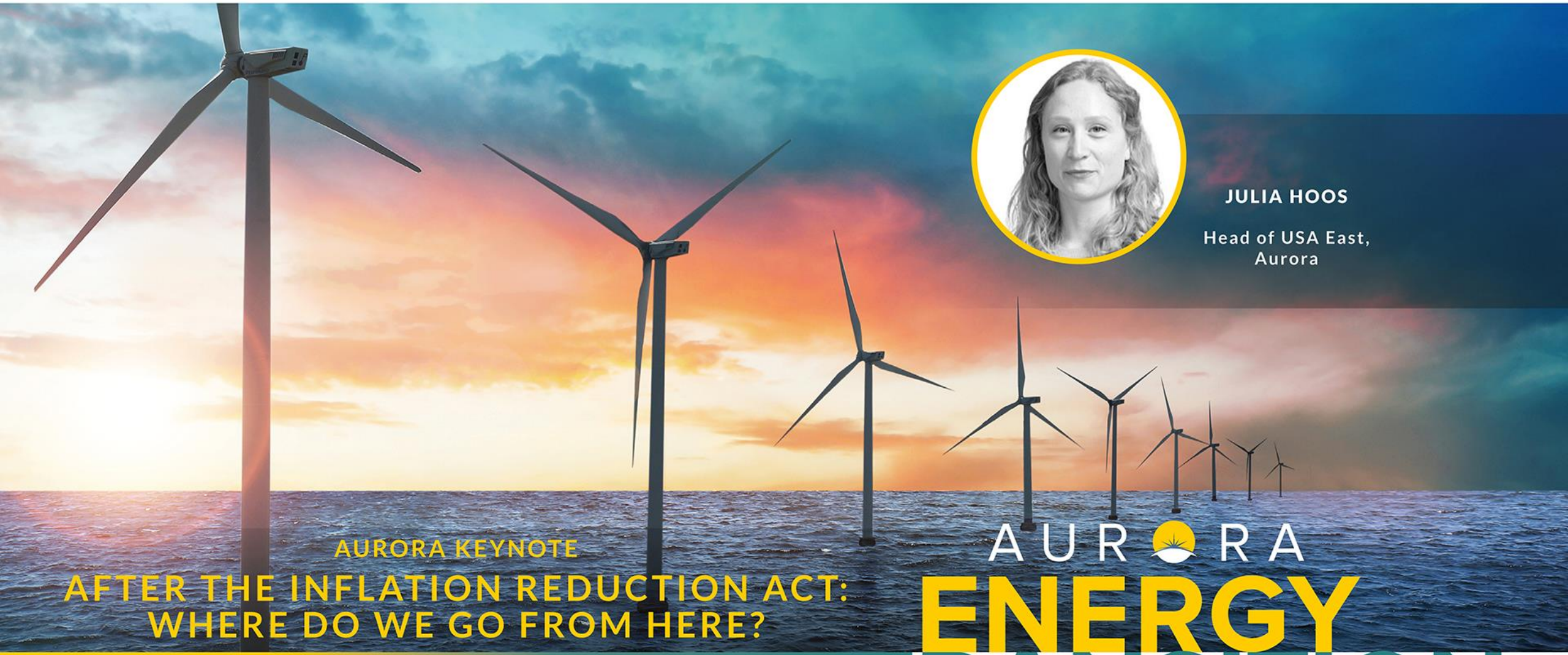



**JULIA HOOS**

Head of USA East,
Aurora

AURORA KEYNOTE

# AFTER THE INFLATION REDUCTION ACT: WHERE DO WE GO FROM HERE?

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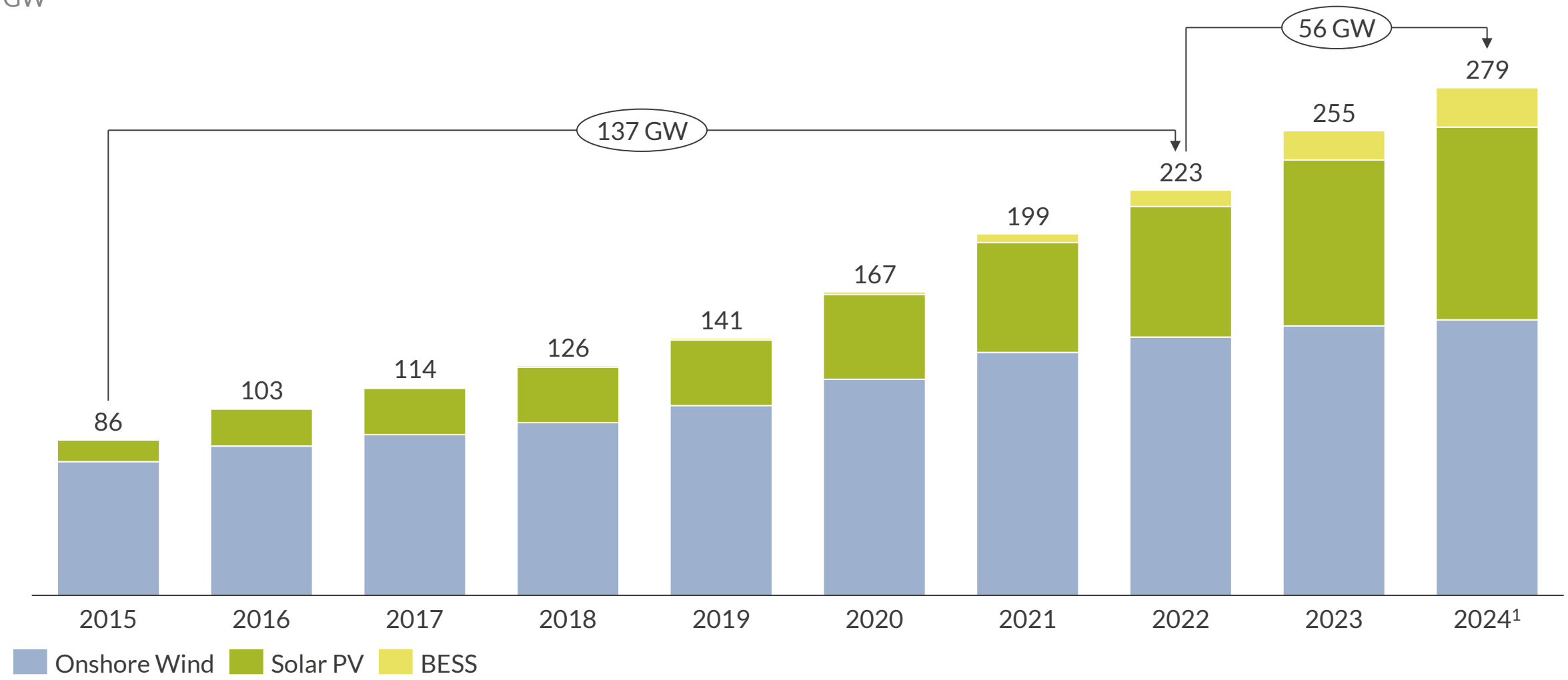
# ENERGY TRANSITION FORUM 2024

The IRA is the **most significant piece of legislation impacting the energy sector** in over a decade.

# The USA has installed 56 GW of renewable and battery in the two years since the IRA – 40% of the previous 6 years

## US nationwide installed capacity by technology

GW




1) As of August 2024.

Sources: Aurora Energy Research, EIA

# Interconnection queues across the US grew 40% immediately after the IRA passed, almost all in battery and renewable technologies

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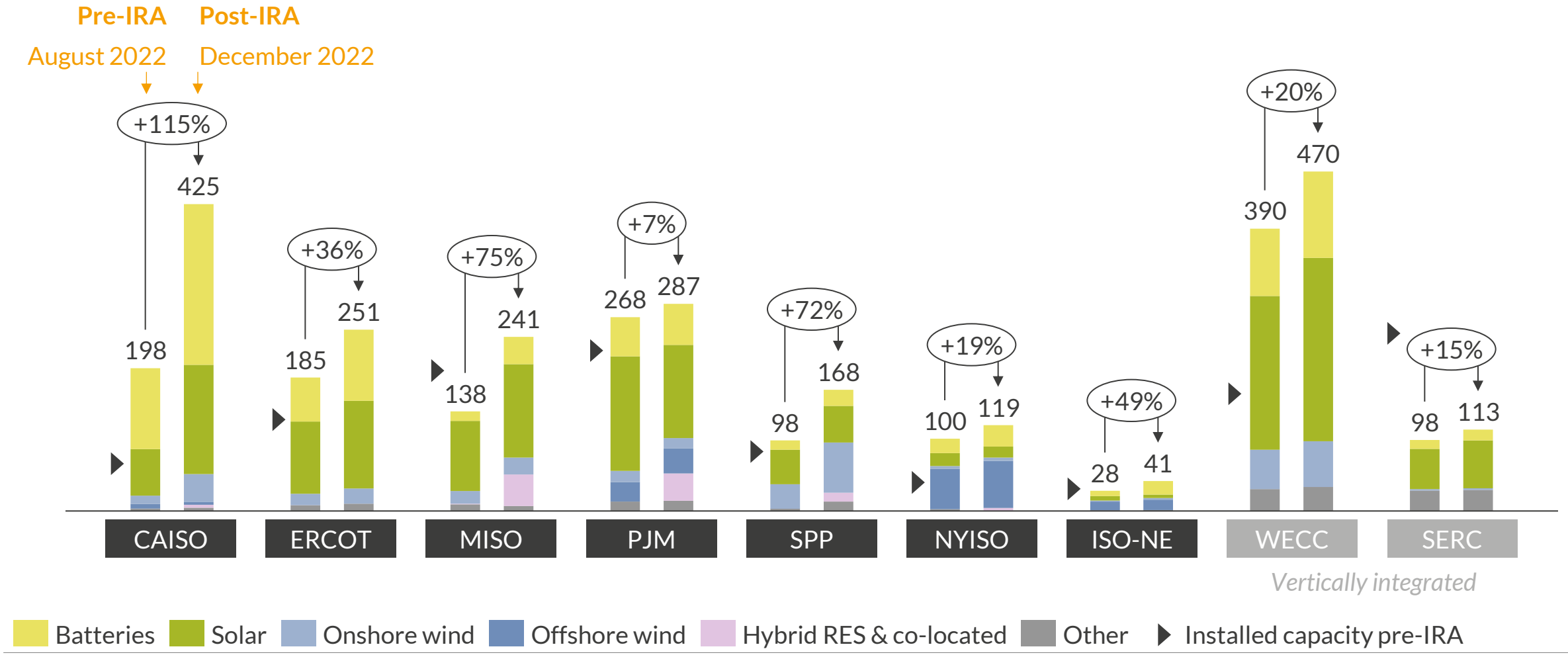
**Total nameplate capacity in interconnection queue**
GW




