings above static ratings by 25-30% on average over a year
  - Increase exceeds 10% during 90% of the year, 25% during 75% of the year, and 50% during 15% of the year
  - Only during 2% of the year dynamic line ratings are below static ratings, increasing reliability.
- Particularly effective in reducing (on-ramp-related) curtailments of wind energy
- Elia, the grid operator in Belgium, has successfully used DLR since 2008; now used on 35 major transmission lines



Offshore Wind Study

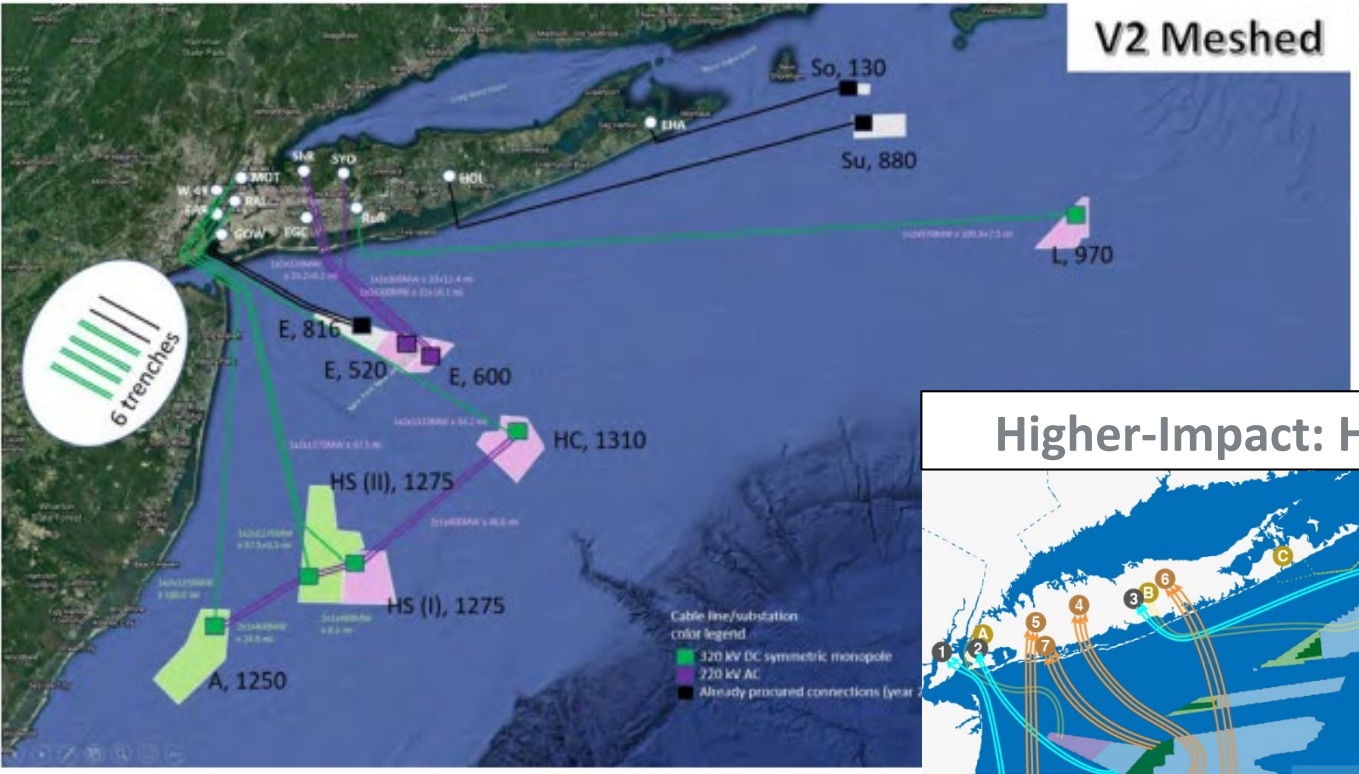
The Offshore Wind Integration Study (OSW Study) assesses bulk transmission needs relating to the integration of 9,000 MW (9 GW) of offshore-wind generation by 2035

- "**Onshore** assessment" to identify points of interconnection (POIs) and on-shore bulk-power transmission upgrades
- Development of **offshore** buildout scenarios from wind energy areas to selected POIs
  - Analyze offshore transmission to connect OSW plants
- Preliminary **permitting and feasibility** study of offshore cable routes and onshore landing points

Findings:

- Integrating 9 GW of OSW is feasible without major near-term bulk transmission upgrades if: 5-7 GW of OSW can be routed into NYC (so only 2-4 GW would need to connect to the grid on L.I.)
  - New transmission from Long Island likely needed by 2030-35 (sooner if more OSW connects on L.I.)
  - Significant uncertainty about most-likely and most-feasible POIs (OSW Study vs. related other studies)
- Requires careful planning of OSW procurement, battery deployment, and coordinated permitting
  - May warrant the development of "OSW hubs" to interconnect 5-7 GW in NYC (as proposed in Utility Study)
- Pursue options that allows for the creation of a more flexible and reliable "meshed" offshore grid

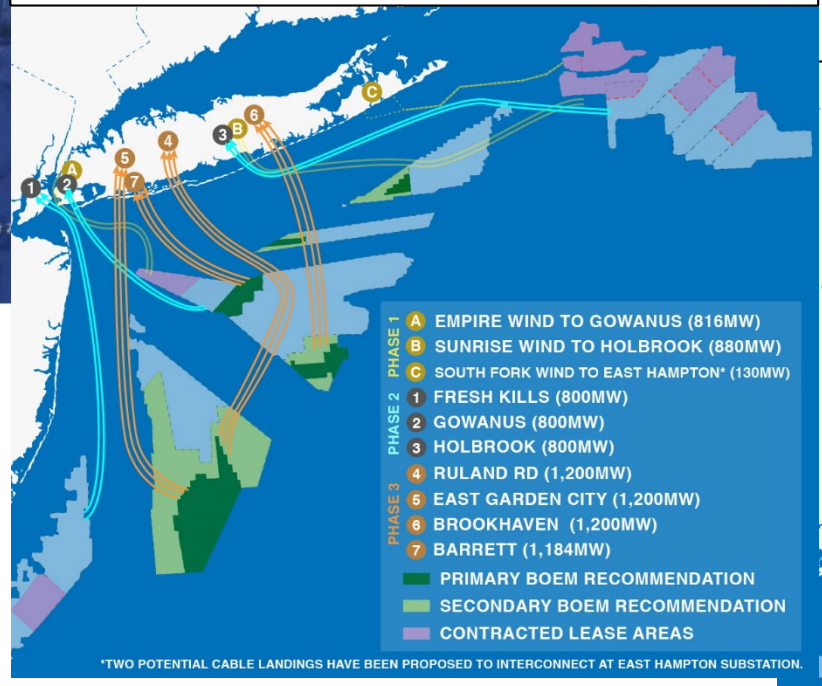
OSW Study vs. Similar Other Studies: Routing and POI Challenges



