Learning from the Experts Webinar Series

How Offshore Wind Can Bolster Grid Reliability

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Principal
Charles River Associates

April 29, 2026

Meeting Procedures

Webinar recordings and presentations will be available at:

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Participation for Members of the Public:

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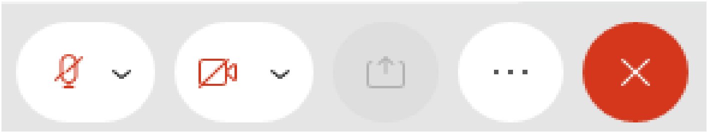
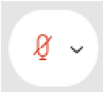


You'll see  when your microphone is muted

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Learning from the Experts

This webinar series is hosted by NYSERDA's offshore wind team and features experts in offshore wind technologies, development practices, and related research.

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The potential role of OSW in meeting emerging reliability stress

Executive Findings

April 29, 2026

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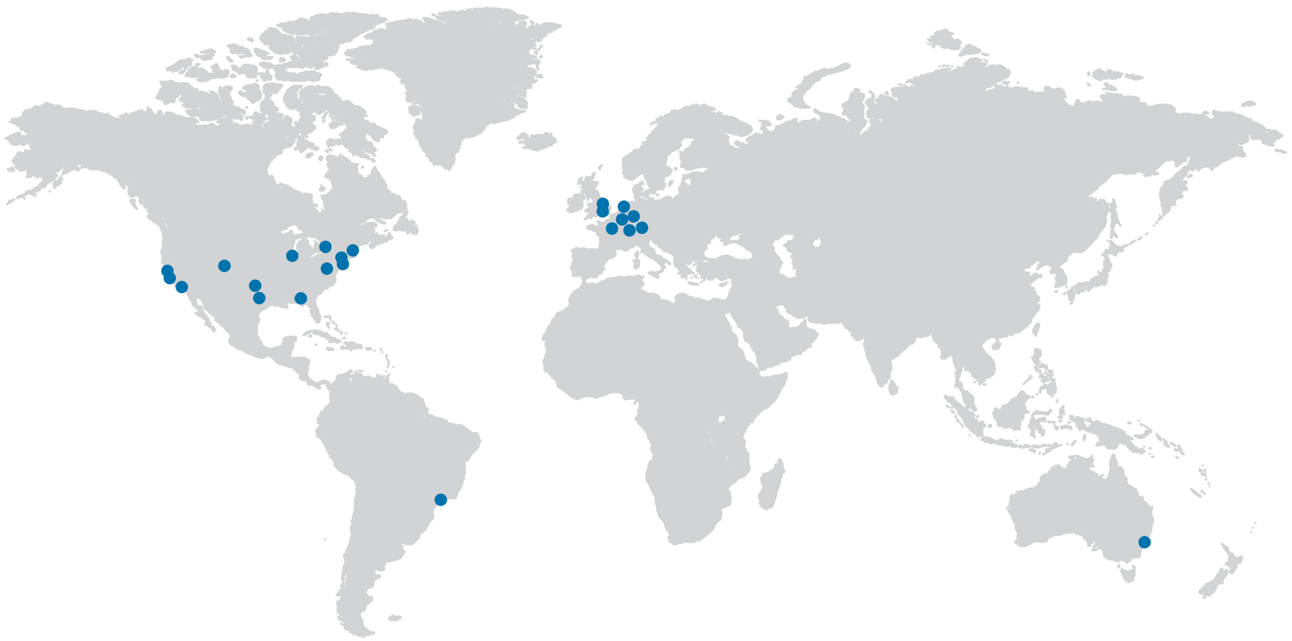

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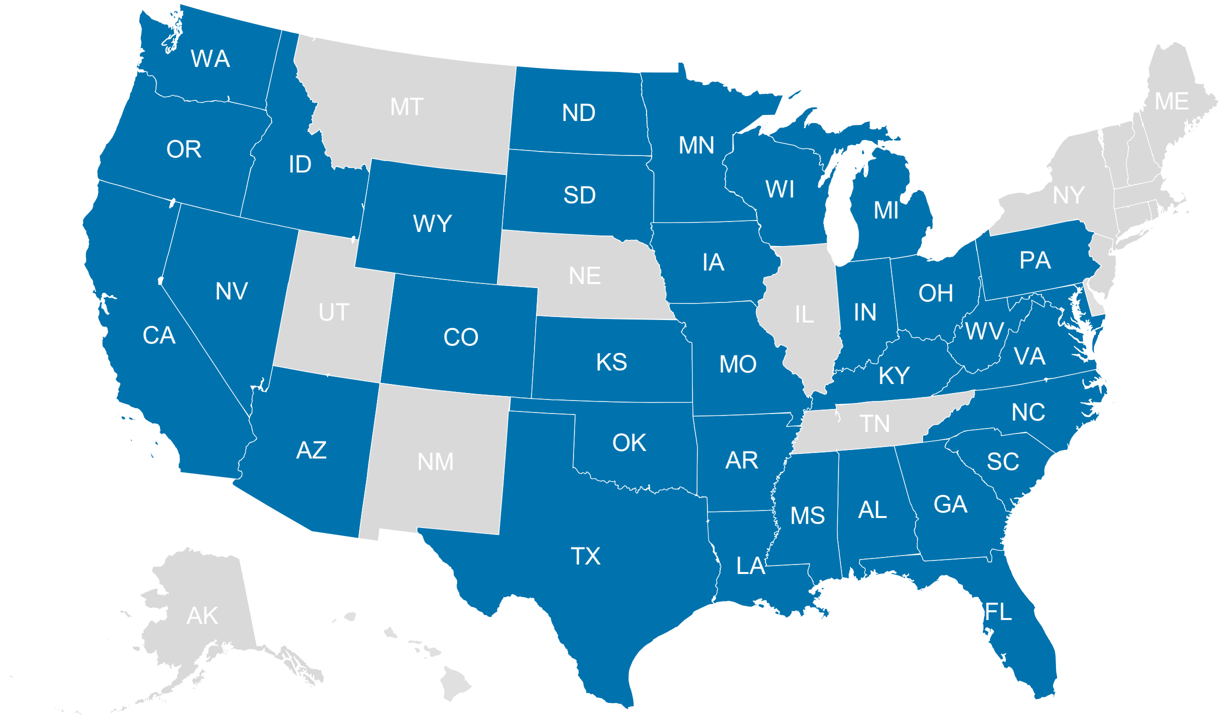
CRA offers resource planning support to utilities across the country

In recent years, CRA has supported electric, gas and combined IOUs and POUs in more than 30 states to address market forecasting, strategy, and investment planning questions.