Sources: Aurora Energy Research, Lawrence Berkeley National Laboratory (LBNL), Individual ISO data

# $130bn has been invested in ~350 large-scale clean energy facilities since the IRA; EV and battery facilities received majority of the total investment

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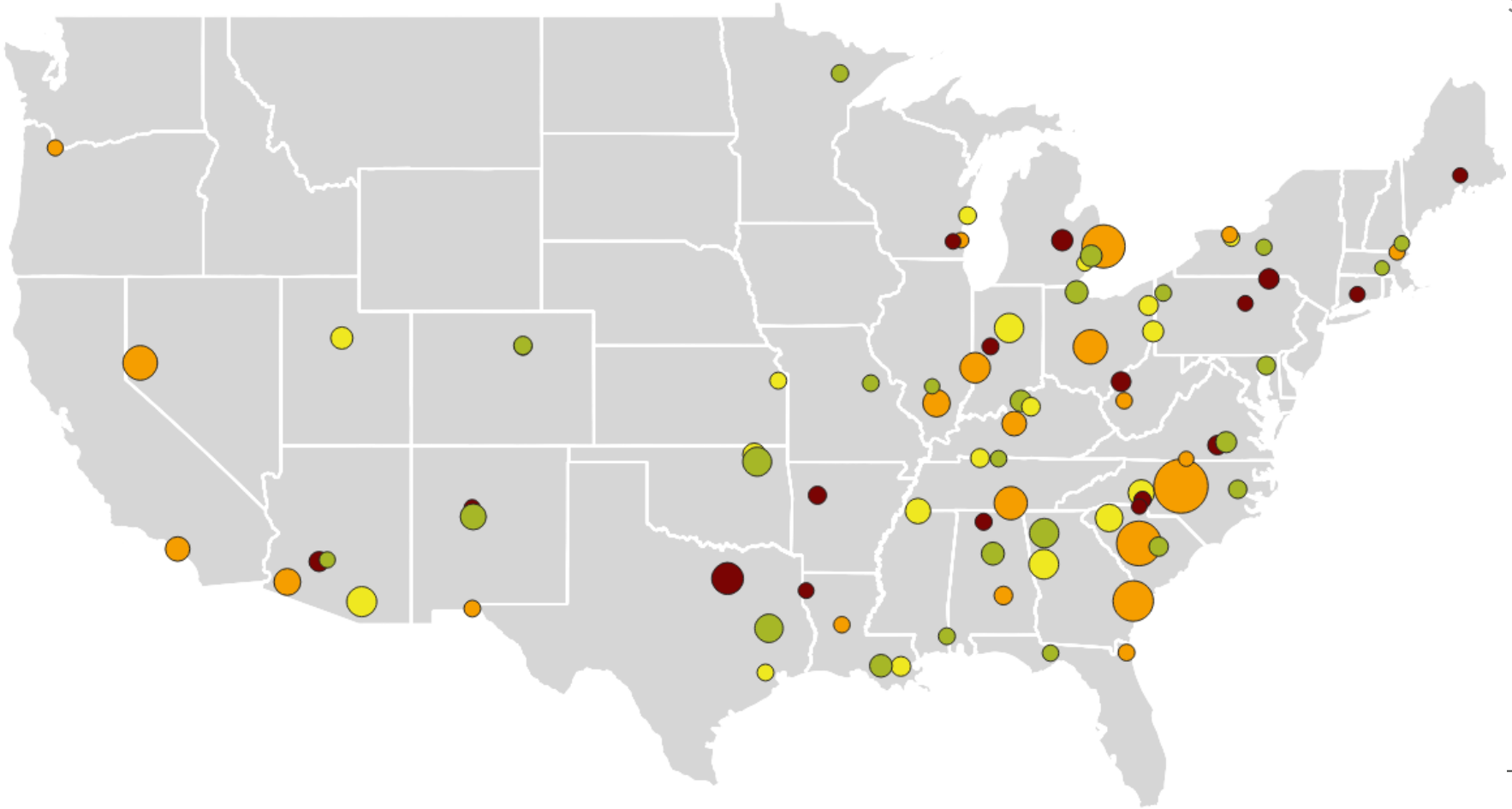
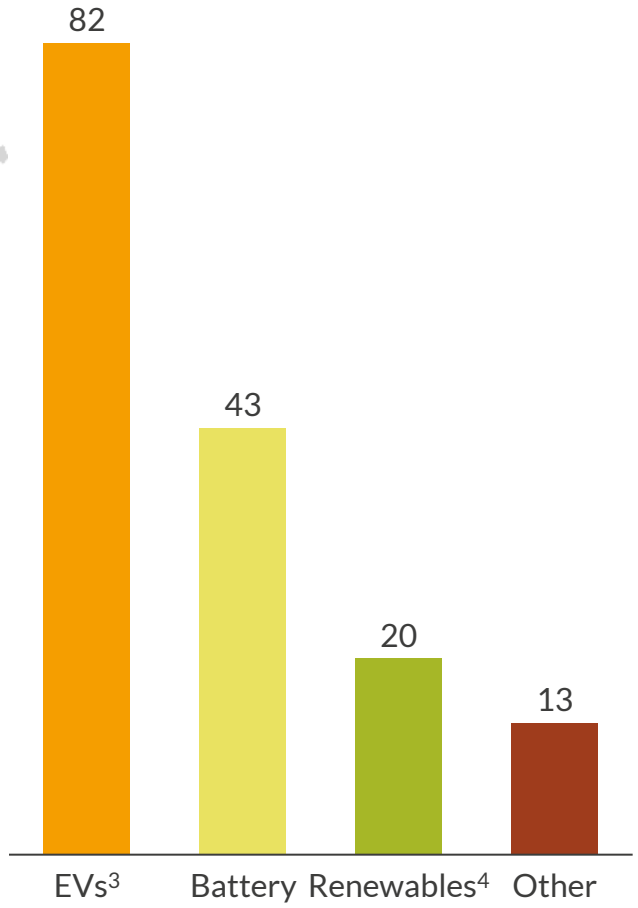
## Major clean energy investments announced post-IRA[1] by state by technology



## Announced investments by technology[2]

$ billion




**Investment size key**
$ billion

15 10 5

**Technology key**

Battery Electric vehicles Renewables Other

1) Investments announced August 2022 through September 2024, not all facilities disclosed their locations. 2) Likely understated. Several projects have been announced without investment data included. 3) EV category includes investments in EV battery manufacturing. 4) Renewables include only wind and solar.

