Coordinated Grid Planning Process (CGPP): Summary of Stage 1 Capacity Expansion Analysis Results

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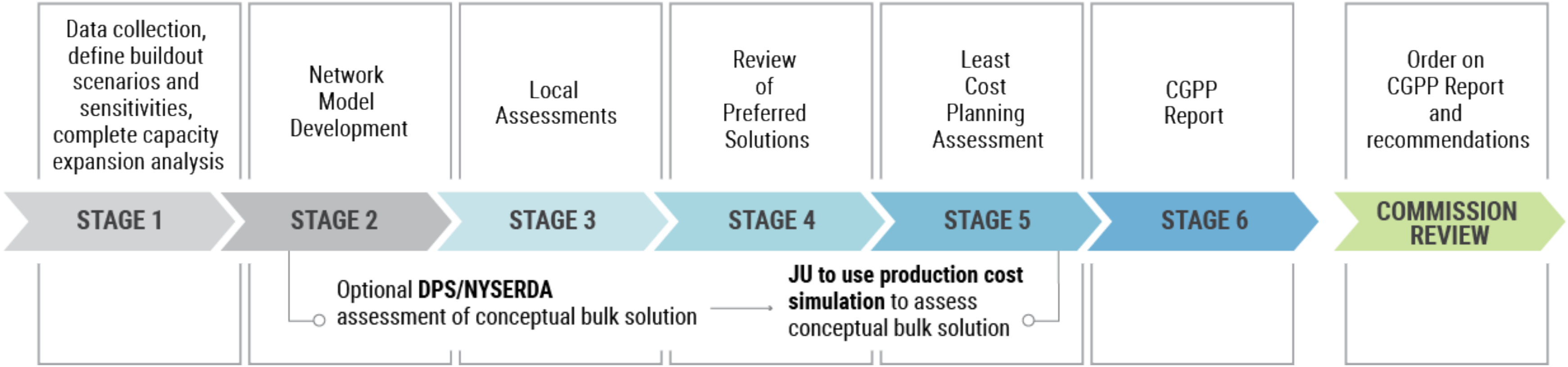
Agenda

- Background on the Coordinated Grid Planning Process ("CGPP")
- Overview of CGPP Scenario Assumptions
- Summary of CGPP Scenario Capacity Expansion Analysis Results

Background

- At the August 6, 2024 TPAS/ESPWG (here) the NYISO presented to stakeholders an overview of the CGPP
- Some of the key items from this August 6, 2024 presentation were:
  - On August 17, 2023 the Public Service Commission ("PSC") issued an order approving the Coordinated Grid Planning Process (CGPP)
  - The CGPP was designed by the Joint Utilities and Long Island Power Authority in response to the PSC's directives with input and collaboration from the NYISO, NYSERDA, and other interested parties
  - The CGPP consists of six stages plus PSC review



Purpose

- This presentation focuses on key capacity expansion analysis results that the Joint Utilities and DPS staff requested that the NYISO perform in support of Stage 1 of the CGPP
- This presentation includes capacity expansion results that the Joint Utilities requested the NYISO to present at the Energy Policy Planning Advisory Council ("EPPAC") meetings listed below
  - State scenario results were presented to EPPAC on June 17, 2024
  - Low transmission impact (scenario 2) results were presented to EPPAC on July 15, 2024
  - High transmission impact (scenario 3) results were presented to EPPAC on August 5, 2024
- This presentation also includes material presented at the August 22, 2024 CGPP technical conference

CGPP Assumptions

CGPP Scenarios

- **In Stage 1 of the CGPP, the Joint Utilities and LIPA, working with EPPAC, established three clean energy generation build-out scenarios to serve as the basis for their evaluations conducted in later stages**
  - Assumptions for these scenarios were discussed at various meetings as early as Q4 2023 with the EPPAC
- **The scenarios for this cycle of the CGPP include:**
  - State Scenario (or Scenario 1): designed to follow the assumptions developed for the Climate Action Council Scoping Plan, specifically scenario 2 of the Integration Analysis
    - The NYISO's 2023-2042 System & Resource Outlook (here) included the preliminary state scenario capacity expansion results for use by the Joint Utilities in the CGPP for directional awareness as the assumptions for continued development of this scenario within the CGPP
  - Low transmission impact (or Scenario 2): designed to reduce the need for transmission buildout
  - High transmission impact (or Scenario 3): designed to increase the need for transmission buildout
- **All CGPP scenarios include achievement of policy targets including:**
  - 70% renewable energy by 2030
  - 6 GW of energy storage by 2030
  - Zero-emissions electric grid by 2040
    - Includes net zero imports overall for IESO, PJM, and ISO-NE starting in 2040

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Energy Forecast & Peak Demand

- For each of the CGPP scenarios, energy and peak demand are based on scenarios from the Climate Action Council ("CaC") Integration Analysis with adjustments made to account for planned large load projects (from the 2023 NYISO Gold Book)
- The demand includes load, electrolysis, charging of storage resources, and the impact of additional load flexibility, particularly from EV charging
  - The electrolysis demand assumes the amount for fuel to the hydrogen-based Dispatchable Emission-Free Resource ("DEFR") generation plus 50% of economy-wide (i.e., industries outside of the electricity sector) hydrogen is being met by in-state electrolysis on an annual basis
- The assumptions also allow the amount of EV charging demand to be shifted out of peak load hours

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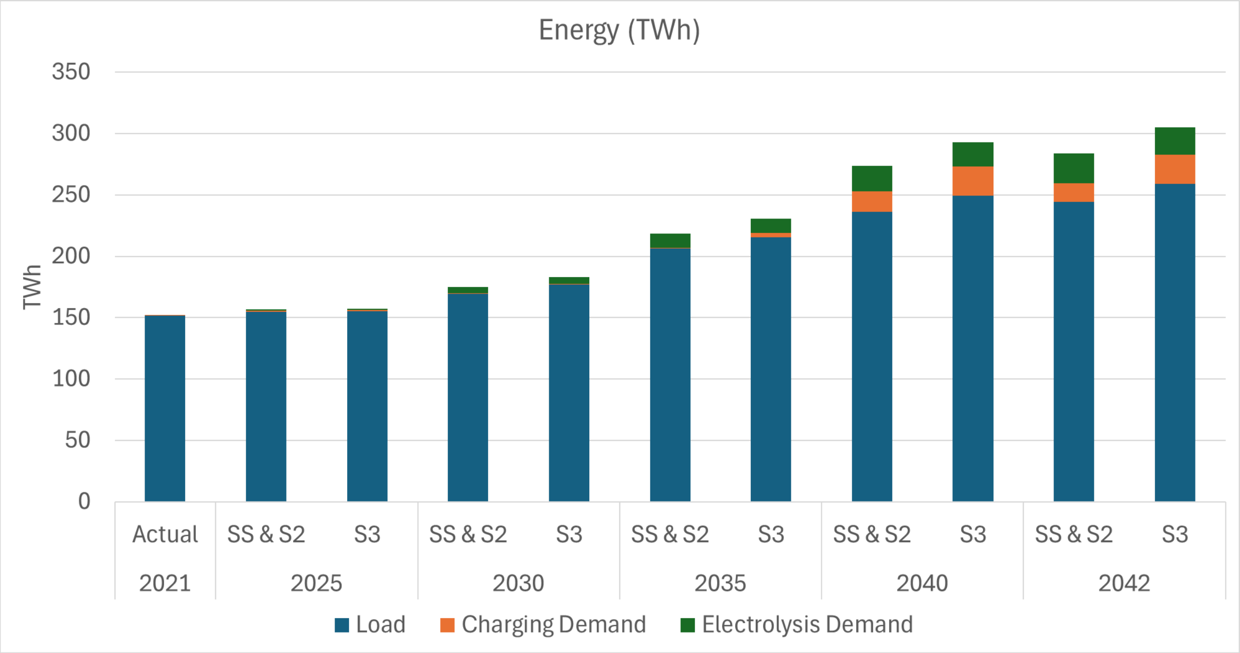
Energy Demand Comparison