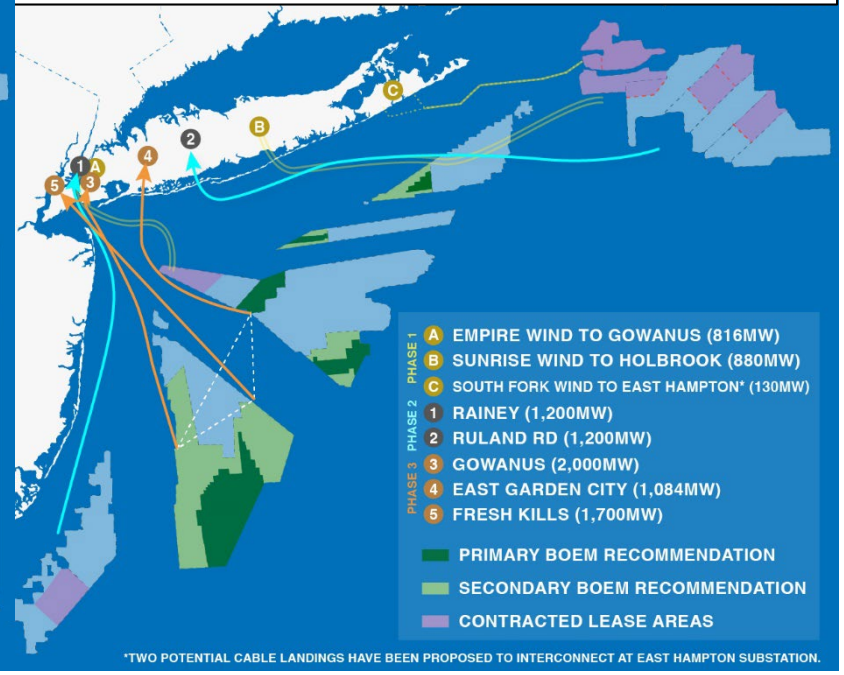
Source: OSW Study

Use of existing/retiring generating plants as points of interconnection: The Beacon Wind project will support the retirement of aging fossil fuel plants in Queens as part of the transition to clean energy; and the Empire Wind project may evolve to potentially support the retirement/repowering of the E.F. Barrett Generation Station in Nassau County

Higher-Impact: HVAC Gen Ties



Lower-Impact: HVDC Gen Ties



Source: Anbaric Study for New York State

NYSERDA Initiative: OSW Cable Corridor Constraints Assessment

There are a limited number of robust POIs for connecting offshore wind to the onshore grid and limited access routes to these POIs

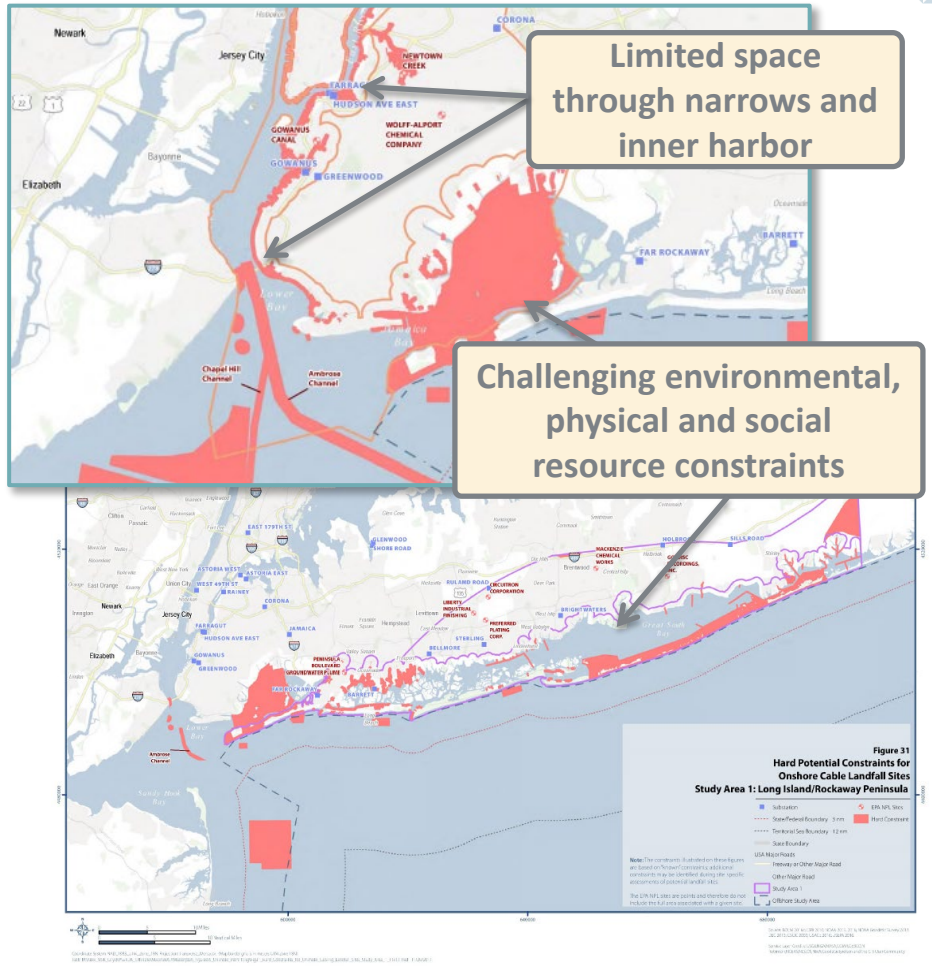
If each OSW project builds its own gen ties to the onshore transmission system (without coordination), **viable landing sites and cabling routes will become constrained. A well-coordinated planned transmission approach can make better use of the limited landing sites**