Sources: Aurora Energy Research, E2

# However, renewables deployment has already lagged expectations in the short term

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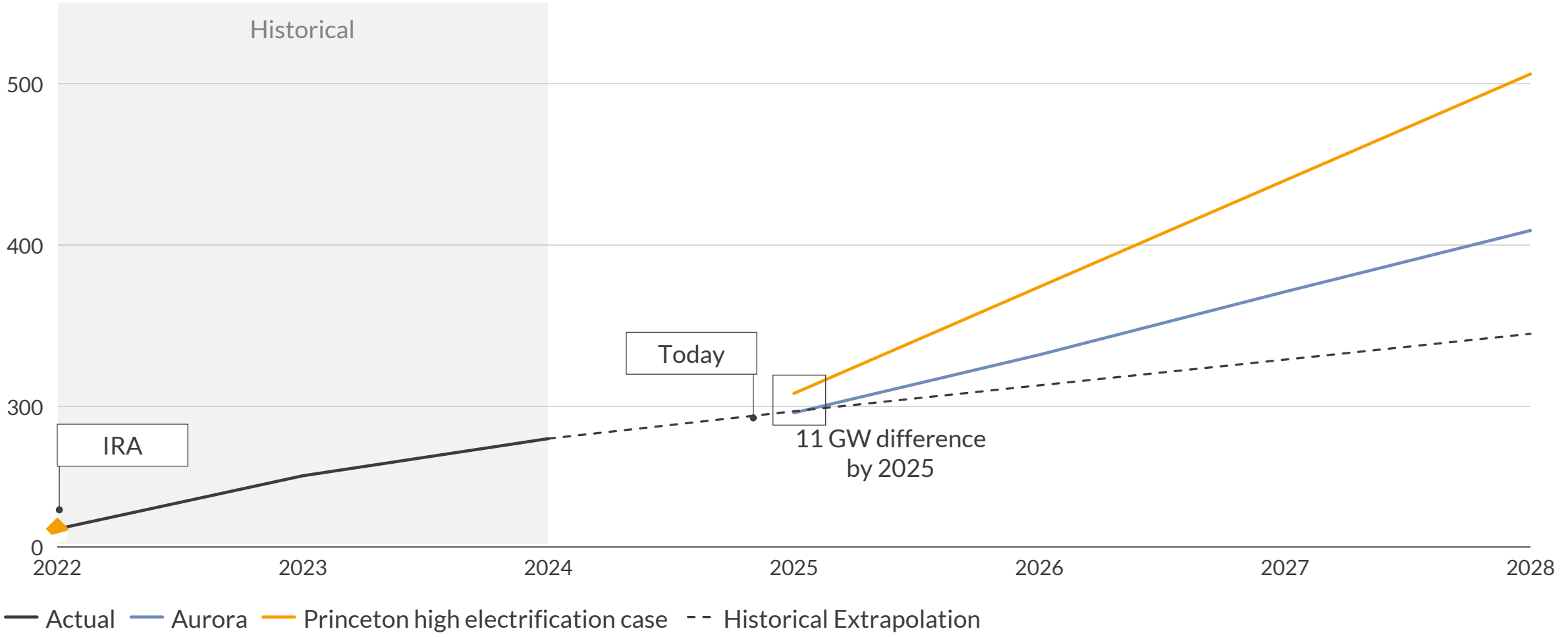
**Installed utility-scale renewable and battery capacity across US markets**

GW




Sources: Aurora Energy Research, EIA, Individual ISO data, Net-Zero America Project

# Bloated interconnection queues and inefficient interconnection processes are partly to blame for the slow renewable addition

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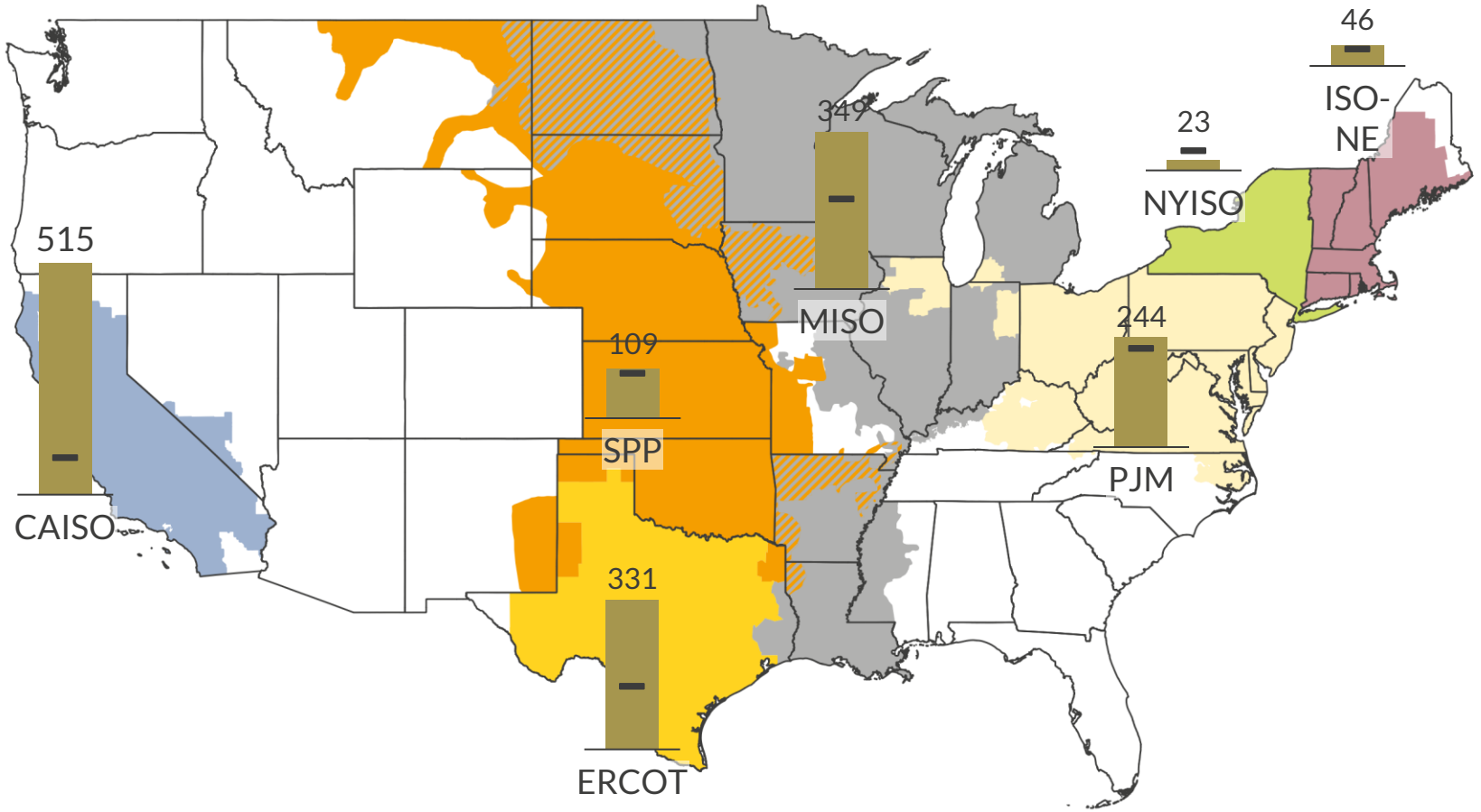
## Interconnection queue capacity by ISO

GW




## Average duration from request to interconnection agreement from 2018-2023

Months

| | |
|---|---|
| ISO-NE | 50 |
| PJM | 45 |
| CAISO | 42 |
| NYISO | 41 |
| SPP | 40 |
| MISO | 37 |
| ERCOT | 27 |

Sources: Aurora Energy Research, Individual ISO data, Berkeley Lab

# Backlogged supply chains are further complicated by mineral production & refining in geopolitically fraught regions

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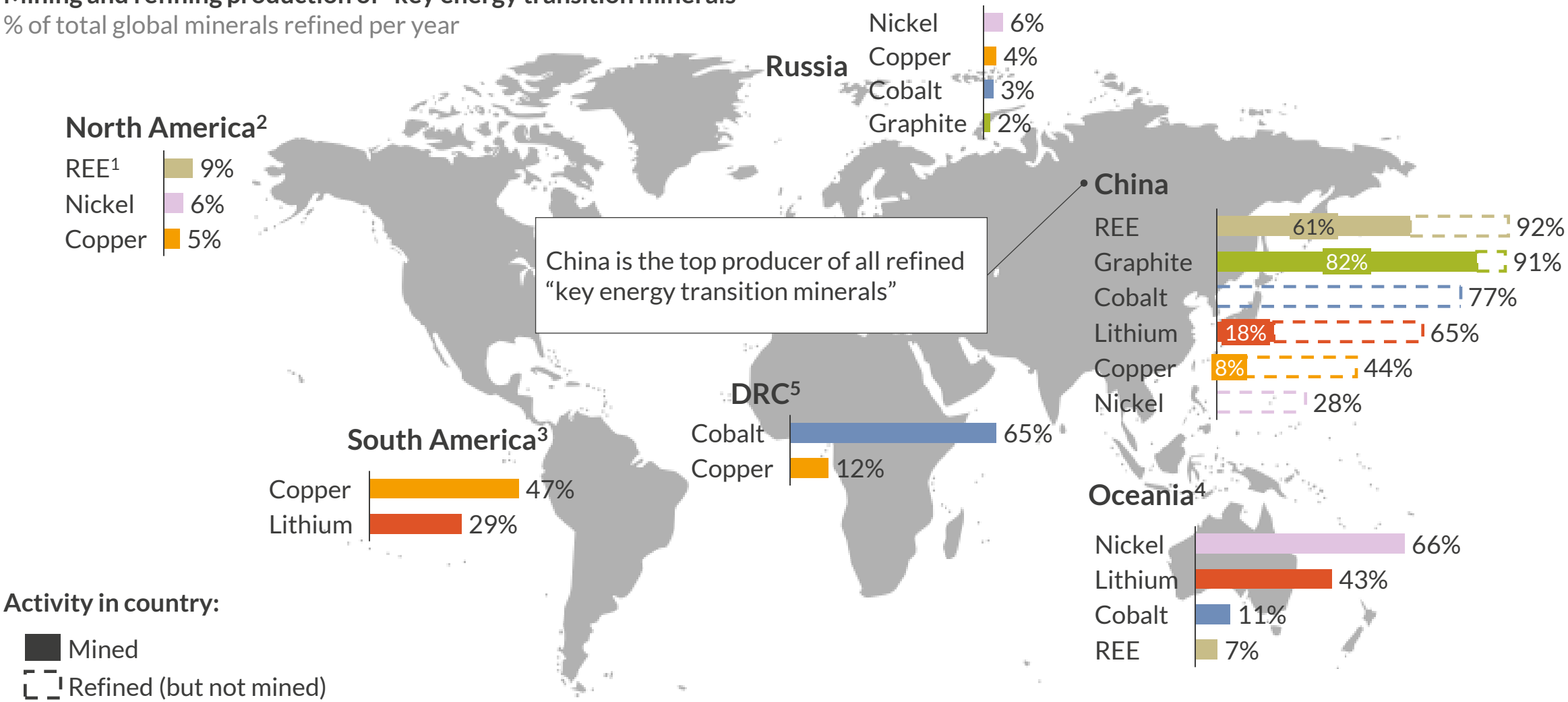
**Mining and refining production of "key energy transition minerals"**
% of total global minerals refined per year




1) Rare Earth Elements. 2) North America includes: USA and Canada. 3) South America includes: Chile, Peru and Argentina. 4) Oceania includes: Australia, Indonesia and the Philippines. 5) Democratic Republic of the Congo.