- Compared to what occurred operationally in 2021, the input forecasts utilized by this study include a doubling of the energy demand by 2042
- Scenario 3 has the largest energy demand with about 22 TWh more demand (approximately 15 TWh more load and 7 TWh of charging and electrolysis) than the other CGPP scenarios in 2042

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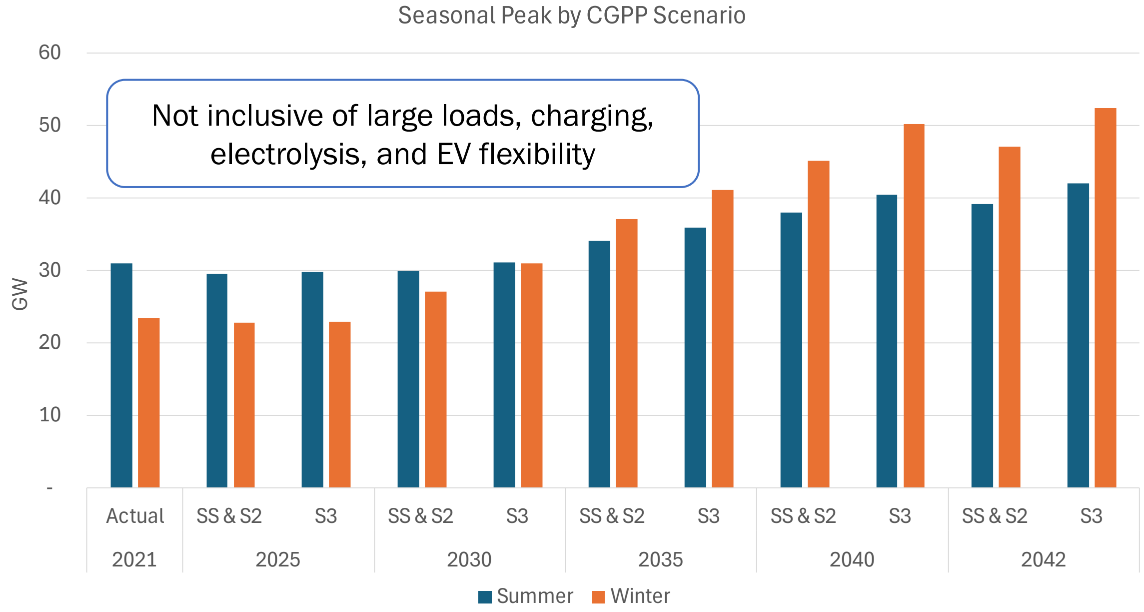
Peak Load Comparison



- Compared to what occurred operationally in 2021, the input forecasts utilized by this study include about a 30% increase in the summer peak load and a 50-70% increase in the winter peak load (depending on the scenario)
- By the mid-2030s, the system becomes winter peaking
- By 2042, Scenario 3 has the largest peak demand with about 3 GW in summer and 5 GW more in winter than the other CGPP scenarios

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Representative Days Overview

- **Similar to what the NYISO did for the 2023-2042 Outlook, each model year in the capacity expansion model in the CGPP is comprised of 13 representative days to represent a year's variety of conditions**
  - Each representative day is broken into six four-hour intervals
  - 78 unique time periods per year
  - Each day is weighted and the culmination of all days results in a quasi 8,760-hour representation
- **The 13 representative days per year are designed to include representations for:**
  - Summer peak and winter peak
  - Near summer peak and near winter peak
  - Four representations of a below average (low) energy day with combinations of wind and solar (from low solar, low wind to high solar, high wind)
  - Four representations of above average (high) energy day with combinations of wind and solar (from low solar, low wind to high solar, high wind)
  - A day representing a moderate amount of energy demand, wind, and solar
- **Interpreting the representative days figures (next slides):**
  - Solid black line indicates NYCA-wide load
  - Dashed black line indicates NYCA-wide load plus the inclusion of battery charging and electrolysis

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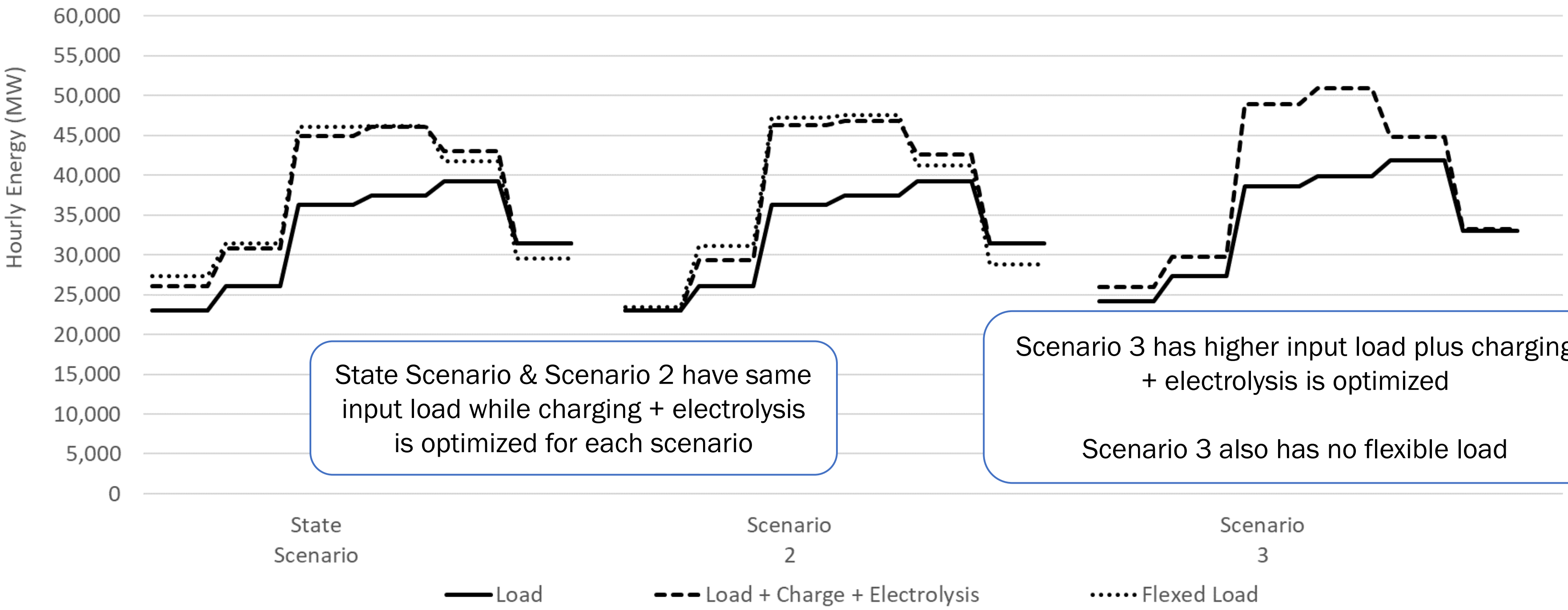
Summer Peak Load Comparison (2042)