The clearest example of this is the cable approach route through the Narrows to reach POIs in New York's inner harbor, but many constraints exist

NYSERDA's OSW Cable Corridor Constraints Assessment to facilitate coordination of routing, permitting and planning

(For example, see [NY Offshore Wind: Evaluating Sea-shore (oedigital.com)])

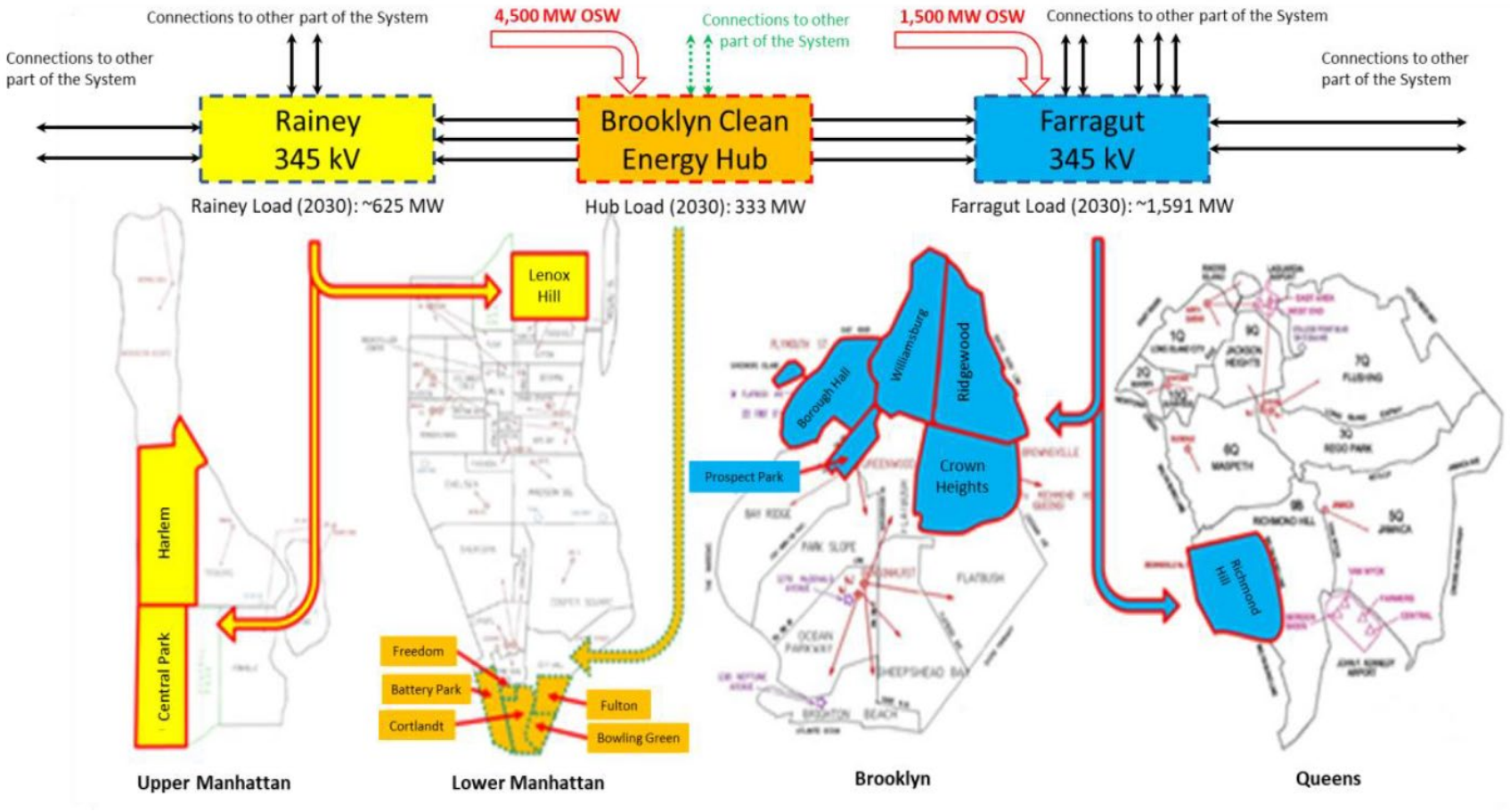
Landing Limitations along NY Coast



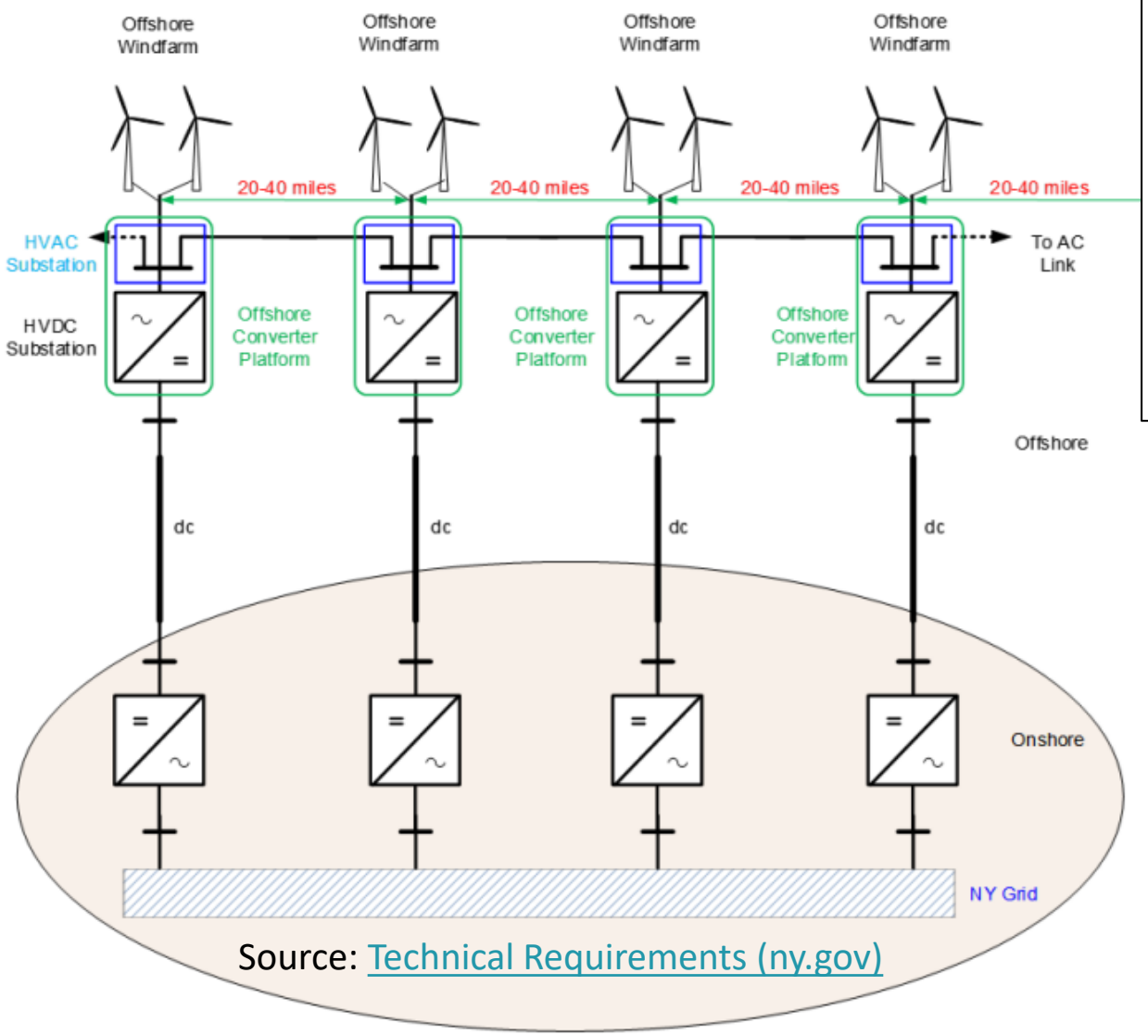
ConEd Energy Hub: Proposal to Address NYC's POI Challenge