Sources: Aurora Energy Research, IEA

# Even with tax credits, additional state funding is required to make renewables economics stack up

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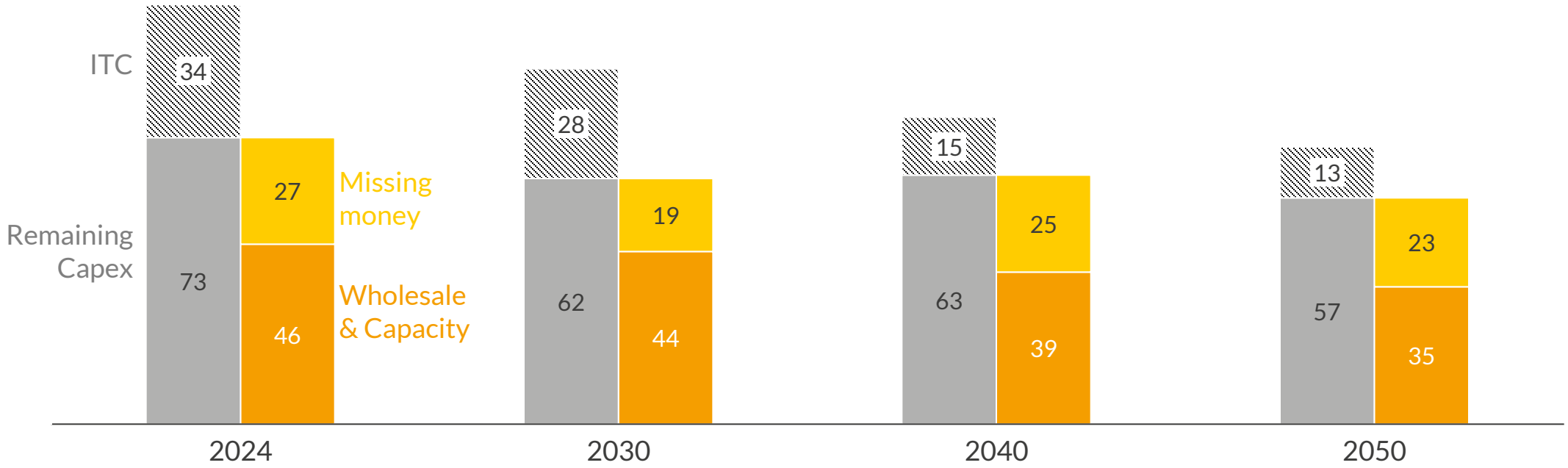
**Lifetime expected solar Levelized Cost[1] and Levelized Revenue[2] by build year (NY illustrative example[3])**
$/MWh (real 2023)




**Missing Money: share of solar levelized revenues that must be provided by REC value**
%

| 2024 | 2030 | 2040 | 2050 |
|---|---|---|---|
| 37% | 30% | 39% | 39% |

1) Levelized Cost of Energy; discount rate of 9%, lifetime of 30 years, a 18% load factor, and Energy Community ITC rate (40% of CAPEX, with 10% transaction costs) stepping down in 2034. 2) Levelized Revenue of Energy. 3) Zone C solar receiving Energy Community tax rates.
Sources: Aurora Energy Research

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# What’s next?

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# What's next?

Decarbonizing the "last mile" will **require more investment and technological development** than even the most ambitious states have committed.

# Case study | New York targets 100% emissions-free power by 2040

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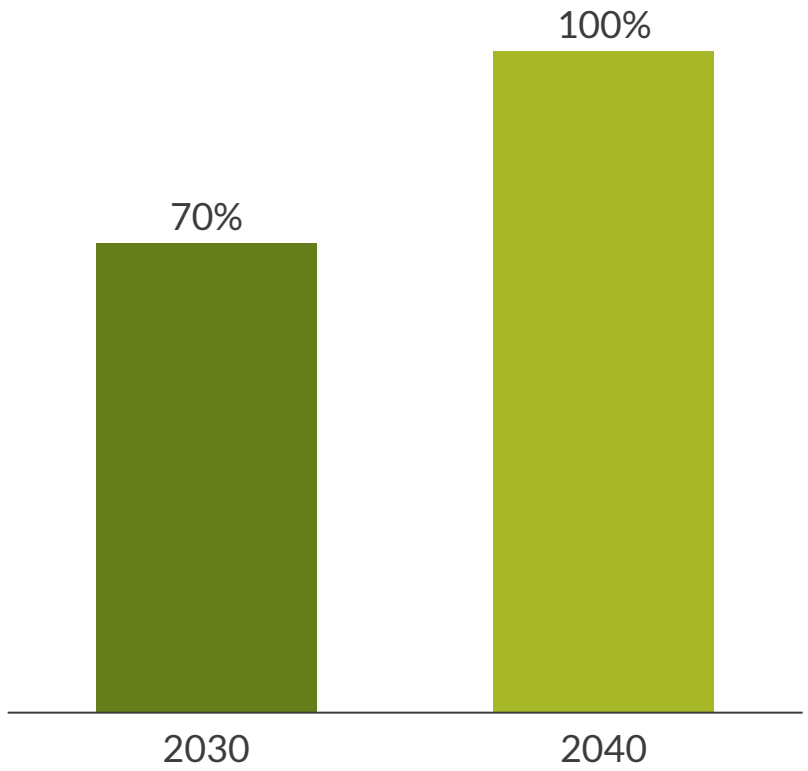
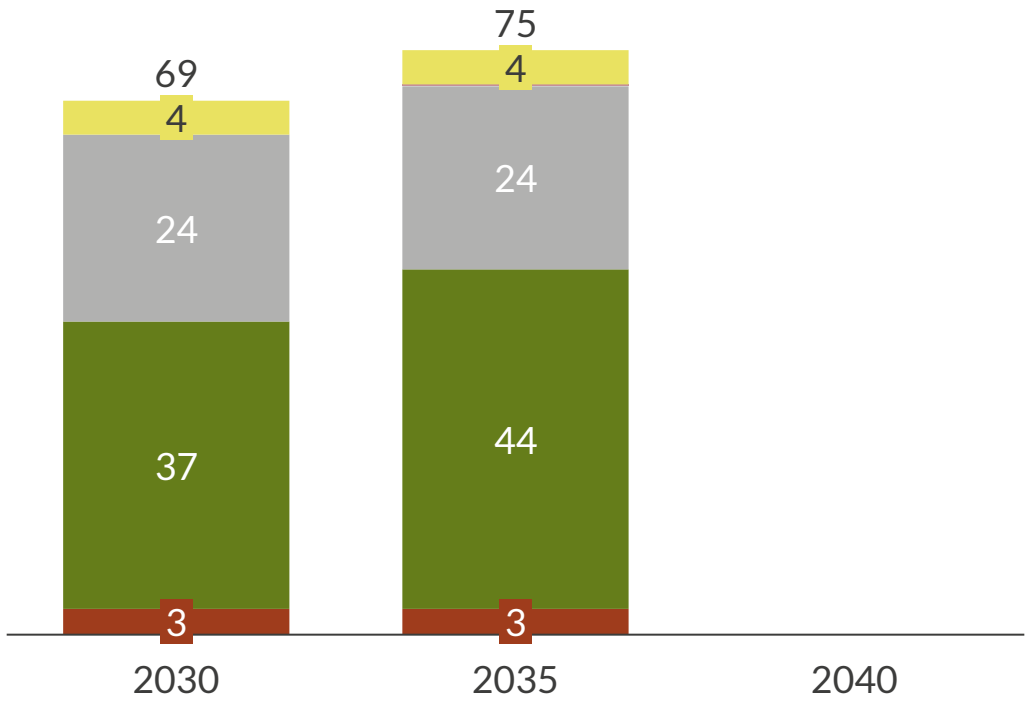
## NYISO System & Resource Outlook RPS generation and target

%




## NYISO System & Resource Outlook installed capacity[1]

GW




Renewable Generation | Zero Emissions Generation[2] | Nuclear | Renewables | Thermal | Battery storage

1) NYISO 2023-2042 System & Resource Outlook , Lower Demand Policy Scenario Capacity Expansion Model Results. 2) includes nuclear generation.