State Scenario & Scenario 2 have same input load while charging + electrolysis is optimized for each scenario

Scenario 3 has higher input load plus charging + electrolysis is optimized

Scenario 3 also has no flexible load

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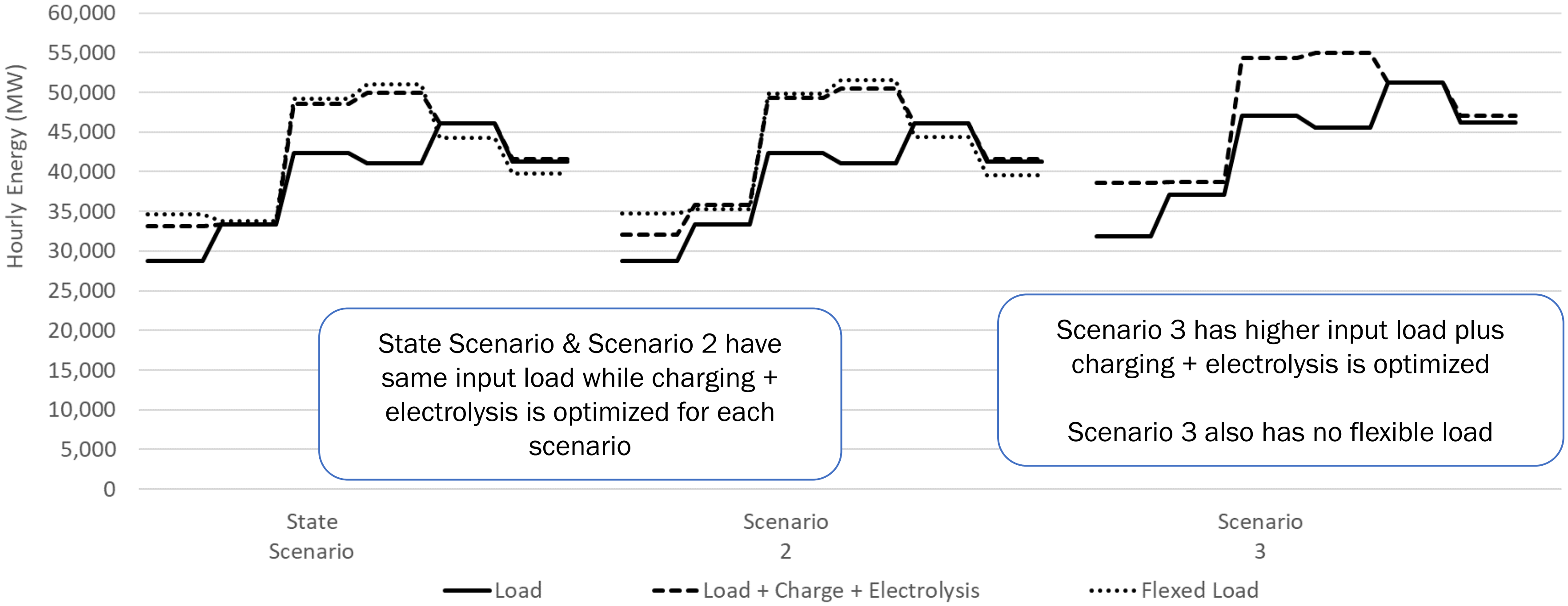
Winter Peak Load Comparison (2042)

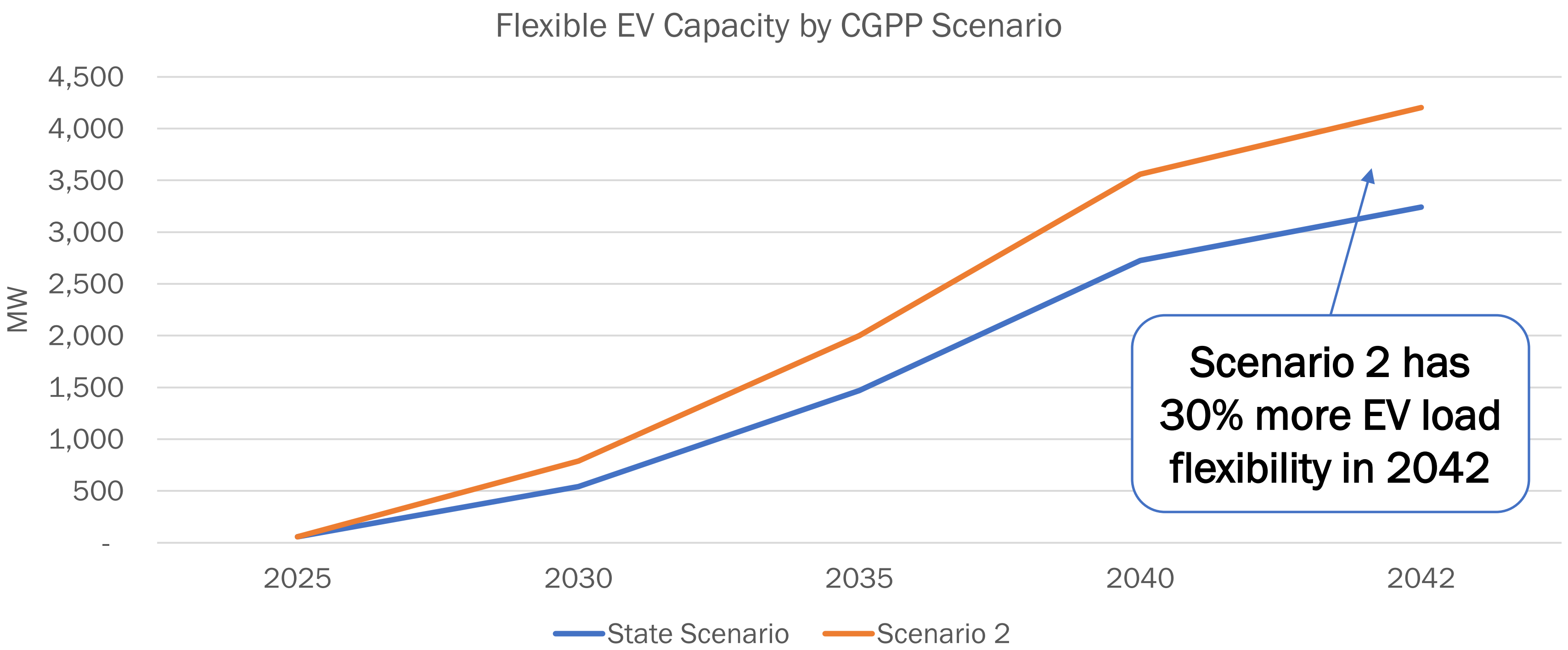


State Scenario & Scenario 2 have same input load while charging + electrolysis is optimized for each scenario