In Case 20-E-0197 (transmission planning pursuant to the AREGCB Act), ConEd petitioned for approval of its proposed **Brooklyn Clean Energy Hub**

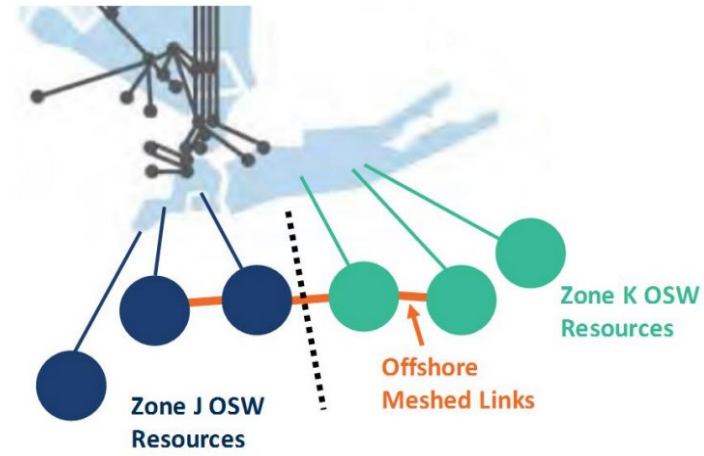
Could integrate up to 6,000 MW of HVAC grid interconnection for OSW generation (e.g., feeds from several separately-located HVDC converter stations)



NYSERDA Initiative: Procure Mesh-Ready HVDC OSW Transmission



Source: Technical Requirements (ny.gov)



Study estimates $60 million of annual meshed link benefits (plus outage mitigation, onshore reliability, resilience, and operational benefits)

NYSERDA's Meshed Grid Study:

- Procuring OSW plants with "mesh-ready" offshore HVDC substations adds only approximately $40 million (1%) to the total cost of a 1,200 MW plant
- HVDC offshore substations can be (later) be meshed at a cost of $120-240 million per link

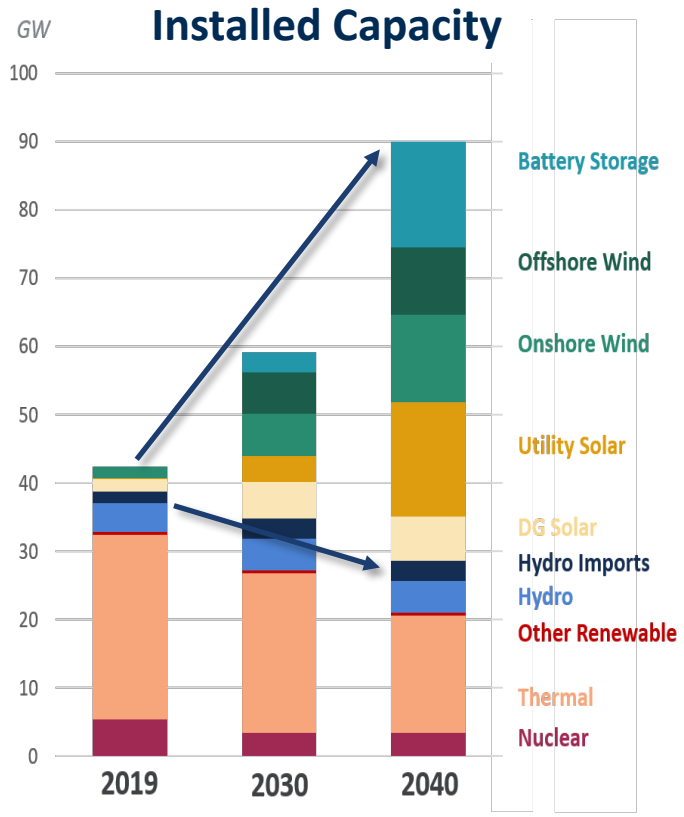
NYSERDA Draft RFP for 2022 OSW Solicitation (for at least 2,000 MW) requires each proposal to utilize HVDC technology and meet mesh-ready standards