Sources: Aurora Energy Research, NYISO

# Case study | New York targets 100% emissions-free power by 2040 – relying on "Dispatchable Emissions Free Resources"

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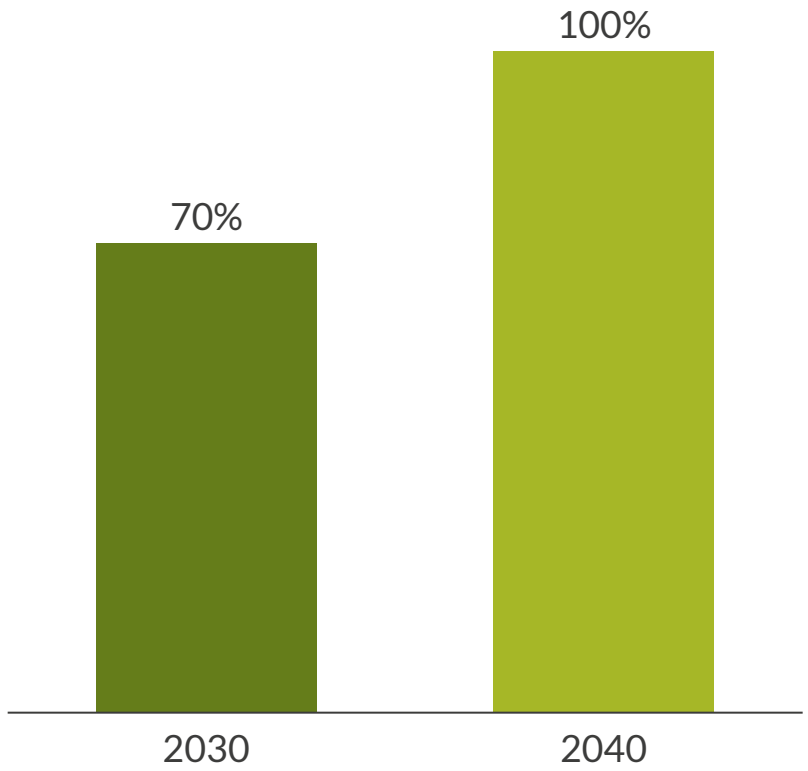
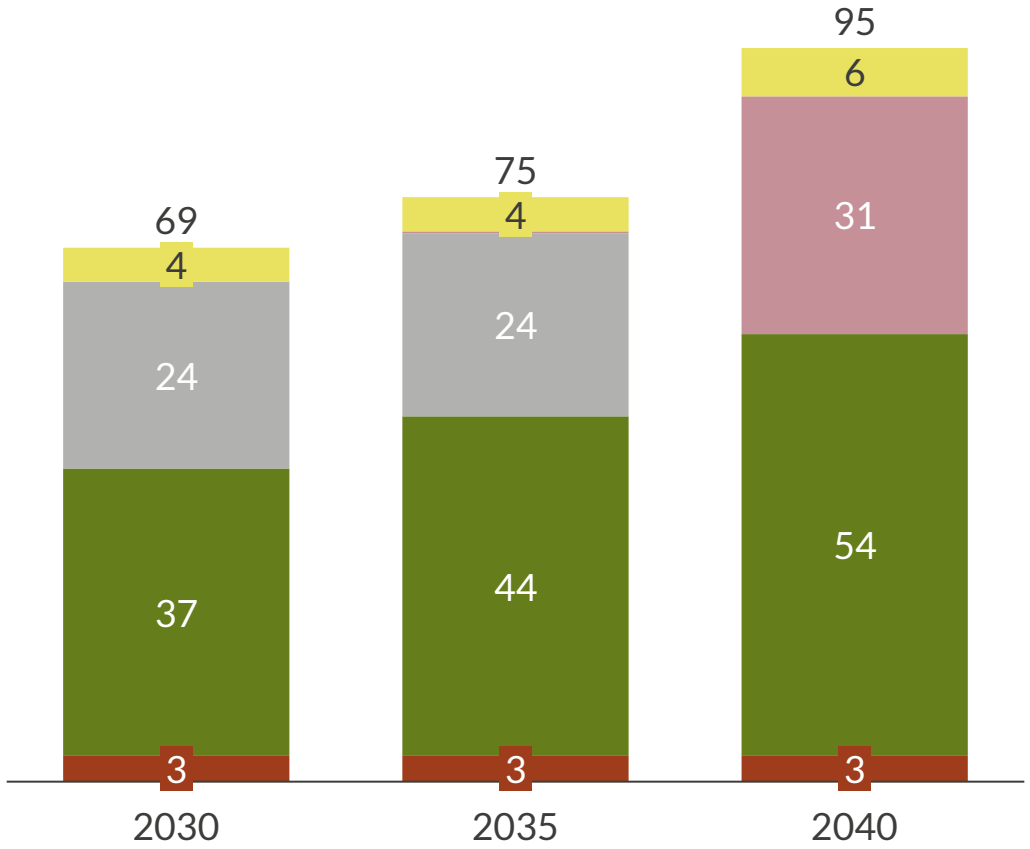
## NYISO System & Resource Outlook RPS generation and target

%




## NYISO System & Resource Outlook installed capacity[1]

GW




Renewable Generation | Zero Emissions Generation[2] | Nuclear | Renewables | Thermal | DEFR[3] | Battery storage

1) NYISO 2023-2042 System & Resource Outlook , Lower Demand Policy Scenario Capacity Expansion Model Results. 2) includes nuclear generation. 3) Dispatchable Emissions-Free Resources

Sources: Aurora Energy Research, NYISO

# We model three potential future scenarios to understand the challenges in pursuing full decarbonization

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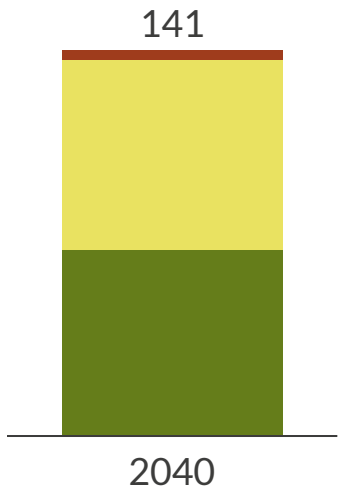
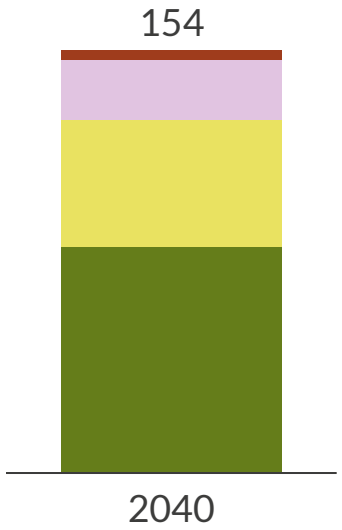
**Capacity in NYISO by technology**
GW

*Fully decarbonized* | *95% decarbonized*

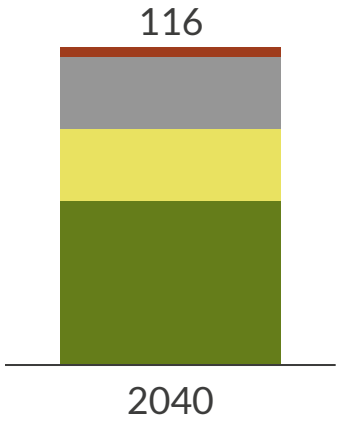
**1 Fully Renewable**
Meet zero-emissions targets using only currently mature technology