Scenario 3 has higher input load plus charging + electrolysis is optimized

Scenario 3 also has no flexible load

Flexible EV Capacity Comparison



There is no EV load flexibility in Scenario 3

Generation

- **The types of candidate renewable and battery generators include:**
  - Land-based wind (LBW), off-shore wind (OSW), utility scale solar (UPV), and battery storage (both 4- and 8-hour)
- **Candidate renewable generator locations and availability across New York was determined by supply curve analysis undertaken by NYSERDA and their consultants**
  - Resource potential is comprised of GIS analysis to review siting and land availability, generation potential, and total MW potential per site, county, and/or zone by year
  - The capital costs of candidate LBW, OSW, and UPV are assumed by technology type per the NYSERDA supply curve analysis and are adjusted on a zonal basis
- **DEFR are included as a generator option for the model to build and use, as needed, in each scenario**
  - State Scenario and Scenario 2 model DEFRs as hydrogen combustion turbine and combined cycle technologies (allows for both new generators and retrofits)
  - Scenario 3 only includes hydrogen fuel cell technology
- **Age-based fossil retirements for existing units are assumed with the phase-in retirements for the fleet of generators past an age-based threshold of 60-years still in operation**

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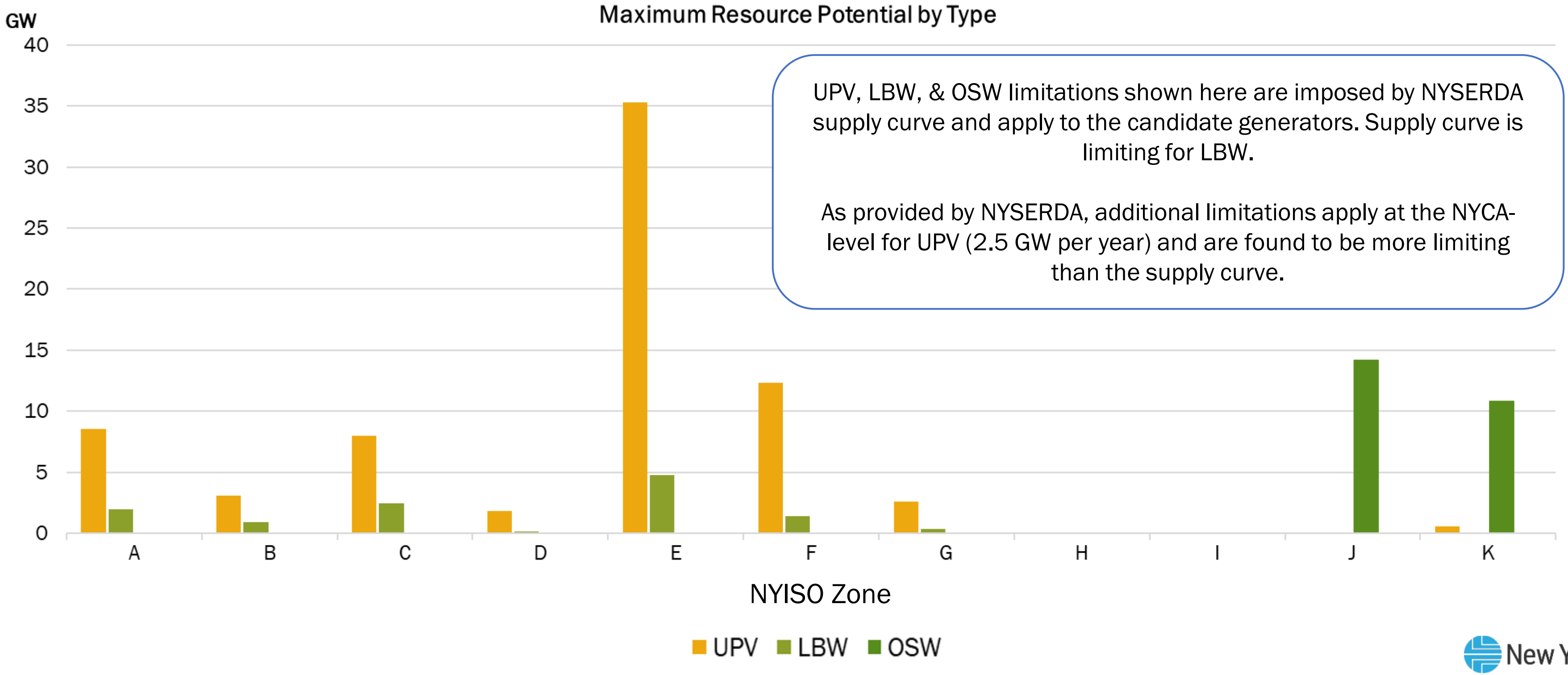
Assumed Capacity Limitations for Candidate Generators