States Where CRA Has Recently Supported Utilities in Strategy, Resource and Investment Planning



Client Examples

NiSource
Dominion Energy
Alliant Energy
PG&E
Southern Company
Great River Energy
FirstEnergy
Liberty
Minnkota Power Cooperative
A Touchstone Energy® Cooperative
CPS Energy
entergy
Southwest Gas
PSE Puget Sound Energy
American Electric Power
Black Hills Energy
Duke Energy
OglethorpePower
Idaho Power
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SRP
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DTE

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This presentation reviews the results of three reports examining offshore wind (OSW)'s effect on resource adequacy.

National trends in resource adequacy + OSW

This report examined national trends in resource adequacy and offshore wind's (OSW) role. Retiring dispatchable resources and long interconnection delays are shrinking reserve margins, causing capacity prices to rise—210% in MISO and 22% in PJM by 2025. The risk is growing in winter. OSW can help reduce the gap but won't fully close it; its capacity accreditation, currently similar to dispatchable resources, is expected to decrease as investments grow.

Source: Stover et al., "The contribution of offshore wind to grid reliability & resource adequacy," Dec 2025

The impact of OSW in ISO-NE and NY

This report performed Integrated Resource Planning (IRP) style analysis to examine the impact of OSW in ISO-NE and NYISO.

Material resource adequacy risks exist in NYC, where OSW can inject directly into constrained load pockets, bypassing transmission congestion that limits onshore alternatives..

Portfolios including OSW blended reliability performance of gas-only resources while brining reductions in energy prices and emissions, like renewables-only. Worst outcomes came with building no resources.

Source: Stover et al, "Impacts of Offshore Wind on Reliability and Affordability in ISO-NE and NYISO," Dec 2025

Synergies between OSW and NG

This report examined the relationship between OSW and natural gas (NG).

OSW peaks during winter mornings and evenings when gas plants face fuel constraints, creating a natural seasonal complement—"stronger together."

OSW reduces reliance on fuel oil burn at co-gen plants during cold snaps, lowering costs for ratepayers and preserving heating oil supplies for residential use.

However, once systems return to stable reliability outlooks, OSW and NG can compete for the remaining "risk" hours.

Source: Dakks et al, "Synergies between offshore wind and natural gas," Jan 2026

Our research shows that electricity grids nationwide are encountering significant reliability challenges. Offshore wind (OSW) is well-suited to help alleviate these growing grid pressures and works most effectively when integrated with broader grid investments.

Background

New York Dynamics

Resource contribution (ELCC)

Quantitative Analysis

Resource adequacy ensures there is enough – and the right kind of – generation

Resource adequacy is one element of maintaining grid reliability.

Resource adequacy ensures there are enough power plants — of the right types — to keep the lights on under a wide range of conditions.
If there is insufficient generating capacity in a given hour, operators will perform **load shedding**, intentionally disconnecting load, to maintain the stability of the grid.

Historically, load shedding risks were limited to a small number of peak hours, but it is increasingly spread across a range of hours.

Utility planners are incorporating increasingly complex planning methods to evaluate the resource adequacy of potential generation mixes. These models include the factors listed below. Resource adequacy is measured with key metrics

Generator outages

Planned and unplanned

Load Uncertainty

Weather and customer variability

Renewable variability

Weather variability

Extreme weather

Multi-hour and multi-day events

Common cause outages

Disruptions in fuel supplies

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Nationally, the grid is facing new challenges due to changing load and resource dynamics

Load Growth

Data centers, manufacturing growth (semi-conductors and others), and electrification are driving load growth

Higher winter load and stress

Many systems remain summer peaking, but are becoming winter constrained

Changes in resource mix

Shift toward natural gas, solar, storage, and wind

Greater spread in risk hours

Historically risk concentrated in peak hours; now risk spread across wider range of hours

Common cause outages

Winter Storms Uri and Elliot highlighted risk of correlated outages in cold weather

Strains on bringing new resources

Disruptions to supply chains and interconnection delays have slowed additions of new resources

Meeting the moment

Energy leaders are investing in infrastructure and developing new approaches for maintaining reliability

Three concepts you need to know…

Expected unserved energy (EUE)

1

EUE, together with other risk indicators, assists grid planners in assessing the risks linked to choosing different generator portfolios. It provides insight into the timing, extent, and frequency of load shedding, events when there is not enough generation to meet demand.

Systems are planned to keep this metric very very low. Think of it like a safety margin. For example, how much cash do you keep in your checking account to always pay your credit card bill….

Effective Load Carrying Capability (ELCC)

2

ELCCs quantify how much a generator contributes to grid stress. It's scored from 0–100%, where higher means the resource is more reliably available when the grid needs it most. However, no resource is perfect, and periods of grid stress aren't just periods of highest demand anymore.

This metric tells us how good a resource is at meeting grid stress.

Levelized Cost of Energy (LCOE)

3

LCOE calculates the average cost of energy produced by a given resource. LCOE is often quoted as a metric of the cost of a resource. While it is a useful metric for tracking technological advancements over time, it frequently overlooks factors such as how different technologies interact and their impact on grid reliability.

LCOE gives us some cost information but misses bigger contexts.

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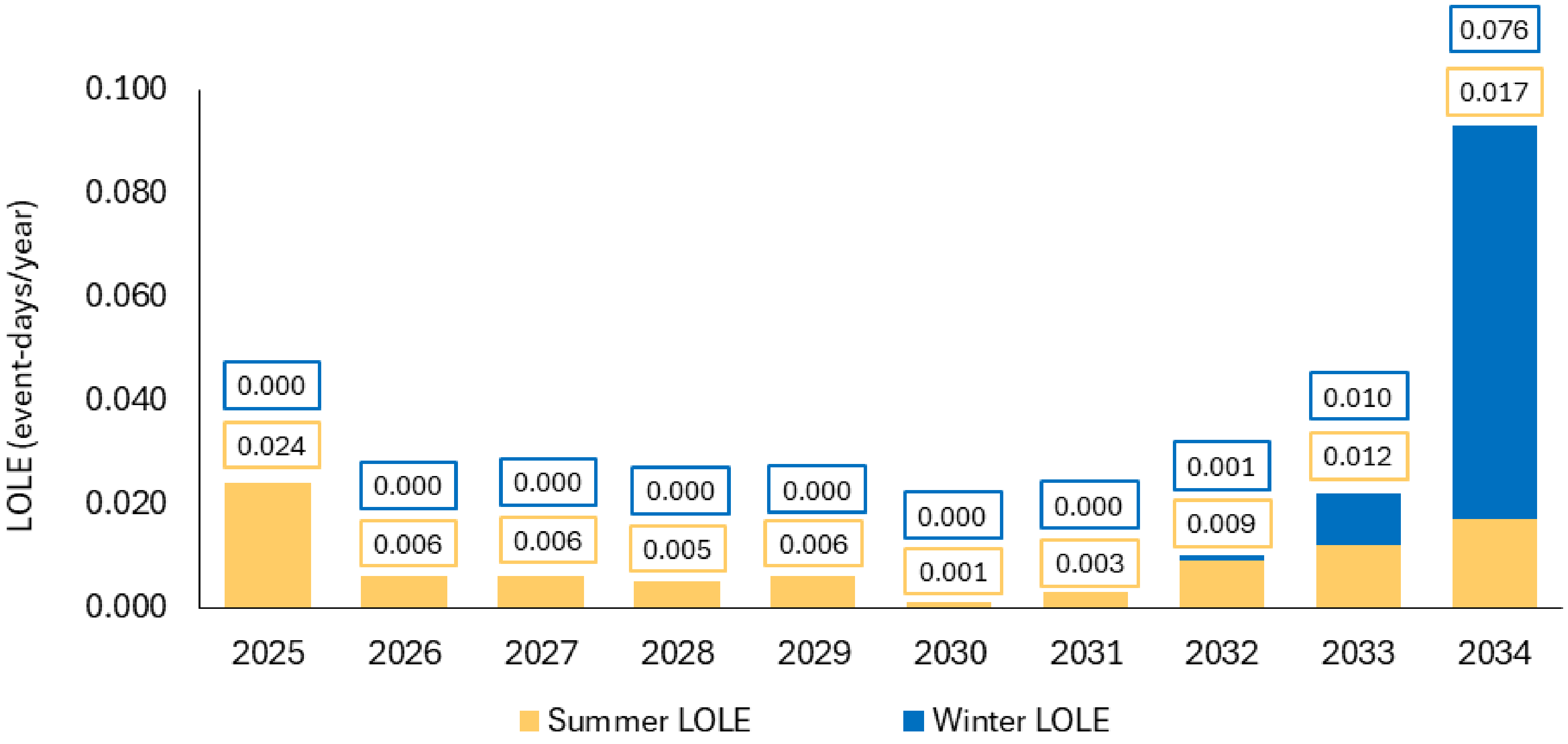
NYISO projects elevated risk in coming years, with a shift toward winter risk