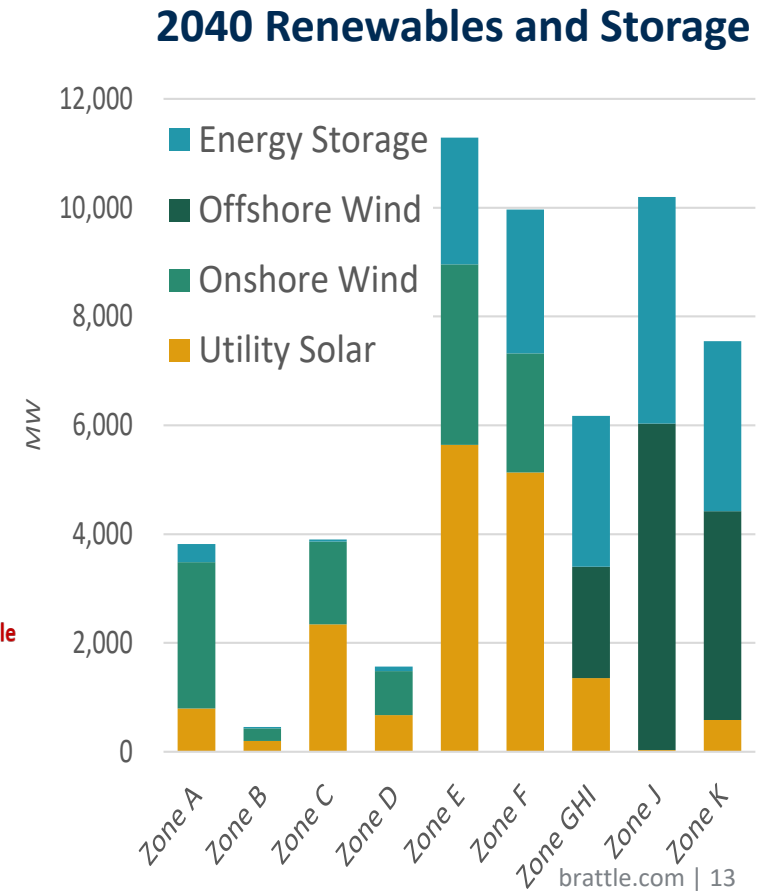
Zero Emissions Study

Analyzes transmission, generation, and storage scenarios for meeting NY's goals of zero-emission electricity by 2040 and 70% renewable generation by 2030 (drawing on New York Decarbonization Pathways Study)

2040 Results:

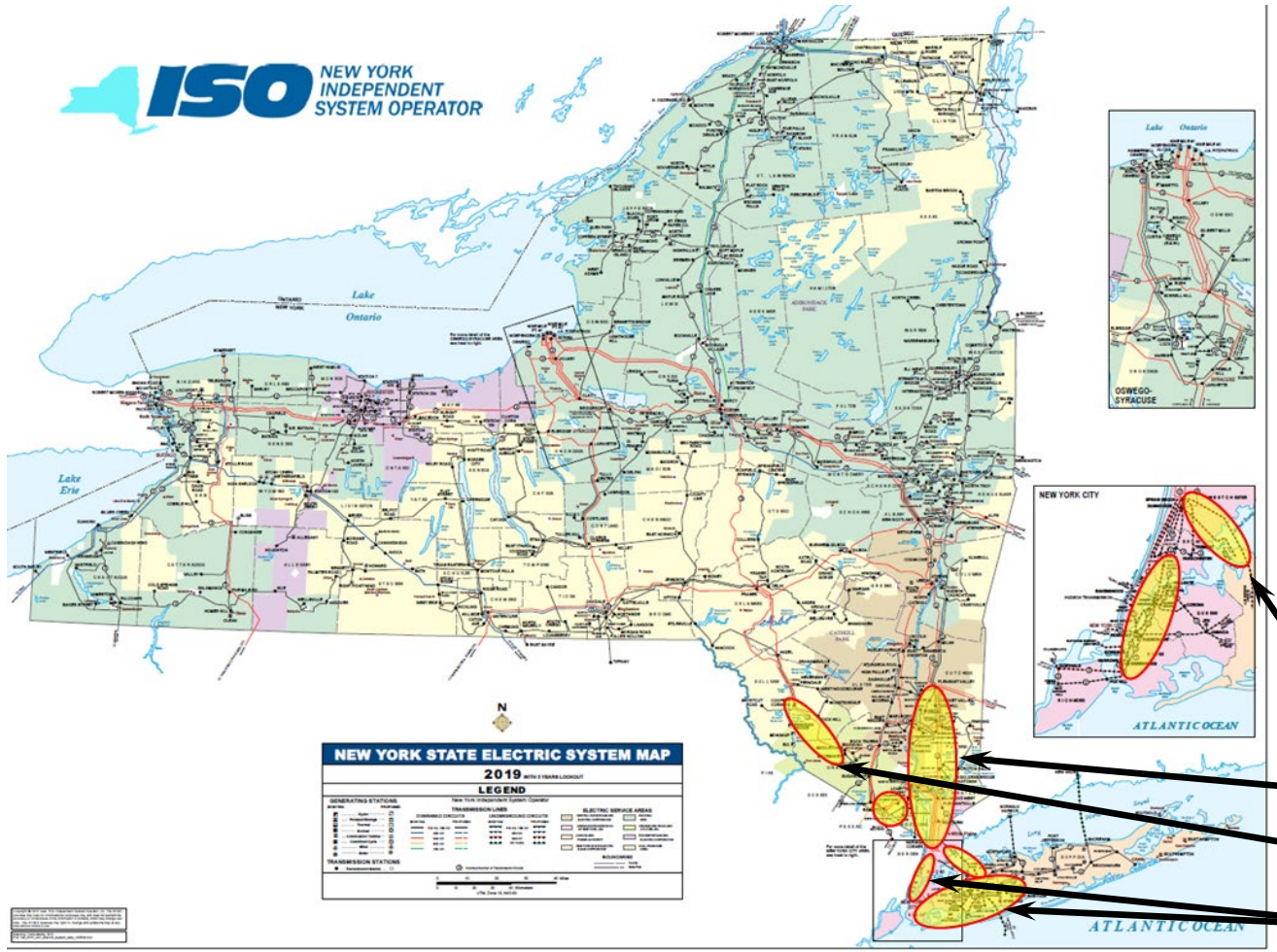
- Installed capacity more than double today's
- 10-15 GW each onshore wind, offshore wind, solar, and storage
- Ideally developed in certain areas:
  - Onshore wind primarily in western and northern NY (NYISO Zones A-F)
  - Offshore wind downstate (I, J, K)
  - Solar in central NY
  - Storage in central and downstate NY
- 17 GW of "thermal" backup generation fueled by renewable natural gas (as placeholder until more clarity exists about future technologies)