**2 Zero-emissions with H2**
Meet zero-emissions targets assuming hydrogen peakers will be available




**3 Low Emissions[1]**
Push the envelope beyond Aurora Central, but allow low (5%) levels of emissions




Renewables BESS Thermal Hydrogen peaker Nuclear

1) Limit the runtime generation of thermal assets to be around 5%

Sources: Aurora Energy Research

# Fully Renewable Case | A zero-emissions case requires over 90GW of additional nameplate capacity constructed by 2040

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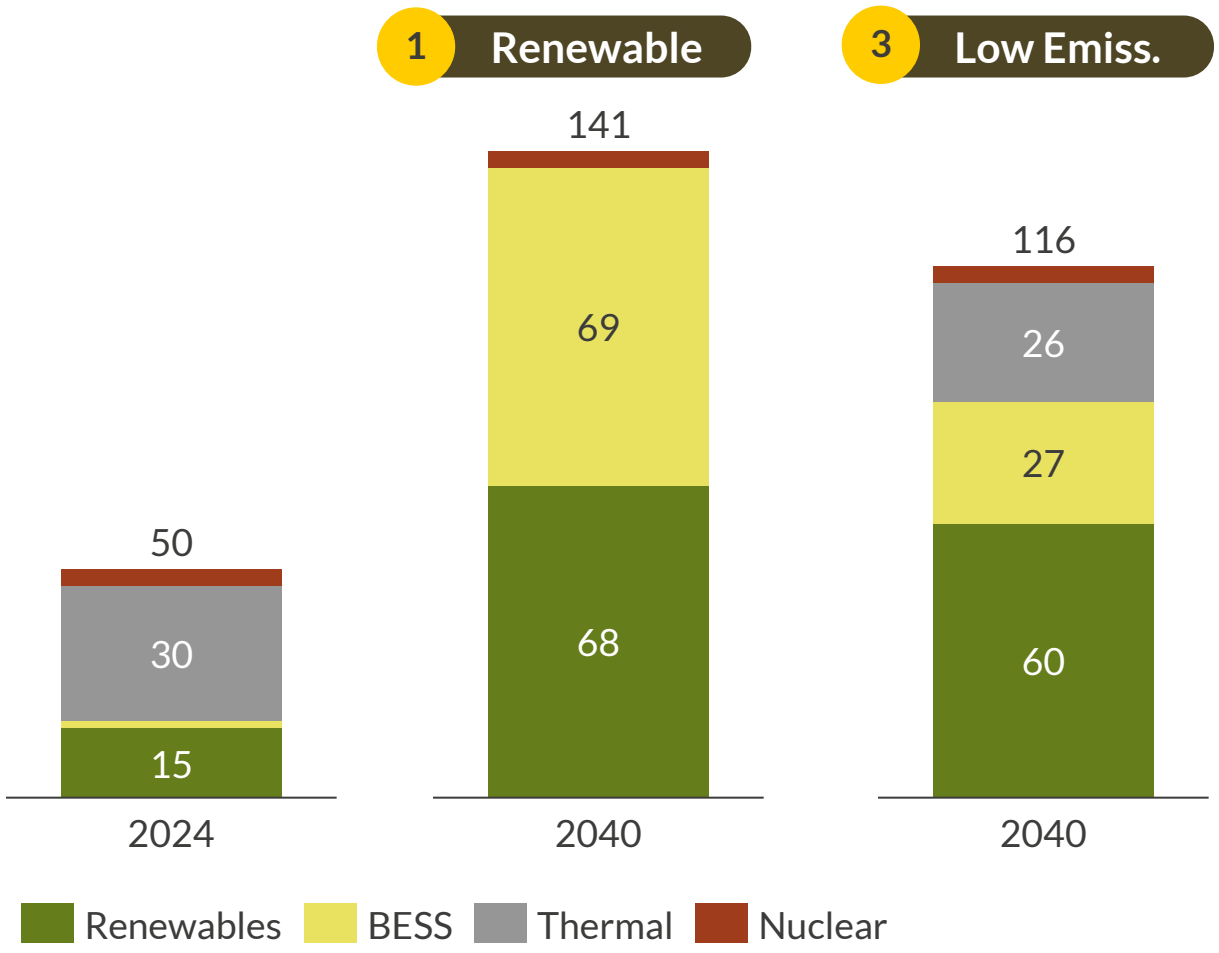
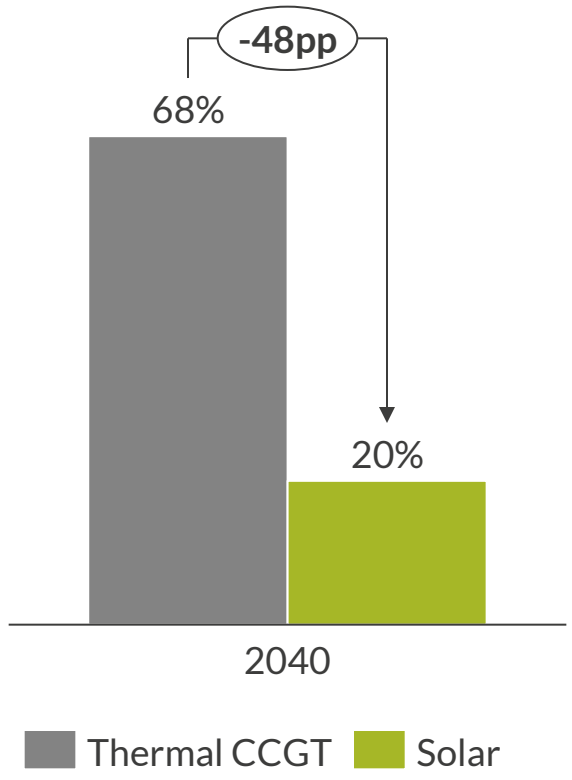
## Capacity in NYISO by technology

GW




## Average capacity factor of solar vs CCGT generator

%




Sources: Aurora Energy Research

# Fully Renewable Case | NYISO needs to import from nearby regions when renewable generation is low

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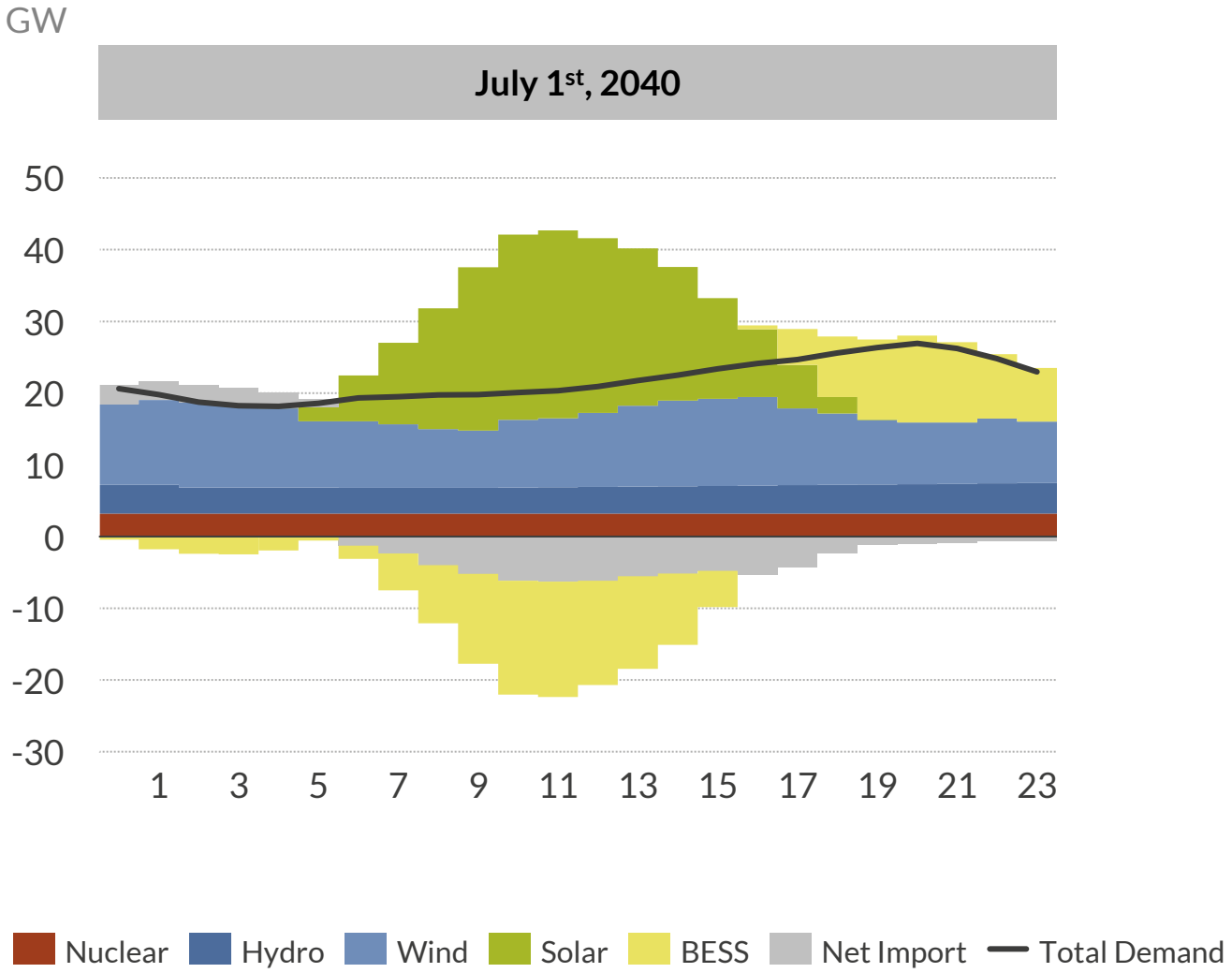
**Generation, demand, and net import in NYISO during a summer day in 2040**




Sources: Aurora Energy Research

# Fully Renewable Case | NYISO needs to import from nearby regions when renewable generation is low – and imports much more during winter

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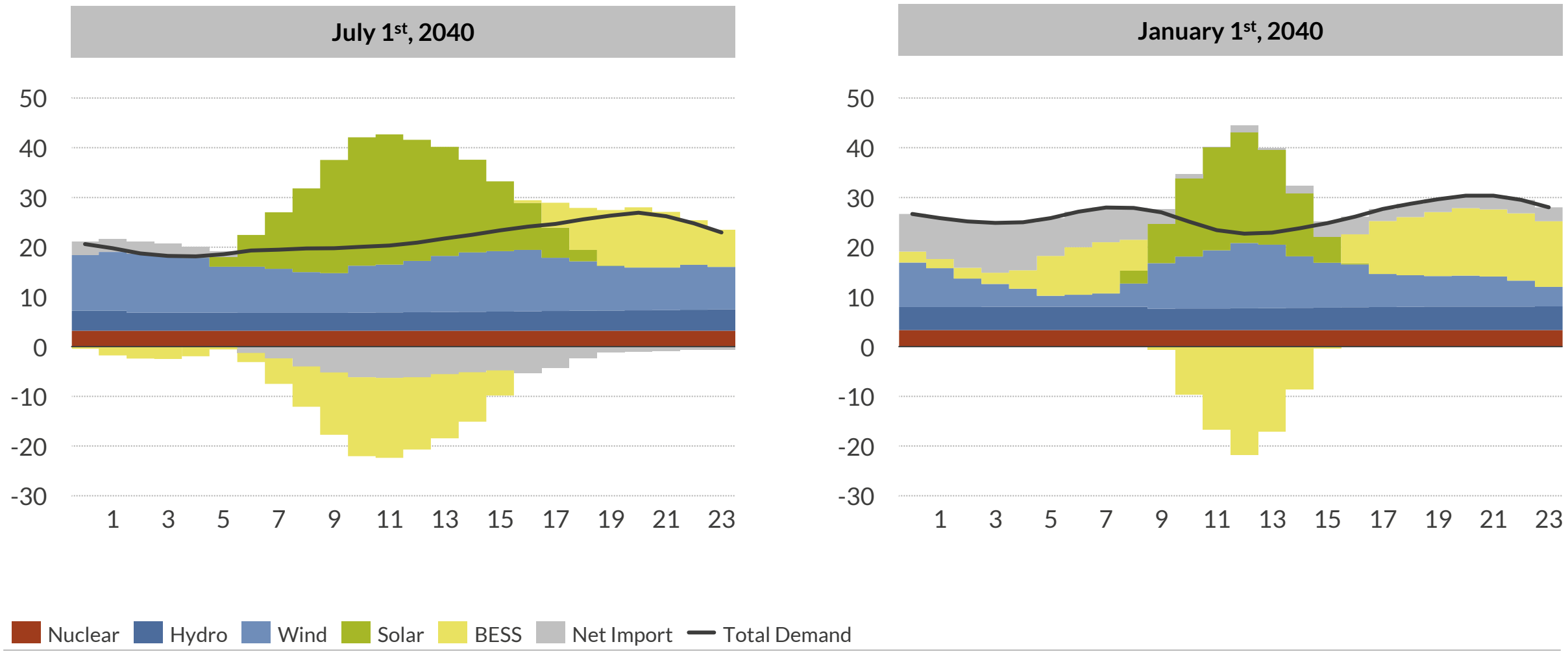
**Generation, demand, and net import in NYISO during a summer day and a winter day in 2040**