Of note, NYISO assumed imports from the Ontario Independent System Operator (IESO), PJM, and Hydro-Québec.

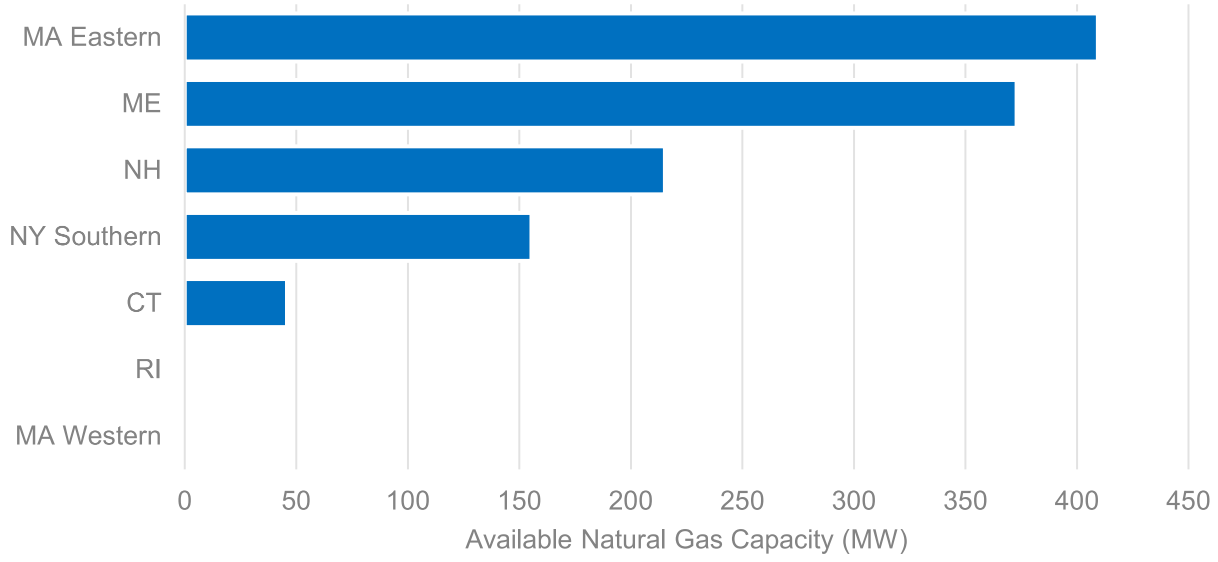
However, **all of these markets are tightening and collectively shifting risk toward the winter months**. To understand this risk, we performed sensitivities with no imports.

Sources:
1. https://www.nyiso.com/documents/20142/2248793/2024-RNA-Report.pdf

NG fuel systems in New York are uniquely stressed

Challenges	
Limited ability to add new resources	Complex permitting, limited land, and limited fuel make adding new NG generation challenging
Aging fleet	The existing NG and oil fleet is aging. Further stress on these resources could accelerate their retirement.
Competing for fuel	NG generators compete with building heating for fuel. While heating electrification will free up fuel, it also drives up winter electricity demand
Back-up fuel usage	Many NG generators are dual fuel. While using back-up fuel oil maintains resource adequacy, it increases wear, emissions, and costs
Timing mismatch	While investments are on their way to expand fuel systems, may not be soon enough to support imminent RA challenges

There is limited headroom on existing gas infrastructure to add new gas generators with firm contracts in the Northeast



From stakeholder feedback, Gas EPCs state that adding new natural gas resources is more challenging and expensive

Stakeholders pointed at strained supply chains, lengthy permitting process, and limited labor pools as key pain points. Manufacturing capacity is operating close to 90%, and prices have tripled between 2022 and 2025.

Sources:
1. https://gasoutlook.com/analysis/costs-to-build-gas-plants-triple-says-ceo-of-nextera-energy/
2. CRA Analysis

South Fork Wind has been used to mitigate local transmission and fuel stress

130 MW

35 mi east of Montauk Point, NY

46.4% CF

In its first full year of operation, with a 53% CF in the first half of 2025

~533 GWh

Annual generation; powers ~70,000 Long Island homes and offsets 300,000 tons of CO_2 per year

New York's first commercial-scale offshore wind farm

- First approved by the Long Island Power Authority (LIPA) in 2017 to meet growing electricity demand on Long Island's South Fork