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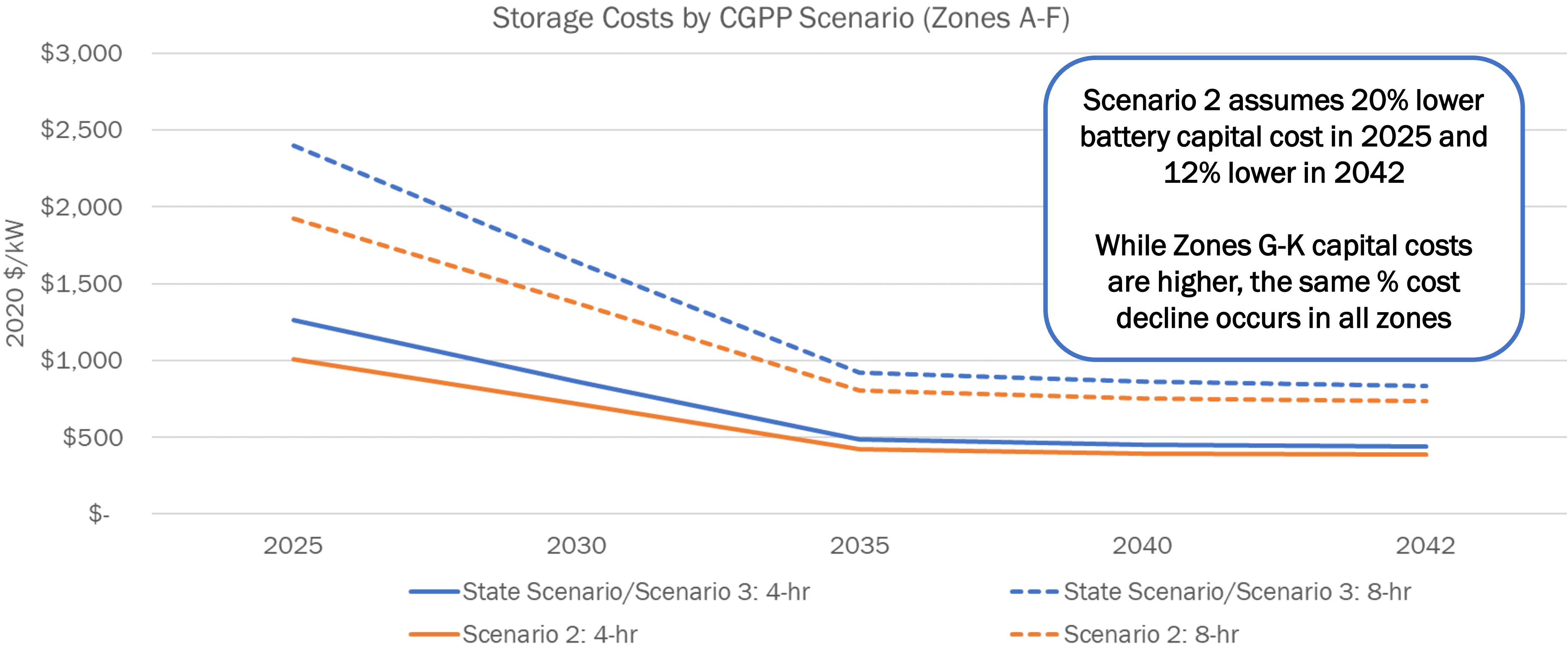
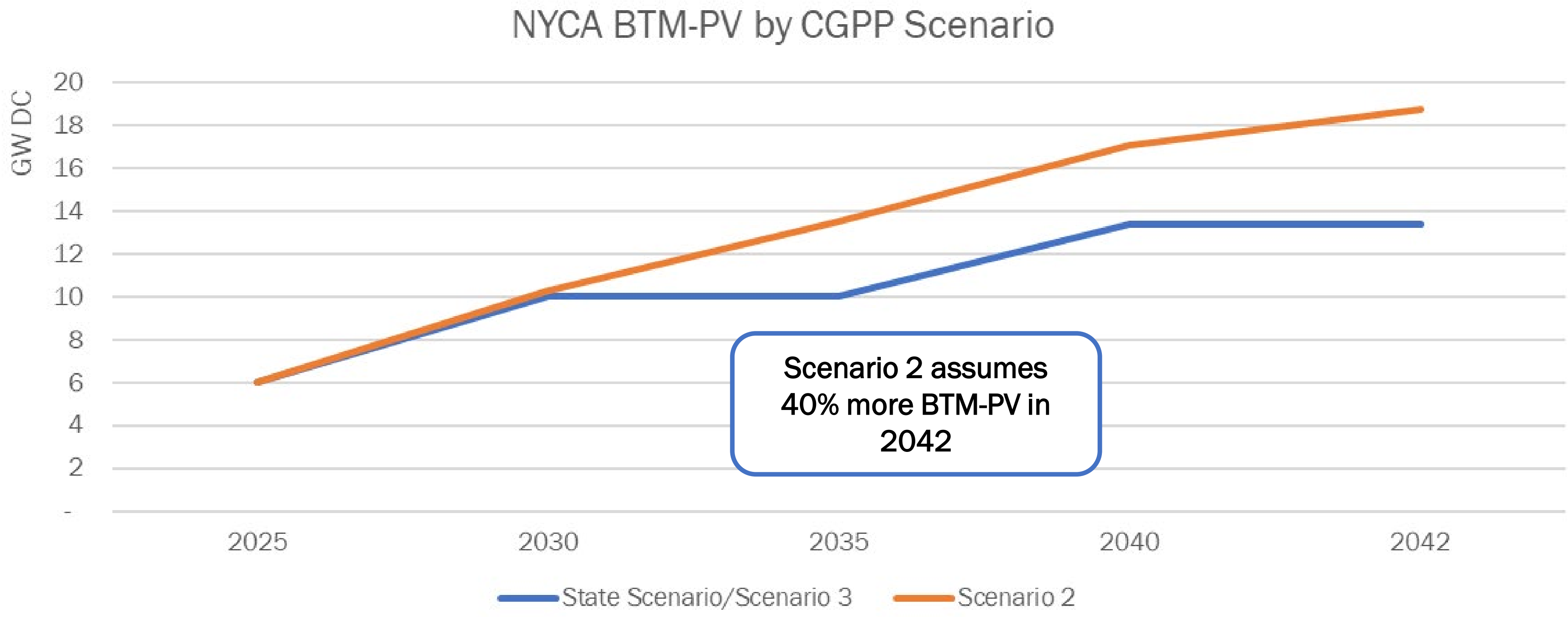
Storage Cost Comparison



Scenario 2 assumes 20% lower battery capital cost in 2025 and 12% lower in 2042

While Zones G-K capital costs are higher, the same % cost decline occurs in all zones

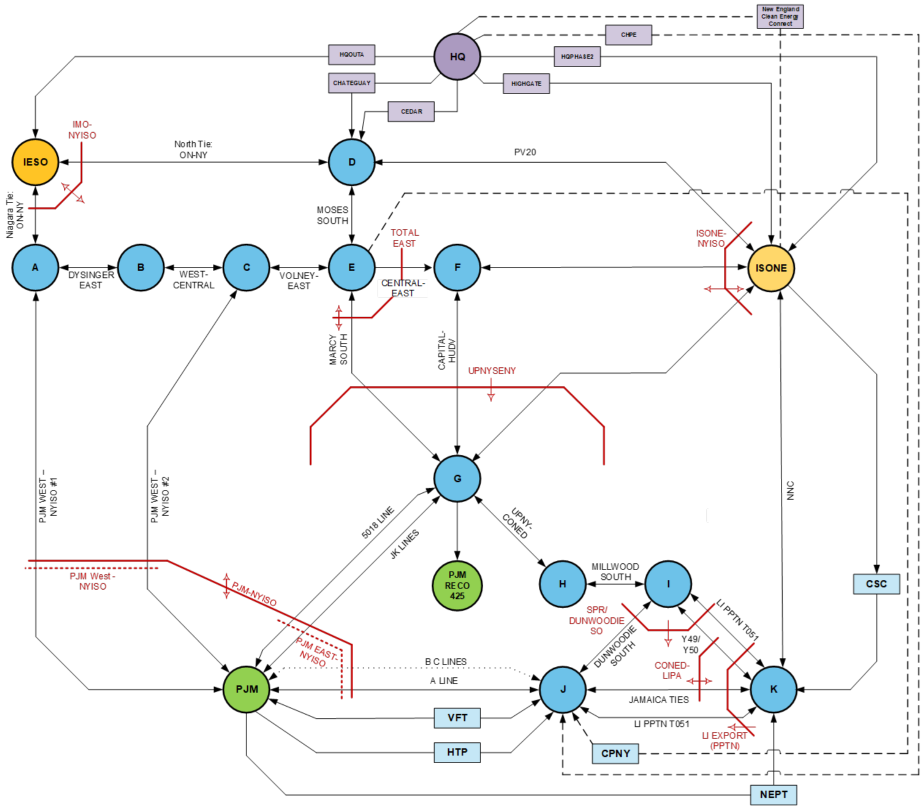
BTM-PV Comparison by Scenario



Scenario 2 assumes 40% more BTM-PV in 2042

Transmission Topology & Constraints

- Capacity expansion is a pipe-and-bubble transportation-type model with the bubbles representing demand and generation within a given zone and the pipes representing inter-zonal bulk transmission paths
- For the CGPP, the model includes intra-zonal transmission constraints characterized by "headroom"
- Headroom is a quasi-representation of local transmission capability
    - Headroom values are provided by the Joint Utilities
- All CGPP scenarios include the CGPP assumption for a 15% compounding cost for every additional 1 GW of headroom required within a zone