Sources: Aurora Energy Research

# Fully Renewable Case | With longer duration batteries procured for reliability, higher cost of new entry will increase capacity prices

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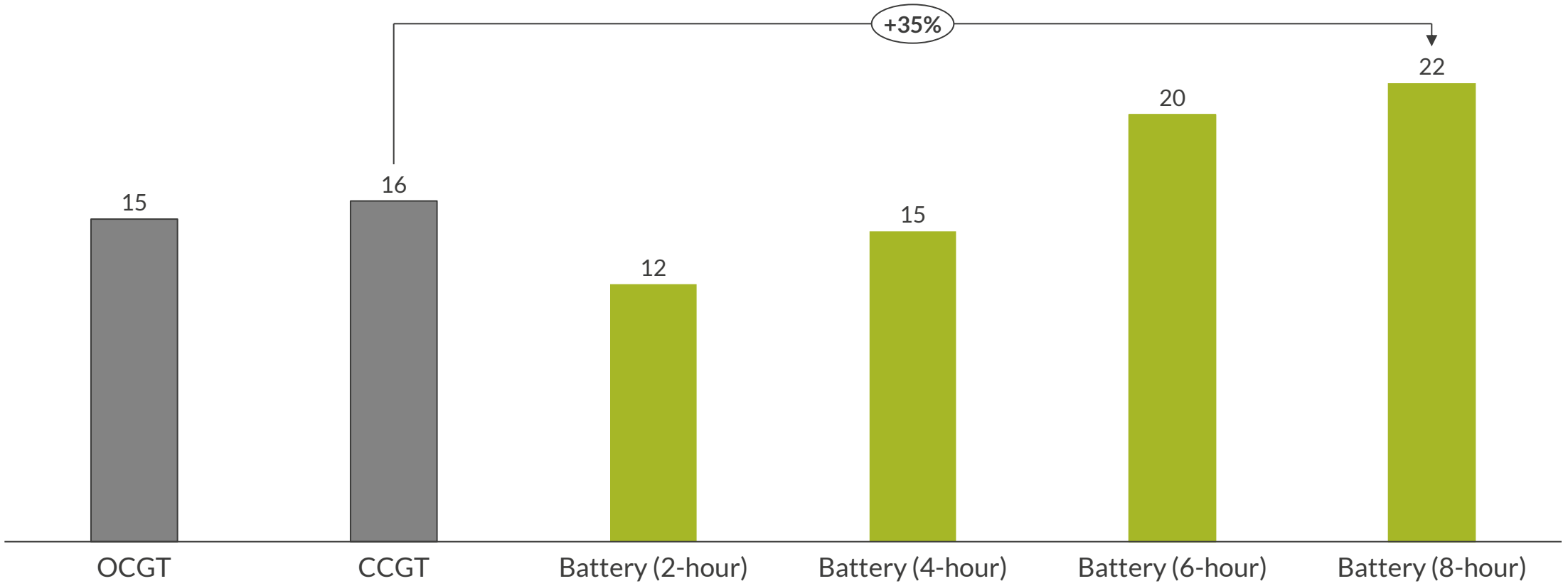
**NYISO Zone C Net Cost of New Entry, 2035**
$/kW-month




Sources: Aurora Energy Research

# A low emissions scenario increases system cost by 13% in 2040; decarbonizing fully via hydrogen increases costs by >80%

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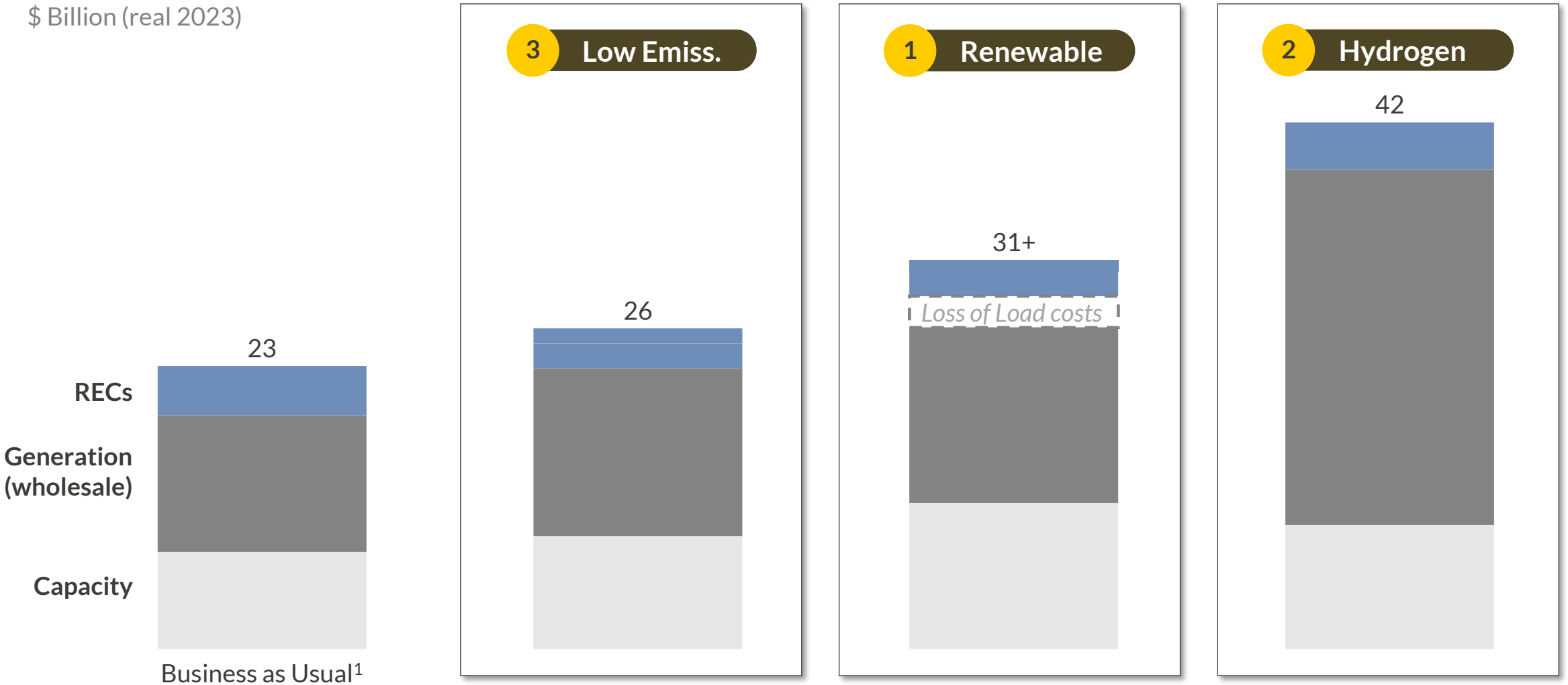
*Indicative results*

**NYISO total system cost in 2040**
$ Billion (real 2023)




1) Business as Usual assumes 70% renewables by 2040.