Grid reliability significance

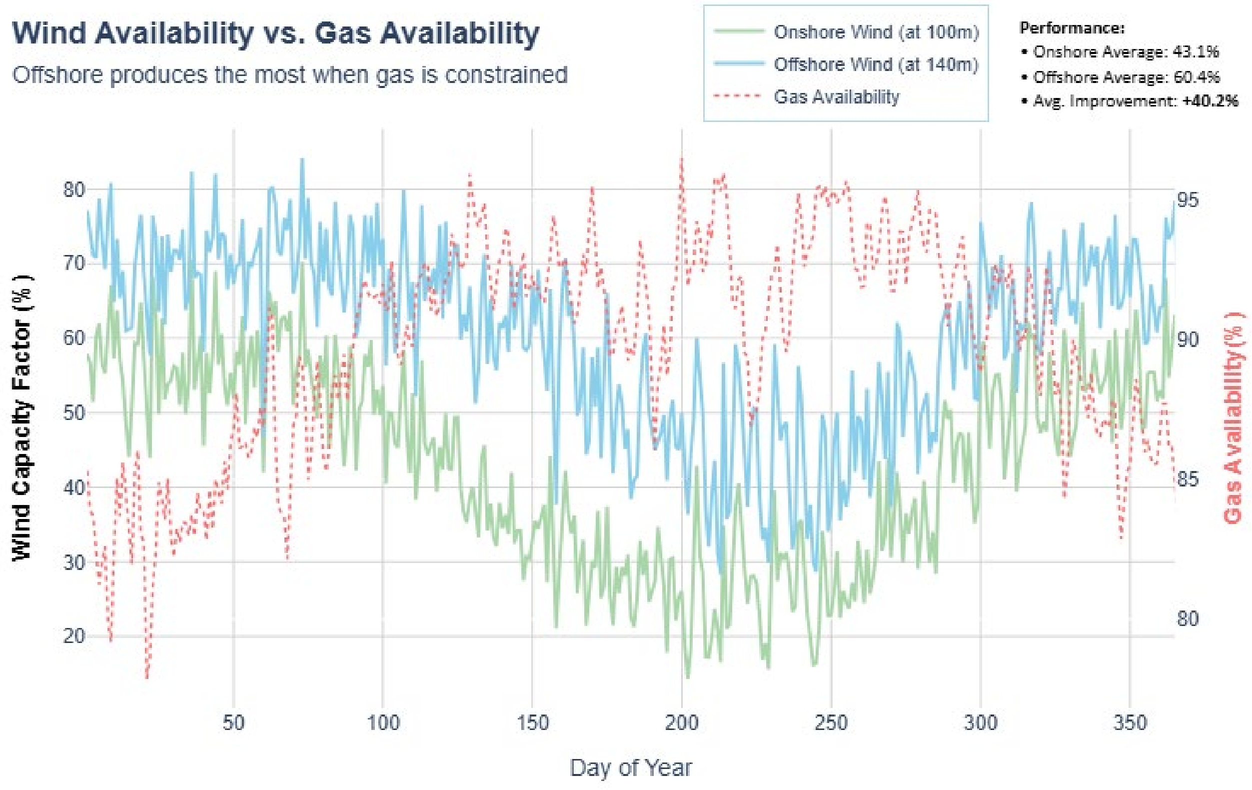
- First utility-scale OSW delivering directly into the NYISO balancing area, serving constrained downstate Long Island load pocket
- Only liquid fuel or fuel-free generators were considered viable options
- Eased local grid and fuel stress, successfully delayed transmission investments
- Hedged against fuel price uncertainty

Synergies with natural gas

South Fork provides electricity to Long Island, reducing strain on transmission lines. OSW generates ample fuel-free energy in winter when natural gas demand is high. Natural gas supplies flexible backup to balance wind variability, ensuring grid stability. Together, they help manage reliability, costs, and policy uncertainties.

OSW shows alignment with emerging grid stress hours

OSW's periods of highest generation coincides with emerging high stress hours when NG and solar are at their lowest generation



Strong year-round generation, but greatest output during **highest stress hours**

Strategic siting near transmission- and natural-gas growing coastal load pockets

Strength together by pairing differing fuel types to hedge against common cause outages

Auxiliary supply chains by bypassing strained natural gas supply chains

Sources:
1. NREL Wind Tool Kit
2. CRA Analysis

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ELCCs represent the contribution of a resource toward solving emerging grid stress

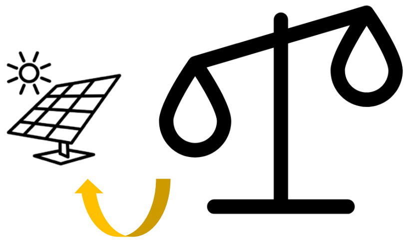
ELCCs represent the contribution of resources during the riskiest hours, which are not always peak gross load hours

Step 1:

Base Case:
LOLE = 0.1 days/year
EUE = 0.002%

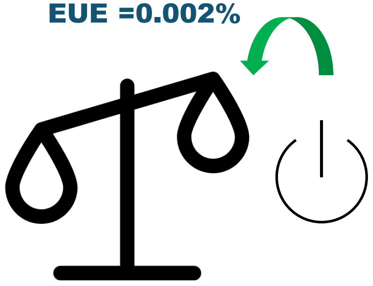
Step 2:

Generation Removed:
LOLE > 0.1 days/year
EUE > 0.002%



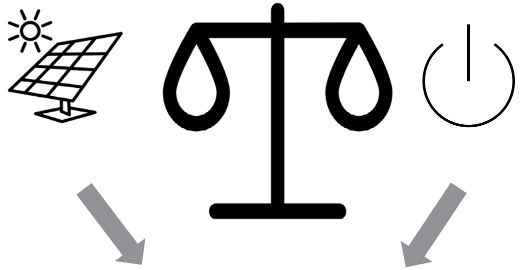
Step 3:

Perfect Gen Iteratively Added:
LOLE = 0.1 days/year
EUE =0.002%

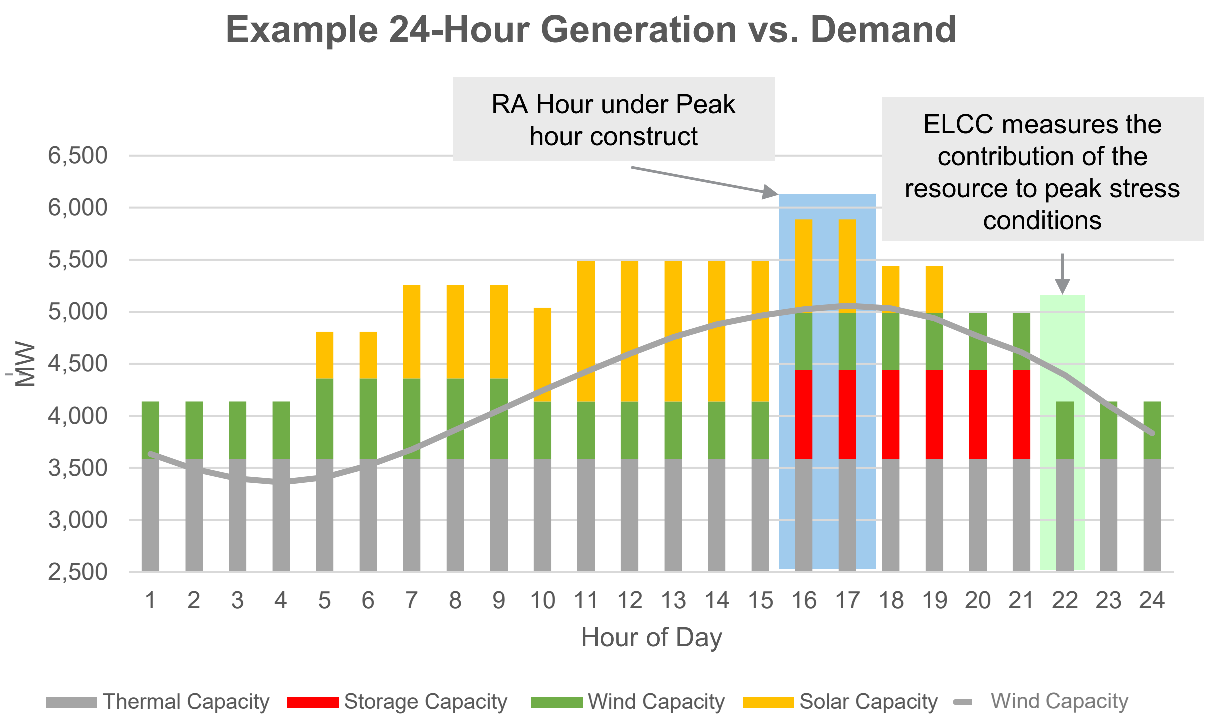


Step 4:

Compute ELCC:
LOLE = 0.1 days/year
EUE = 0.002%



$$\frac{\text{Added Perfect Gen}}{\text{Nameplate Generation}} \rightarrow \textit{Average ELCC}$$



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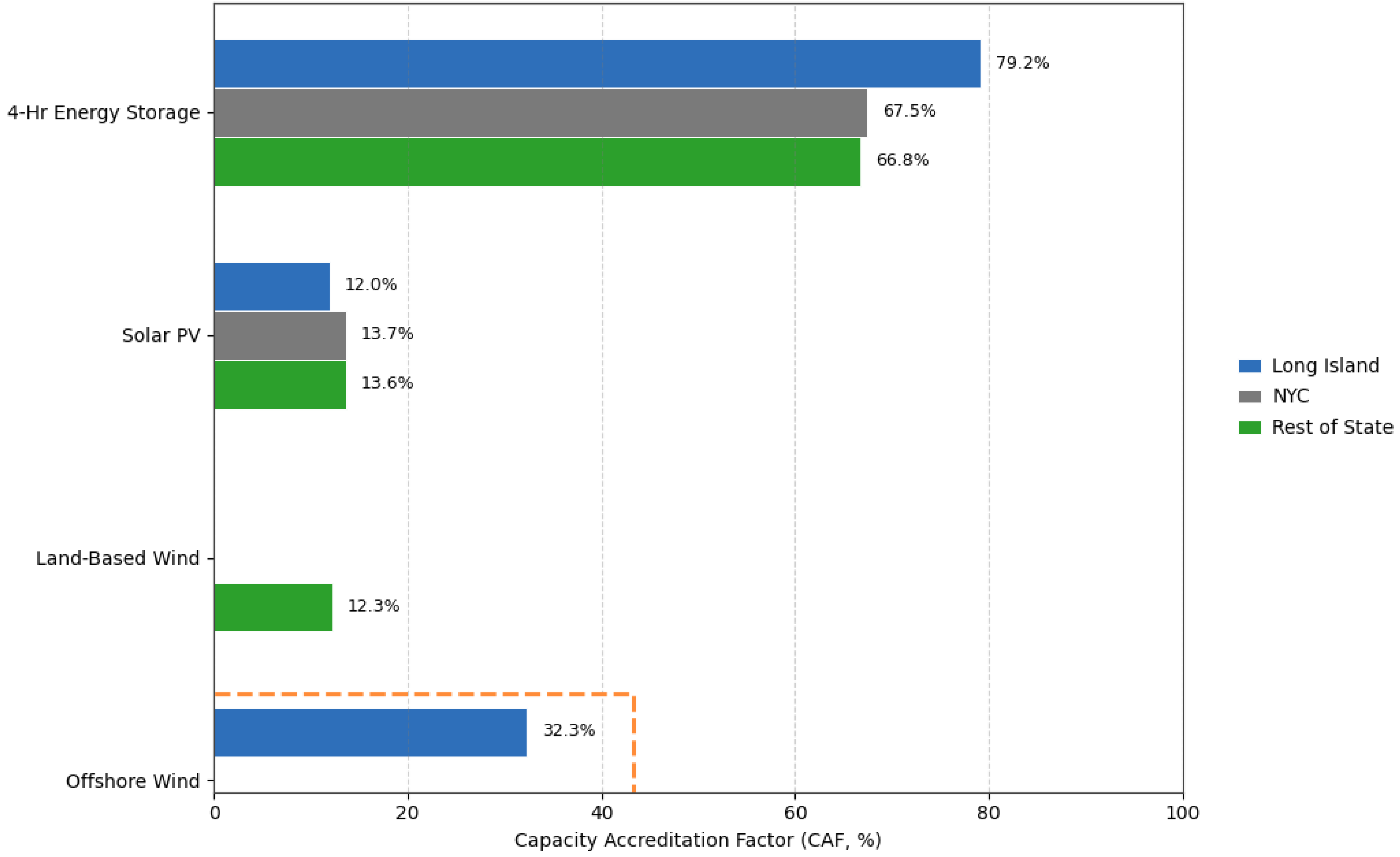
NYISO's ELCC values evolving and do not fully capture the reliability potential of OSW



OSW leads among renewables but is only provided for existing OSW project – South Fork. South Fork demonstrates the role OSW can play in solving transmission and NG constraints.

OSW's accreditation is likely to increase substantially as methodology **evolves to capture winter risk.**

Higher = more reliable!