Zero Emissions Study: Transmission Needs

2040 Projected Congestion Areas



2030 goals can likely be met at low levels of curtailment and congestion without significant bulk-power transmission beyond those already planned and under development

- Contingent on study's renewable/storage buildout
- Lower-voltage system needs are assessed in NYISO's CARIS and the Utility Study

- By 2040, high congestion and some curtailments point to the potential for cost-effective bulk transmission upgrades
- High projected 2040 congestion costs can be mitigated cost-effectively with bulk transmission projects in four specific grid locations:
  - at the Dunwoodie to Shore Rd cables
  - at the Millwood South Interface
  - downstream of Coopers Corner into Zone GHI
  - at NYC and west Long Island area

Power Grid Study: Additional Findings & Recommendations

Future NY **transmission needs will depend on** total load and which new resources are developed where over next 20 years—all major uncertainties

- The Zero Emissions Study's renewables and storage investments were optimized to the grid's capabilities but differ from similar other studies (CARIS, E3, Brattle), illustrating uncertainty
- Renewable generation ranges 29-42 GW in 2030, and 53-66 GW in 2040 across studies
- Different load, renewable generation, and battery investment locations will affect grid needs

Achieving the Study's high level of **coordinated development of location-specific renewable generation, storage, and transmission** may be challenging. It requires:

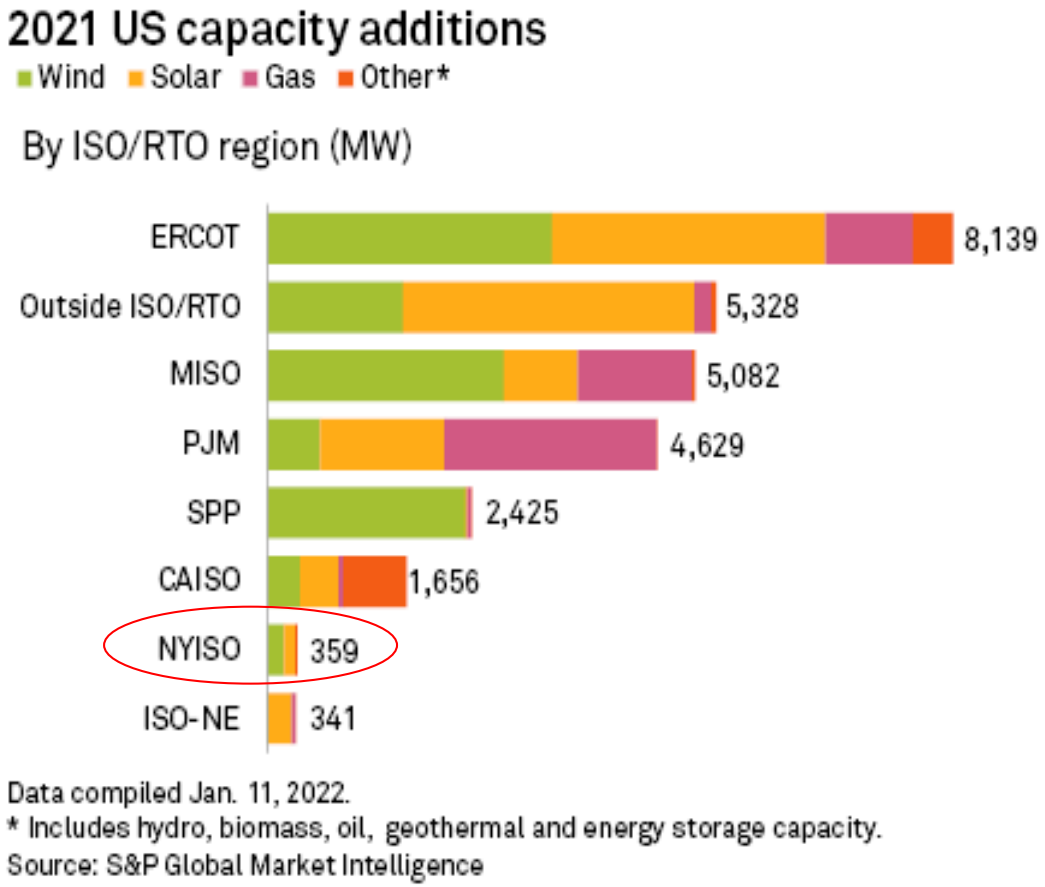
- More coordinated planning for bulk transmission, local transmission, and distribution infrastructure
- Careful planning and contracting for timely and location-specific optimization of storage deployment
- Updating wholesale market rules to support this market evolution (including to allow storage facilities to capture the full value they are assumed to provide in the study)
- Development of retail regulations that support distributed renewable generation and storage and allow for their contribution to wholesale market needs

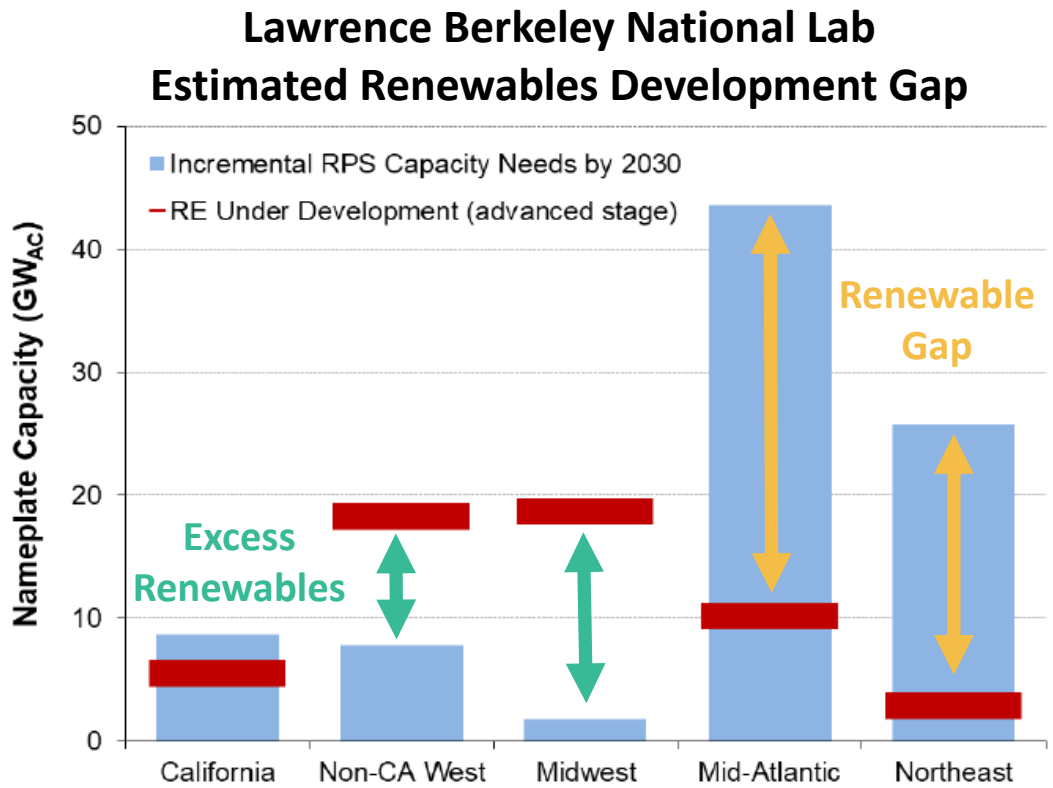
Power Grid Study: Additional Findings & Recommendations (cont'd)