Sources: Aurora Energy Research

# A system with only 5% gas remaining has reduced emissions by 93% from today's level

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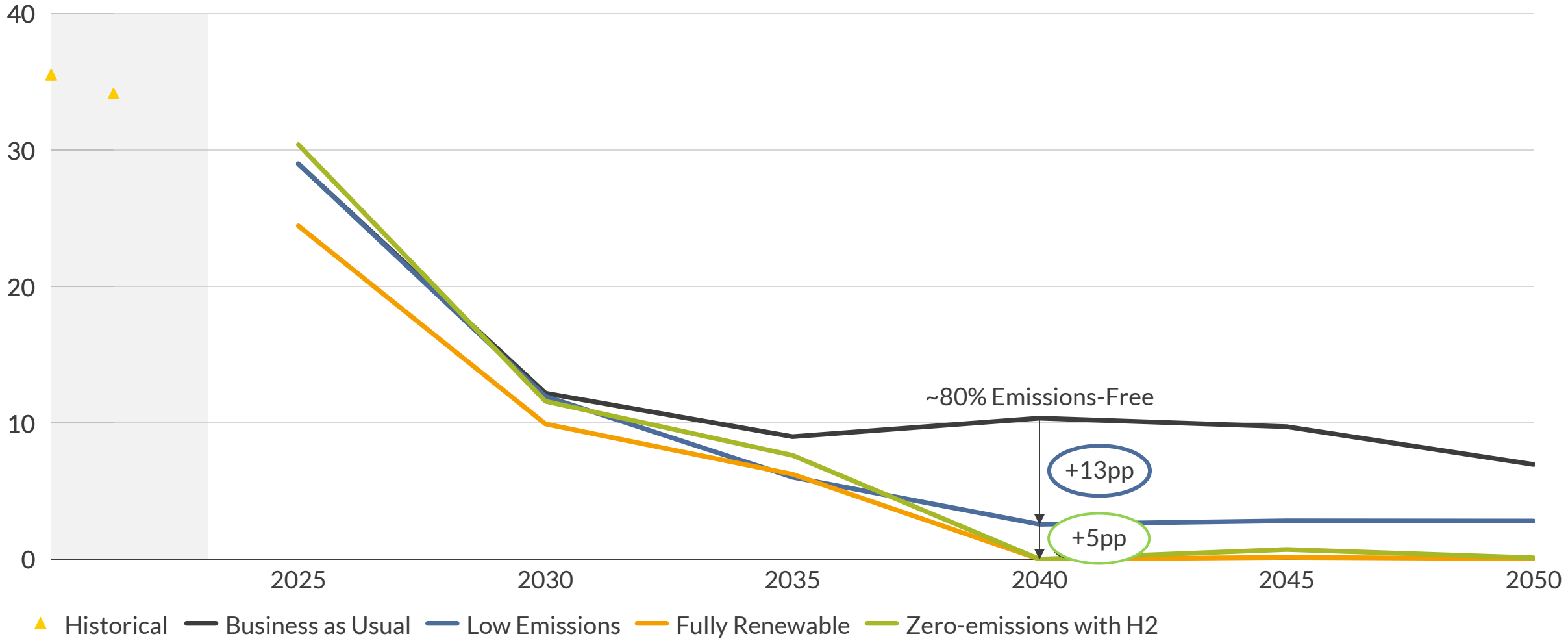
**NYISO total power sector emissions**
Million metric tons $CO_2$




Sources: Aurora Energy Research

# A system with only 5% gas remaining has reduced emissions by 93% from today's level

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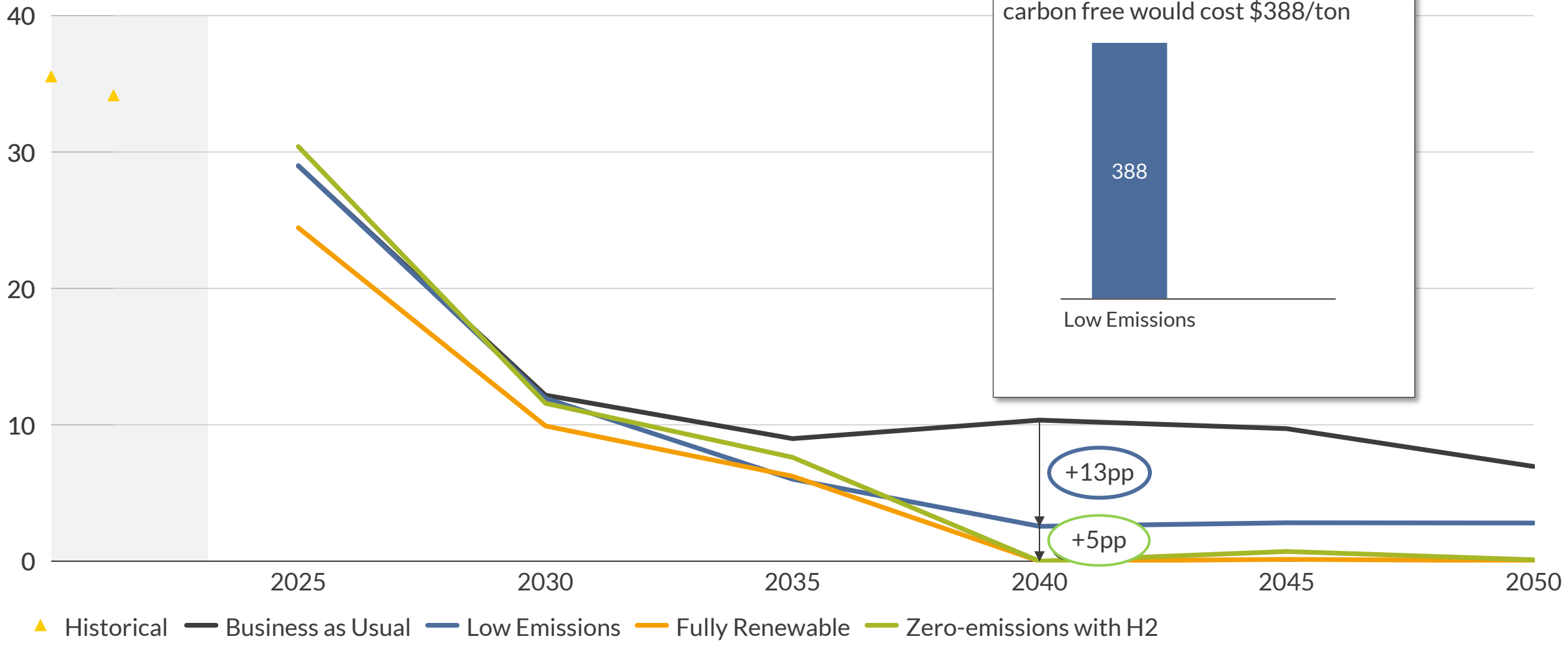
**NYISO total power sector emissions**

Million metric tons $CO_2$




Sources: Aurora Energy Research

# A system with only 5% gas remaining has reduced emissions by 93% from today's level – and the last mile is exponentially more expensive

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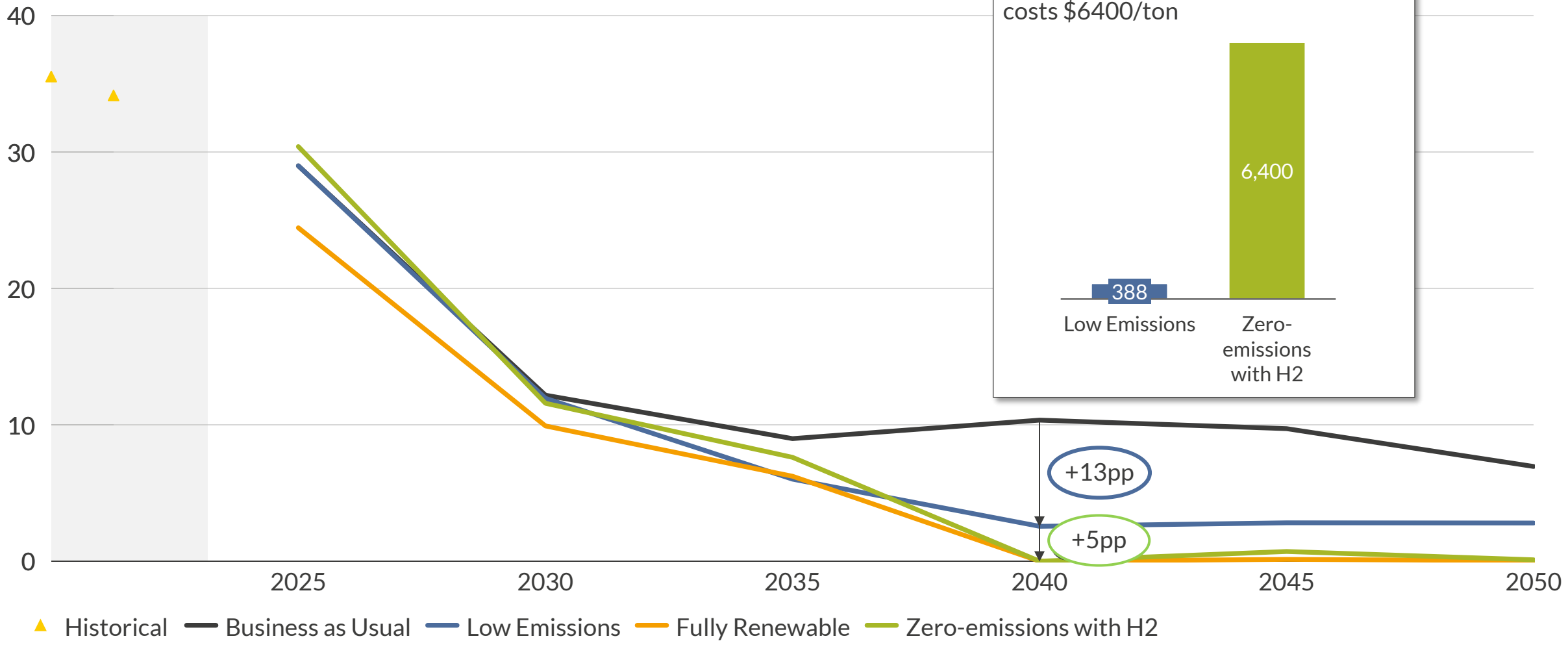
**NYISO total power sector emissions**
Million metric tons $CO_2$




Sources: Aurora Energy Research

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# What’s next?


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ENERGY RESEARCH