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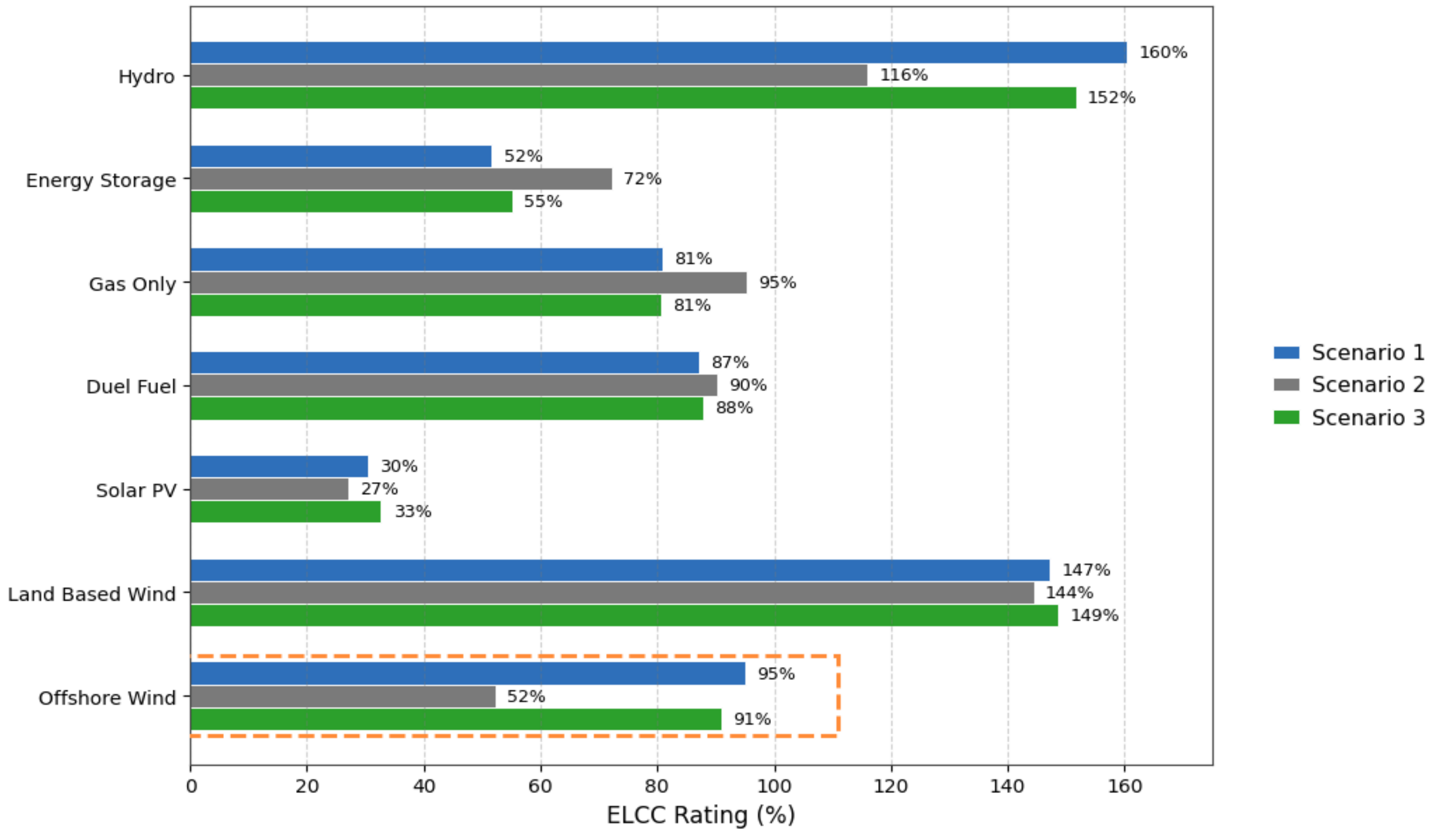
ISO-NE ELCC values are high for initial investment, but decline as the technology becomes mature



OSW is competitive with thermals at lower penetration (1 GW), but declines as OSW becomes mature (3.3 GW) and **shifts risk from high wind hours**

OSW can still play a role in charging storage and easing NG constraints as ELCC declines

S1	1 GW offshore/0.3 GW onshore
S2	3.3 GW offshore/1GW onshore
S3	1 GW offshore/0.3 GW onshore

- Background
- New York Dynamics
- Resource contribution (ELCC)
- **Quantitative Analysis**

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OSW can play a role, but must be balanced with wider investments

Using a range of quantitative metrics and all of portfolio analysis, we evaluated the resource adequacy risks facing NYISO and examined how OSW could play a role in mitigating emerging grid stress

1 Reliability risks facing NYC without action

Our findings align with concerns raised by NYISO and highlight exposure to tightening conditions from neighbors

2 OSW shows synergies with emerging risk profile and other technologies

OSW's strongest output aligns with times of greatest system stress. It can be developed offshore in constrained regions and help harden gas systems

3 OSW is less competitive on LCOE, but LCOE does not capture benefits

Portfolios with OSW show balance of performance, particularly with respect to resource adequacy

4 OSW's ELCC is competitive but will decline

OSW's ELCC is strong but expected to decline with higher penetration.

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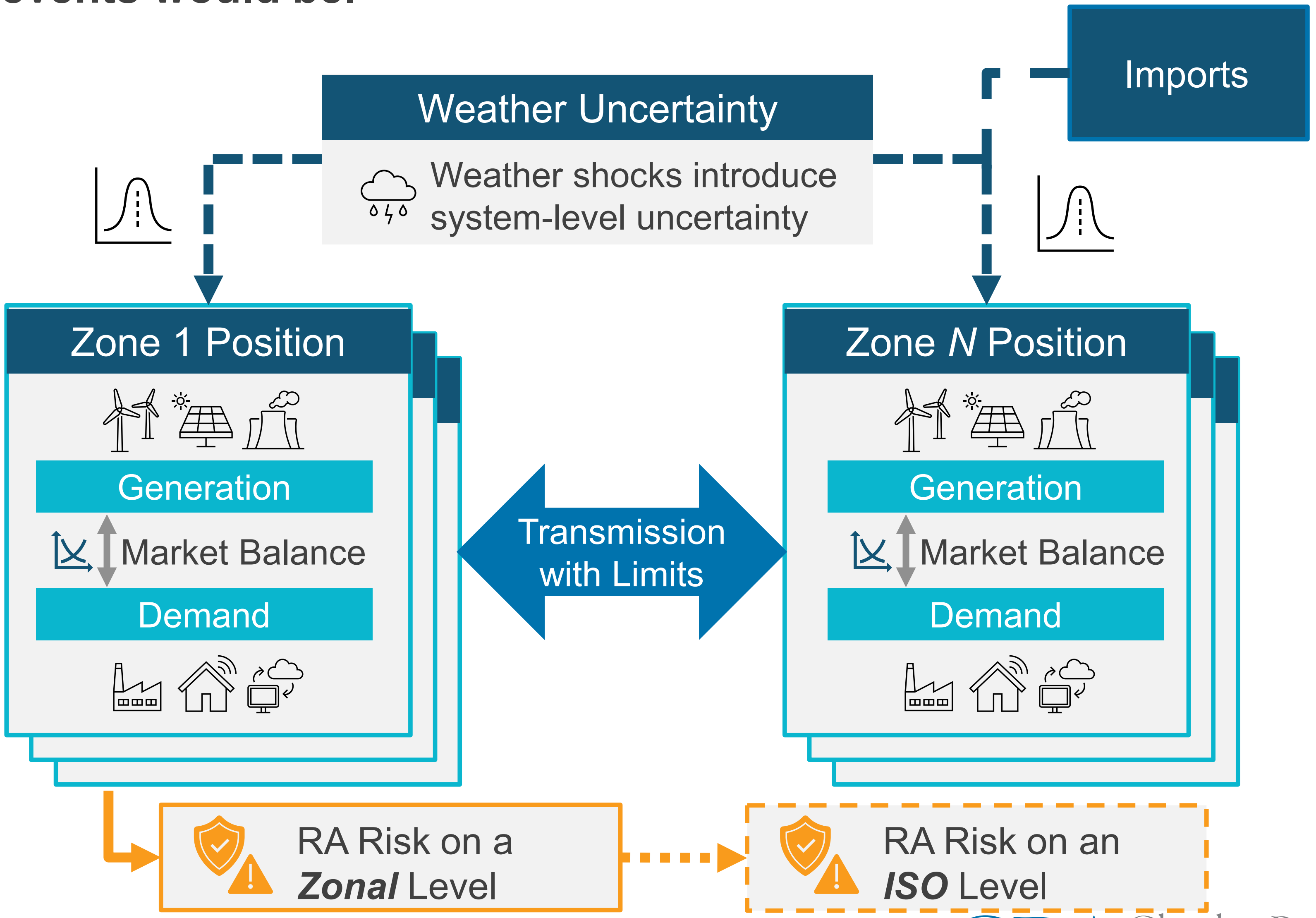
When demand exceed supply, load shedding occurs. Our model tells us when, how often, and how big those events would be.