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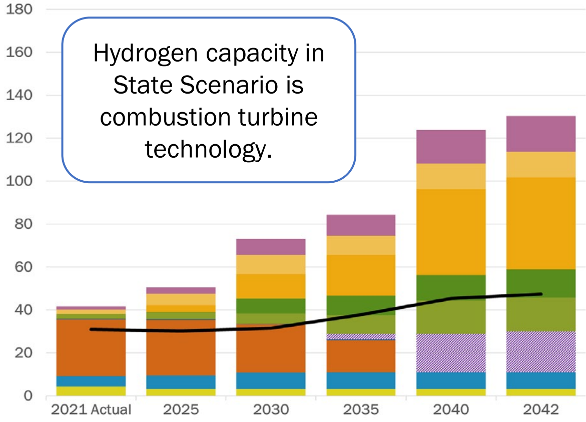
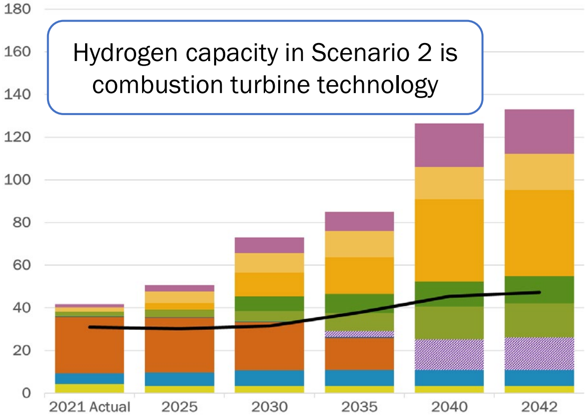
CGPP Scenario Comparison

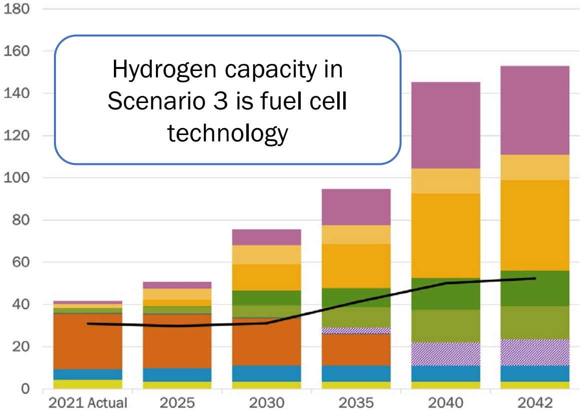
State Scenario Policy Case: Installed Capacity



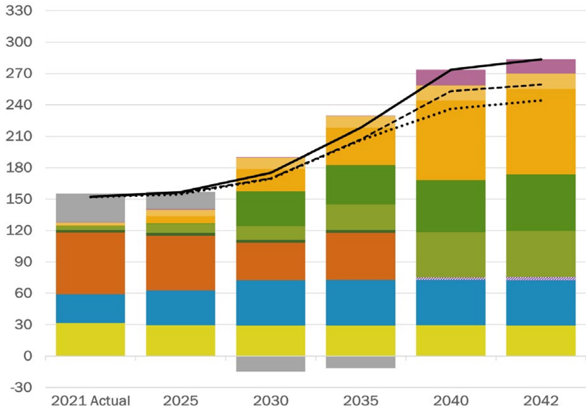
CGPP Scenario 2: Installed Capacity



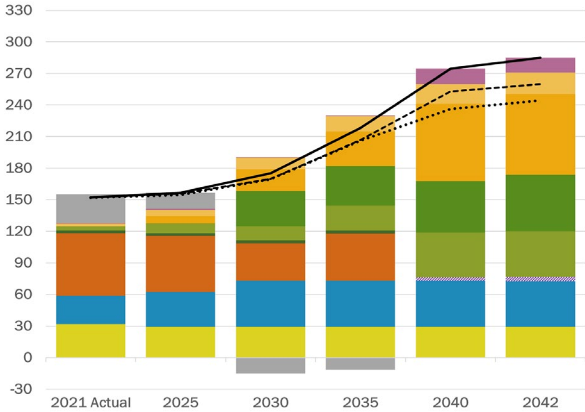
CGPP Scenario 3: Installed Capacity



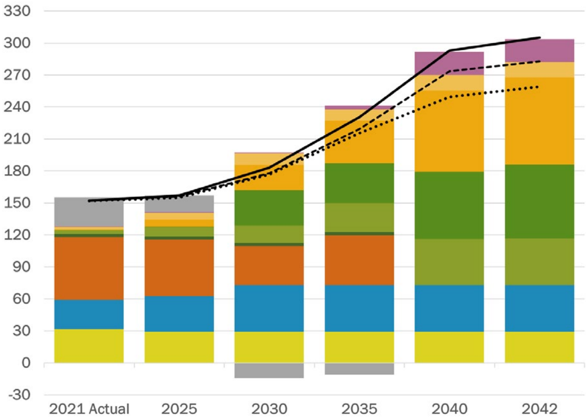
State Scenario Policy Case: Annual Generation