- Study reflects an optimistic view of congestion, curtailments, operational challenges
  - Significant congestion and curtailments may result from constraints on the lower-voltage transmission (rated at 115/138 kV) and during outages on the bulk transmission system
- Continue to **improve studies and planning processes** to better coordinate NYISO, Utility, and NYSERDA efforts and periodically reassess transmission needs
  - Address OSW-related transmission on/from Long Island and initiate multi-disciplinary planning and coordination to develop cost-effective options for routing up to 6 GW of OSW into NYC
  - Develop more detailed and consistent studies to quantify existing and new headroom in various transmission-constrained areas on both the local and bulk transmission systems
  - Conduct further studies to better understand future generation and long-duration storage technology options available after 2035 to achieve a zero emissions grid by 2040
- NYISO's economic and public-policy planning processes can provide effective mechanisms for identifying bulk needs and developing innovative, integrated solutions

Challenge: Generation Interconnection Processes

NYISO, PJM, and ISO-NE have interconnected significantly less renewable generation despite the significant renewable development needs to meet state policies





Source: Galen Barbose, "U.S. Renewables Portfolio Standards: 2021 Status Update (Early Release)," Lawrence Berkeley National Lab, Feb 2021. rps.lbl.gov

Challenge: Improving Generation Interconnection Processes

More proactive transmission planning and reducing the scope of upgrades triggered by generation interconnection processes will be necessary to accelerate and lower the cost of renewable interconnection:

- ERCOT's generation interconnection process is generally seen as most effective in the U.S.
  - Efficient handoff of study roles by ERCOT and Transmission Owners limits restudy needs
  - Projects can be developed and interconnected within 2-3 years; in other regions, the interconnection study process itself takes longer than that
  - Upgrades focused more on local needs (similar to ERIS) and are recovered through postage stamp
  - Network constraints managed through market dispatch – which imposes high congestion and curtailment risks on interconnecting generators due to insufficiently proactive multi-value grid planning
  - See working-paper.pdf (enelgreenpower.com) [Note: Brattle was not involved]
- Attractive: UK "Connect and Manage" (replaced prior "Invest and Connect")
  - Similar to ERIS; reduced lead times by 5 years; network constraints addressed later (e.g., with congestion management) https://www.gov.uk/guidance/electricity-network-delivery-and-access#connect-and-manage
- Generation interconnection study criteria matter, yet differ substantially across RTOs
  - Overly stringent study criteria can trigger expensive "deep network" upgrades, which increases churn and restudy requirements; congestion management and proactive transmission planning offer more cost-effective solutions

The Need for Proactive Multi-value Transmission Planning

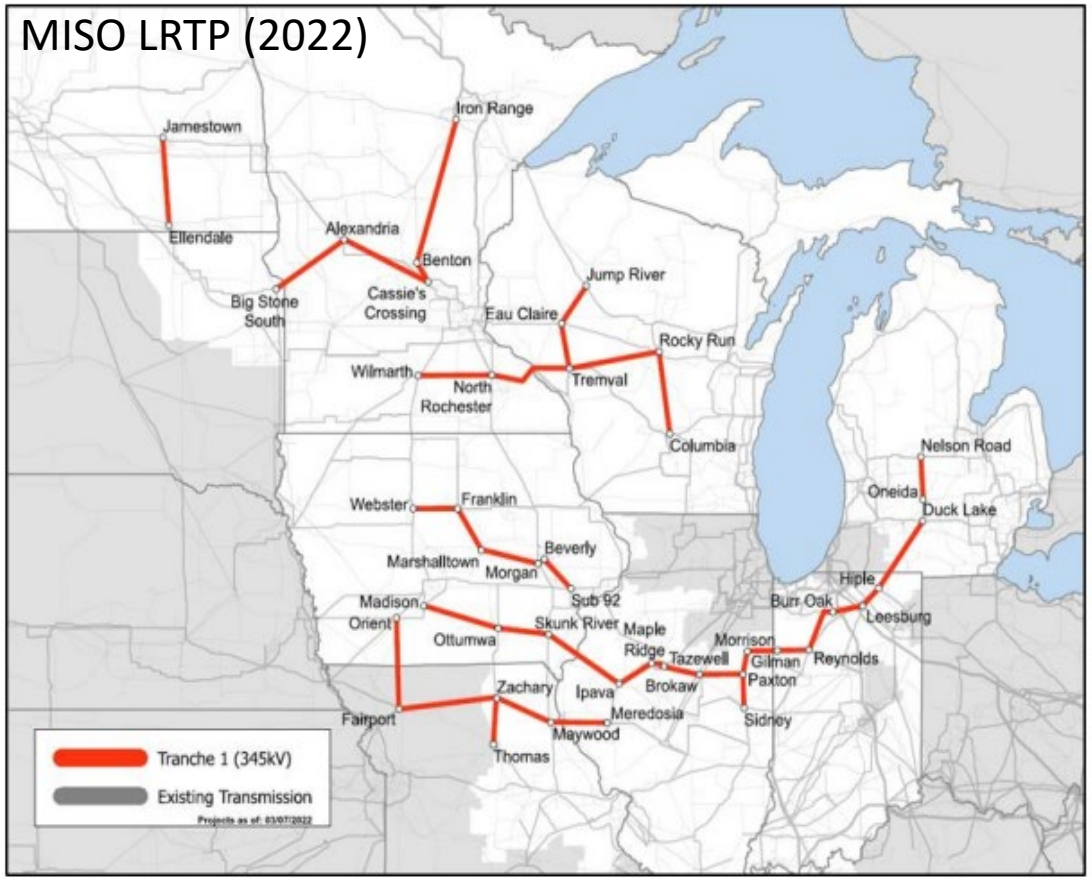
Proactive multi-value transmission planning will be necessary to create a cost-effective grid and to reduce the cost and time required to interconnect renewables at scale