Loss of Load Analysis

- ✓ AdequacyX mirrors analytical approaches performed by other ISOs
- ✓ Loss of load modeling is focused on identifying the frequency, magnitude, duration, and seasons of load shedding events
- ✓ We matched NYISO's assumptions for Hydro-Quebec, IESO, and PJM. We performed additional sensitivities with no imports



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Scenarios enable us to evaluate multiple possible generator technology futures

Base Case (Including OSW) – Expected portfolio mix

Use ISO load forecast, CRA generator portfolio forecast including OSW and no retirements

Goal: Evaluate the current trajectory of the systems

Counterfactual Scenarios

No Alternatives – Base Case with OSW removed

Goal: Evaluate the impact of canceling or delaying OSW, without alternatives

Rationale: Many OSW projects are advanced. There may be limited time to pivot to alternative generator resources, given supply chain and permitting challenges

Renewables Only – Replace with onshore renewables (scaled based on equivalent clean energy)

Goal: Evaluate the performance of OSW relative to inland, onshore renewables

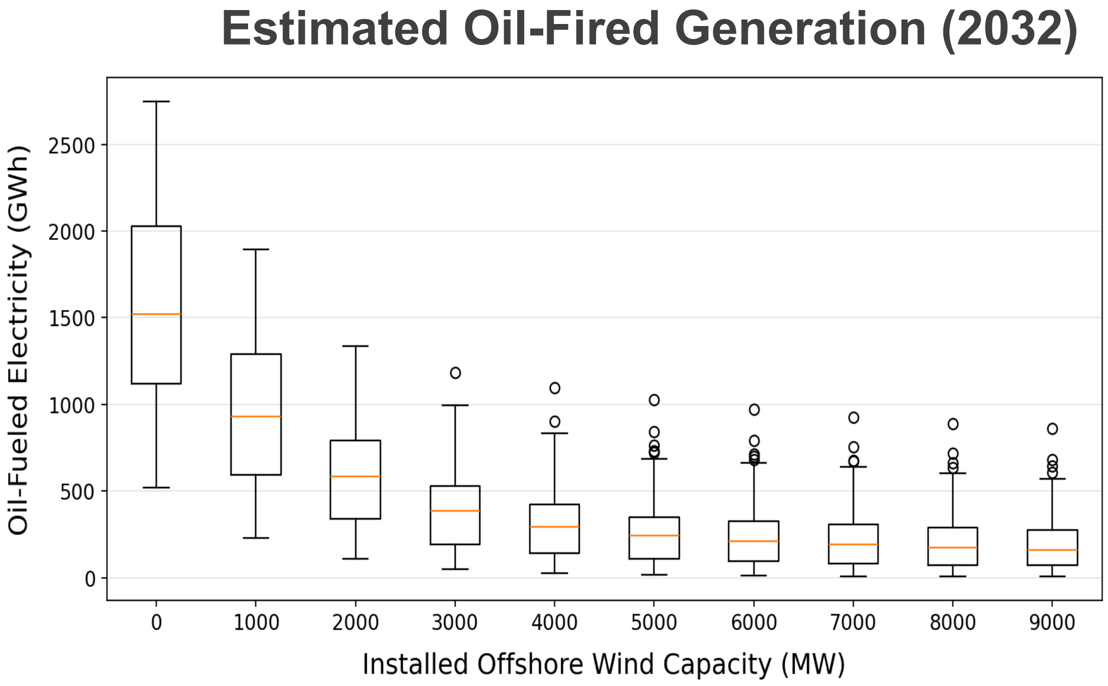
Rationale: Replacing OSW with in-load zone resources may result in worse reliability performance, given transmission congestion and worse alignment with key stress periods

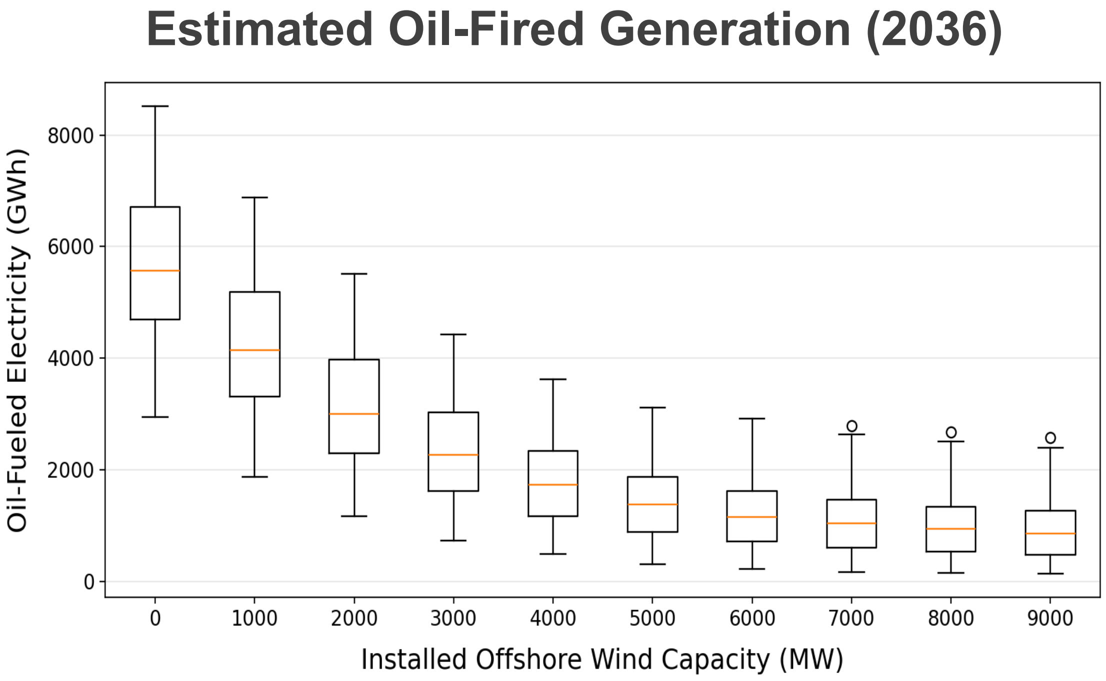
Gas Only – Replace with gas peaker in load zone (scaled on capacity contribution)