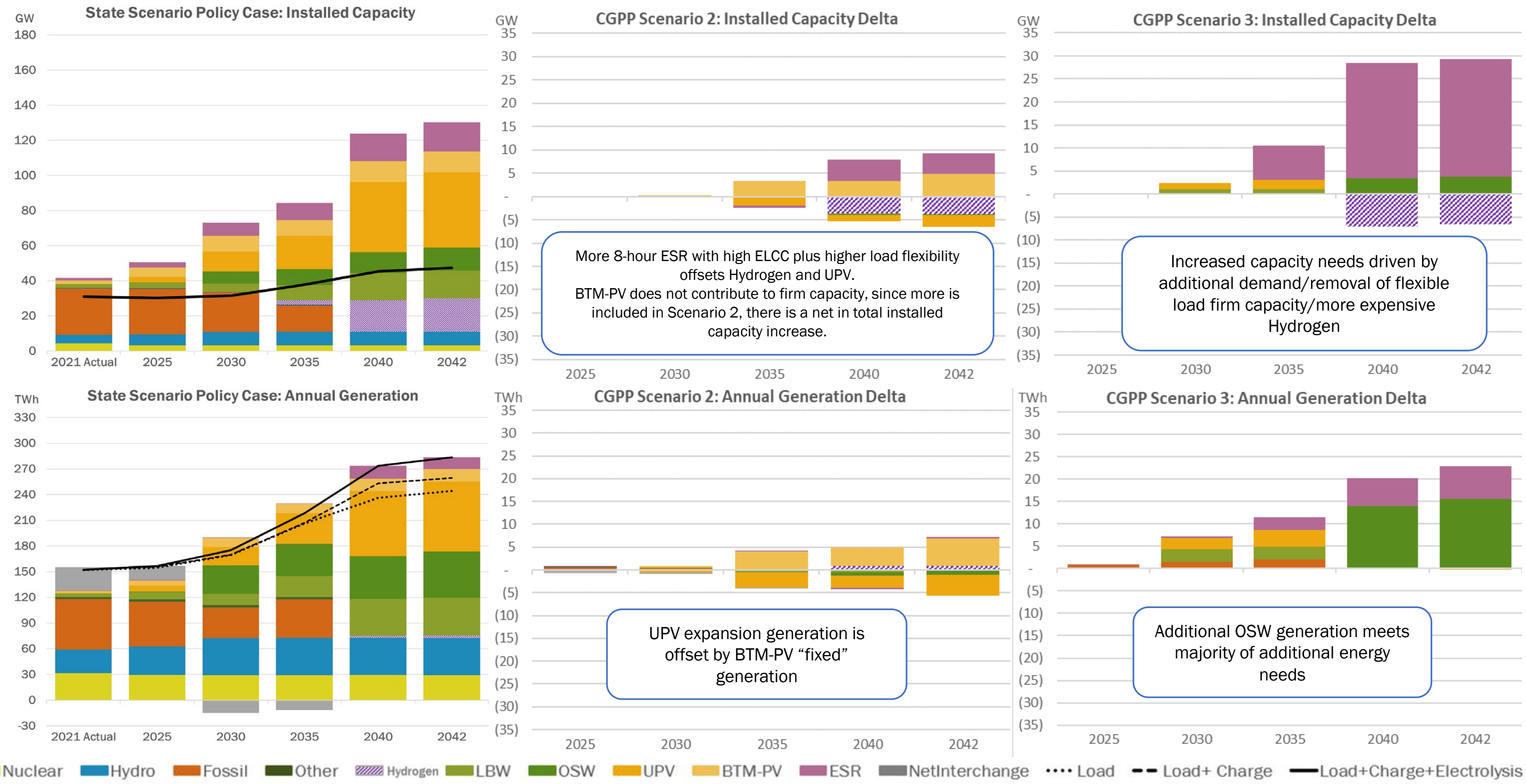
CGPP Scenario 2: Annual Generation



CGPP Scenario 3: Annual Generation



Nuclear Hydro Fossil Other Hydrogen LBW OSW UPV BTM-PV ESR NetInterchange Load Load+ Charge Load+Charge+Electrolysis



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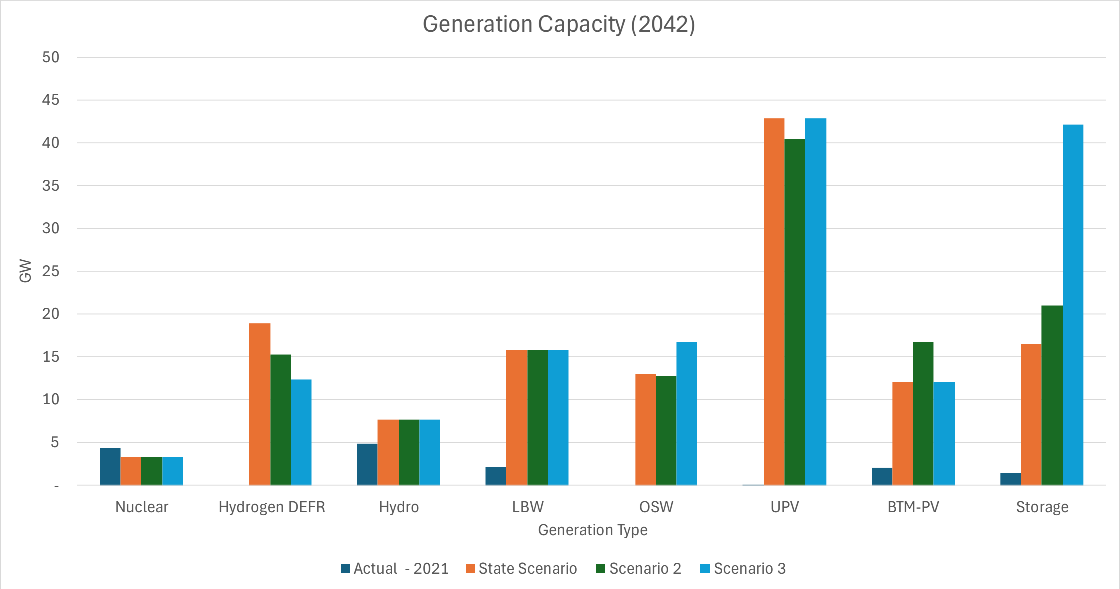
Key Findings: Statewide

Key Findings: Statewide Capacity



- All three CGPP scenarios show that the amount of capacity needed to meet the growth in peak demand, while achieving policy objectives, is approximately 3 times what is on the system today with substantial growth in the capacity of zero-emissions resources

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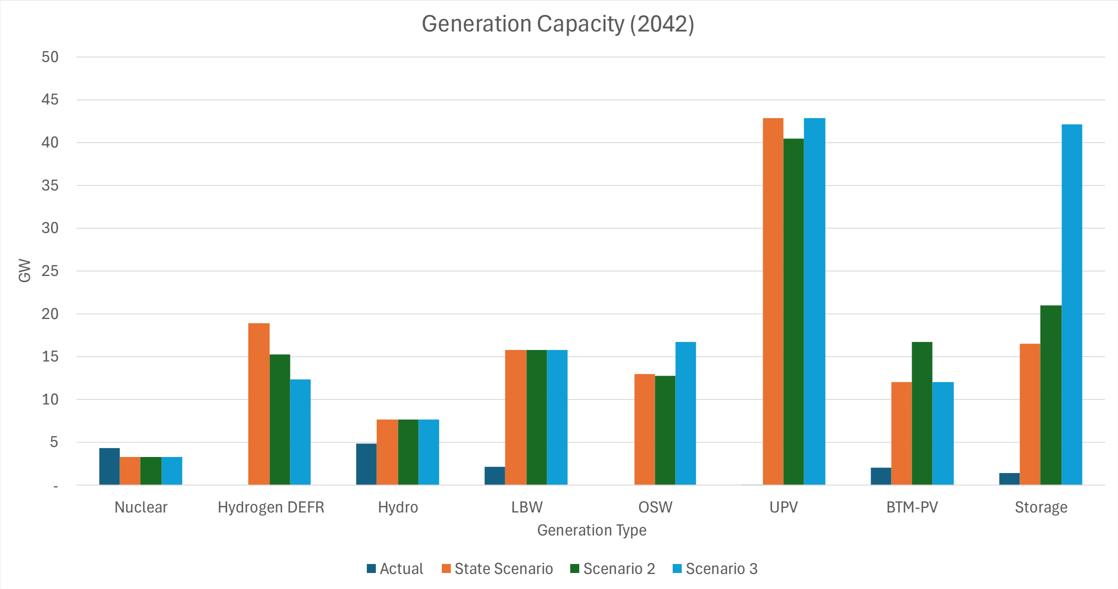
Key Findings: Statewide Capacity

- All CGPP scenarios assume no changes to the available nuclear capacity beyond the retirement of Indian Point
- Hydrogen DEFR capacity ranges between 12 GW (hydrogen fuel cell in scenario 3) to around 15-20 GW with hydrogen combustion (State Scenario and Scenario 2)
- Hydro capacity increases to a little more than 7 GW with the addition of the CHPE project