Example: MISO 2022 LRTP results

- Tranche 1: $10 billion portfolio of proposed new 345 kV transmission projects for its Midwestern footprint
- Supports interconnection of 53,000 MW of renewable resources
- Reduces other costs by $37-68 billion

Example: PJM Transmission Study

- Proactively evaluated all existing state public policy needs
- Identified only $3.2 billion in upgrades to integrate 75,000 MW of renewables ($40/kW)
- Would be significantly more cost effective than continued reliance on incremental upgrades through PJM's interconnection process



About the Speaker

Johannes P. Pfeifenberger

PRINCIPAL
BOSTON

Hannes.pfeifenberger@brattle.com

+1.617.234.5624

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 transmission-related renewable generation 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.

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

Additional Reading on Transmission

Pfeifenberger, New York State and Regional Transmission Planning for Offshore Wind Generation, NYSERDA Offshore Wind Webinar, March 30, 2022.

Pfeifenberger, The Benefits of Interregional Transmission: Grid Planning for the 21st Century, US DOE National Transmission Planning Study Webinar, March 15, 2022.

Pfeifenberger, 21st Century Transmission Planning: Benefits Quantification and Cost Allocation, Prepared for the NARUC members of the Joint Federal-State Task Force on Electric Transmission, January 19, 2022.

Pfeifenberger, Spokas, Hagerty, Tsoukalis, A Roadmap to Improved Interregional Transmission Planning, November 30, 2021.

Pfeifenberger, Tsoukalis, Newell, "The Benefit and Cost of Preserving the Option to Create a Meshed Offshore Grid for New York," Prepared for NYSERDA with Siemens and Hatch, November 9, 2022.

Pfeifenberger, Transmission–The Great Enabler: Recognizing Multiple Benefits in Transmission Planning, ESIG, October 28, 2021.

Pfeifenberger et al., Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs, Brattle-Grid Strategies, October 2021.

Pfeifenberger, Transmission Options for Offshore Wind Generation, NYSERDA webinar, May 12, 2021.

Pfeifenberger, Transmission Planning and Benefit-Cost Analyses, presentation to FERC Staff, April 29, 2021.

Pfeifenberger et al., Initial Report on the New York Power Grid Study, prepared for NYPSC, January 19, 2021.

Pfeifenberger, Ruiz, Van Horn, "The Value of Diversifying Uncertain Renewable Generation through the Transmission System," BU-ISE, October 14, 2020.

Pfeifenberger, Newell, Graf and Spokas, "Offshore Wind Transmission: An Analysis of Options for New York", prepared for Anbaric, August 2020.

Pfeifenberger, Newell, and Graf, "Offshore Transmission in New England: The Benefits of a Better-Planned Grid," prepared for Anbaric, May 2020.

Tsuchida and Ruiz, "Innovation in Transmission Operation with Advanced Technologies," T&D World, December 19, 2019.

Pfeifenberger, "Cost Savings Offered by Competition in Electric Transmission," Power Markets Today Webinar, December 11, 2019.

Chang, Pfeifenberger, Sheilendranath, Hagerty, Levin, and Jiang, "Cost Savings Offered by Competition in Electric Transmission: Experience to Date and the Potential for Additional Customer Value," April 2019. "Response to Concentric Energy Advisors' Report on Competitive Transmission," August 2019.

Ruiz, "Transmission Topology Optimization: Application in Operations, Markets, and Planning Decision Making," May 2019.

Chang and Pfeifenberger, "Well-Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning is Key to the Transition to a Carbon-Constrained Future," WIRES and The Brattle Group, June 2016.

Newell et al. "Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades," on behalf of NYISO and DPS Staff, September 15, 2015.

Pfeifenberger, Chang, and Sheilendranath, "Toward More Effective Transmission Planning: Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid," WIRES and The Brattle Group, April 2015.

Chang, Pfeifenberger, Hagerty, "The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," on behalf of WIRES, July 2013.

Chang, Pfeifenberger, Newell, Tsuchida, Hagerty, "Recommendations for Enhancing ERCOT's Long-Term Transmission Planning Process," October 2013.

Pfeifenberger and Hou, "Seams Cost Allocation: A Flexible Framework to Support Interregional Transmission Planning," on behalf of SPP, April 2012.

Pfeifenberger, Hou, "Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada," on behalf of WIRES, May 2011.

Our Practices and Industries

ENERGY & UTILITIES

- Competition & Market Manipulation
- Distributed Energy Resources
- Electric Transmission
- Electricity Market Modeling & Resource Planning
- Electrification & Growth Opportunities
- Energy Litigation
- Energy Storage
- Environmental Policy, Planning and Compliance
- Finance and Ratemaking
- Gas/Electric Coordination
- Market Design
- Natural Gas & Petroleum
- Nuclear
- Renewable & Alternative Energy

LITIGATION

- Accounting
- Analysis of Market Manipulation
- Antitrust/Competition
- Bankruptcy & Restructuring
- Big Data & Document Analytics
- Commercial Damages
- Environmental Litigation & Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Labor & Employment
- Mergers & Acquisitions Litigation
- Product Liability
- Securities & Finance
- Tax Controversy & Transfer Pricing
- Valuation
- White Collar Investigations & Litigation

INDUSTRIES

- Electric Power
- Financial Institutions
- Infrastructure
- Natural Gas & Petroleum
- Pharmaceuticals & Medical Devices
- Telecommunications, Internet, and Media
- Transportation
- Water

Our Offices

BOSTON

BRUSSELS

CHICAGO

LONDON

MADRID

NEW YORK

ROME

SAN FRANCISCO

SYDNEY

TORONTO

WASHINGTON