Goal: Evaluate the performance of OSW relative to in-zone dispatchable resources

Rationale: NYISO has identified a continued need for dispatchable (gas or DEFR) resources, particularly down-state

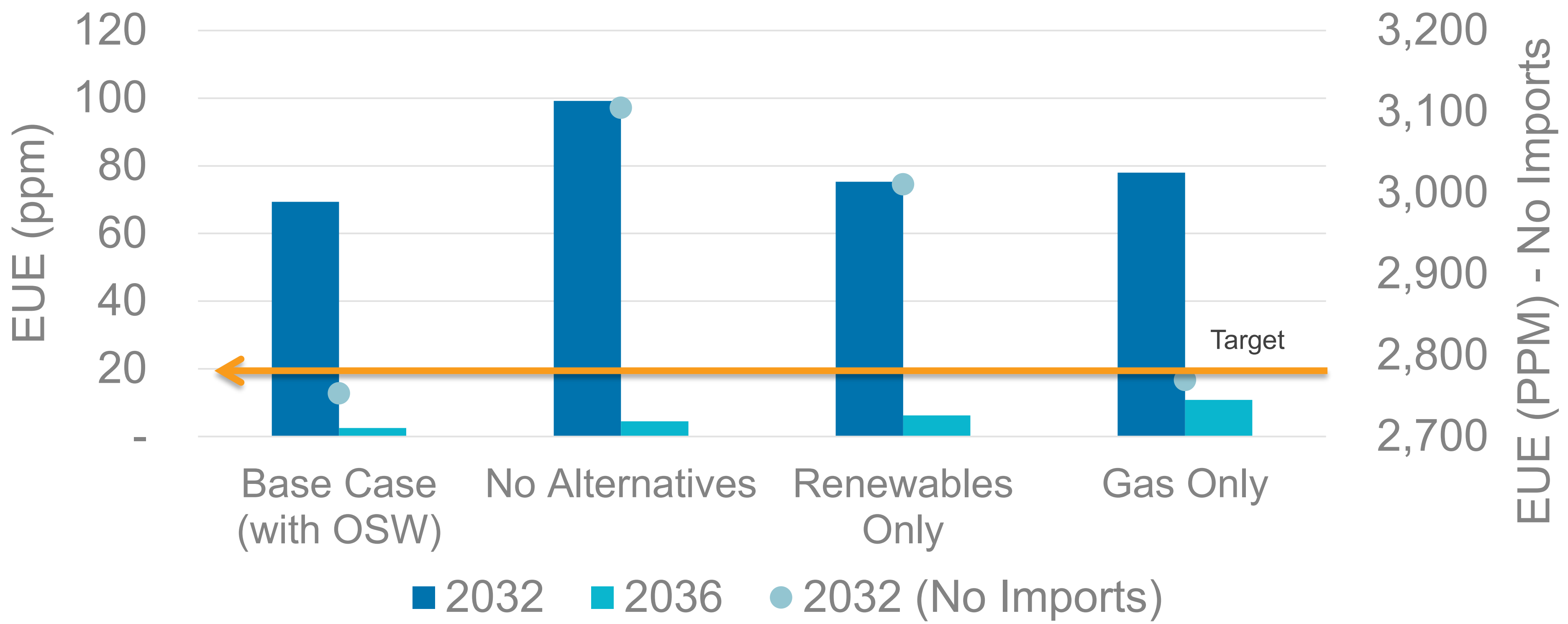
OSW can ease stress on fuel systems by meeting winter load growth





OSW drives down usage of oil-fired generation downstate. Its efficacy increases as winter generation grows. OSW's direct impact declines past ~5GW

OSW and gas offer the strongest reliability performance and hedge against tightening in surrounding regions



OSW maintains or improves reliability due to strong winter generation in NYC. OSW performance relative to gas is influenced based on the size and technology selected for the alternative gas resource.

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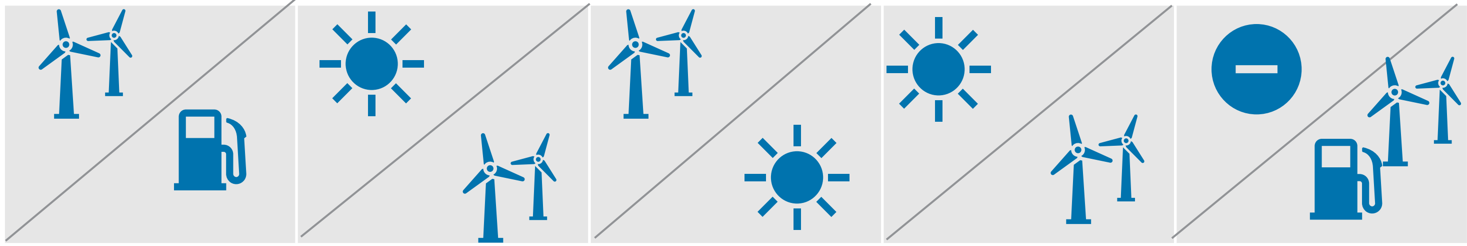
Including OSW resulted in lower energy prices and emissions, while maintaining reliability

Portfolios that include OSW have the balanced performance and lead on most metrics, except for capital costs which were mixed across markets

Resource Adequacy	Energy price	Natural gas capacity factor	Emissions	Net Capital costs



Natural gas

Onshore renewables

Offshore wind

Winner / Runner-up

No Alternatives

Greatest output during **winter hours** when fuel systems and wider markets are stressed

Strategic siting near transmission-constrained urban centers, particularly NYC

All MWs are good MWs
Portfolios without new resources have the worst performance

Native investment mitigates but does not eliminate exposure to region-wide tightness

OSW’s potential role in grid reliability

While there is no single path to a reliable grid, OSW has the potential to play a meaningful role — bringing strong winter generation, siting advantages near constrained coastal regions, and consistently high ELCC values.

Growing Risks

Growing winter demand, aging infrastructure, and fuel supply constraints are driving reliability concerns across the Northeast, with NYC facing near-term risks.

OSW Aligns with Peak Stress

OSW delivers its strongest output during winter hours when natural gas, solar, and surrounding markets are at their most constrained.

Strategic Coastal Siting

OSW can be developed offshore near transmission-constrained urban load pockets like NYC, bypassing land, permitting, and interconnection bottlenecks.

Eases Fuel System Stress

Portfolios with OSW reduce oil-fired generation and natural gas dependency, lowering energy prices and emissions while hardening fuel supply resilience.

Portfolio-wide planning

OSW’s role is best understood in a portfolio- and region-wide context. Emerging planning best practices must be future-looking and increasingly regional.

Competitive but Declining ELCC

OSW's capacity contribution is strong at initial penetration and competitive with thermals but declines at higher penetration — reinforcing the need for diversified portfolios.

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