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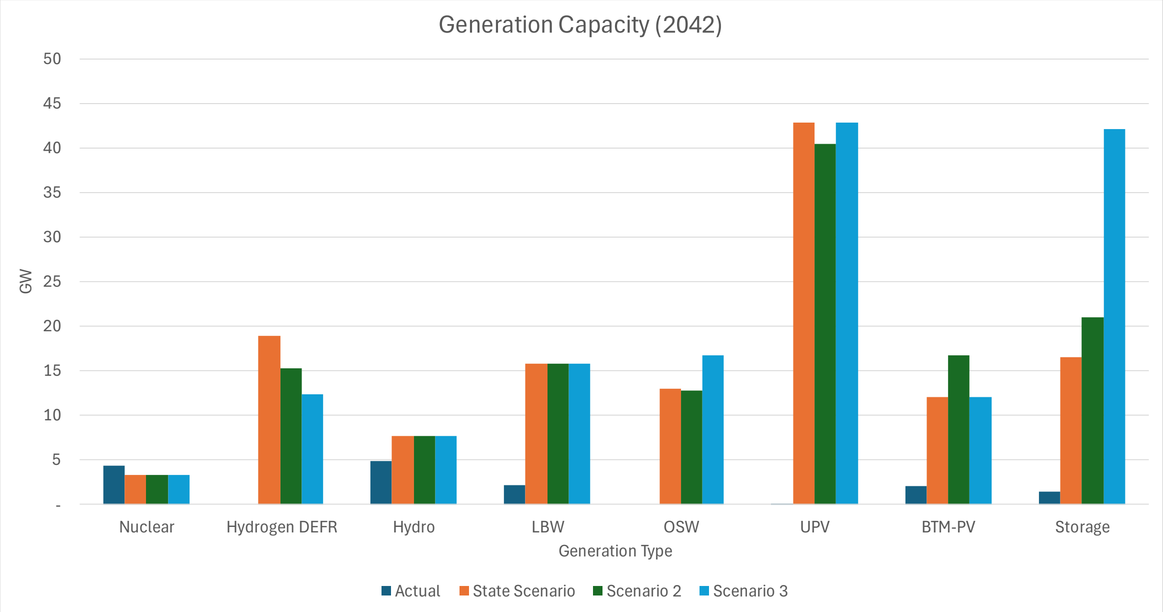
Key Findings: Statewide Capacity

- **In all CGPP scenarios, both UPV and LBW are close to or have reached their maximum available capacity by 2040 based on supply curve or other build constraints**
  - LBW capacity by 2040 is a little less than 16 GW in all three CGPP scenarios
  - Total solar capacity (including both utility scale and behind-the-meter) by 2040 is around 50-60 GW
- **OSW across all three CGPP scenarios shows similar capacity through 2035**
  - By 2042, the OSW ranges from about 13 GW in the state scenario and scenario 2 and about 17 GW in scenario 3
- **Battery storage varies across all three CGPP scenarios and is primarily driven by changes in capital costs, as well as increased demand, with as little as about 16 GW in the State Scenario and just over 42 GW in Scenario 3**



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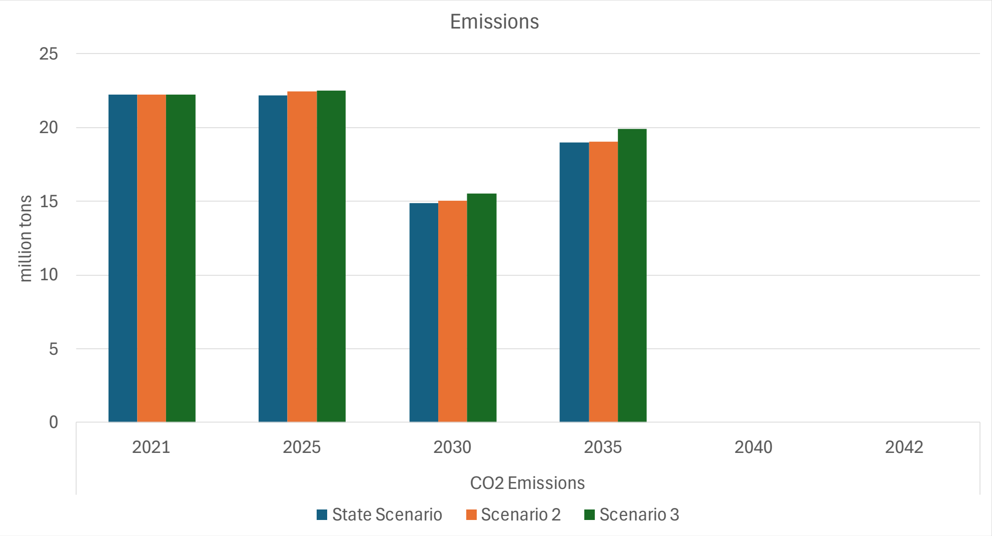
Key Findings: Emissions

- With the assumption for age-based generator deactivation provided by NYSERDA, the system continues to rely on approximately 15 GW of fossil capacity through 2035
- The CO_2 emissions trend downward through 2030 with about 7 million tons less emissions than produced in 2021
- The CO_2 emissions increase between 2030 and 2035 by about 4 million tons due to increased energy demands placed on the remaining fossil fleet



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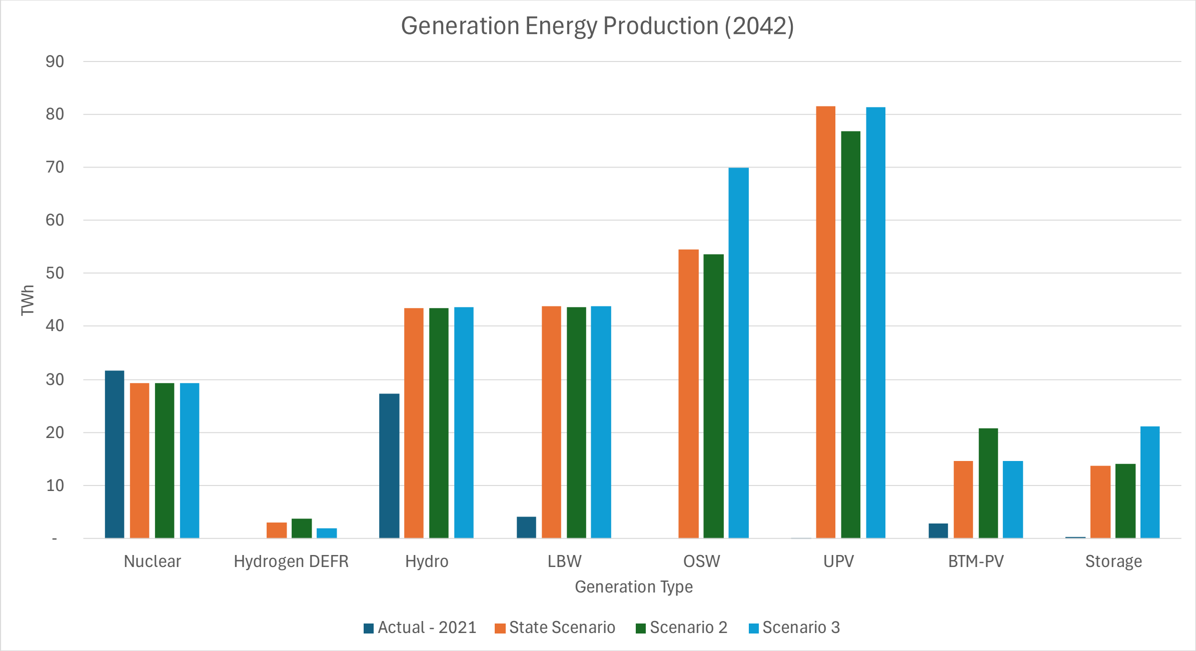
Key Findings: Statewide Energy



- **All three CGPP scenarios show that the amount of energy needed to meet the growth in energy demand, while achieving policy objectives, is more than twice the energy capability of the system today with substantial growth for all zero-emissions resources**

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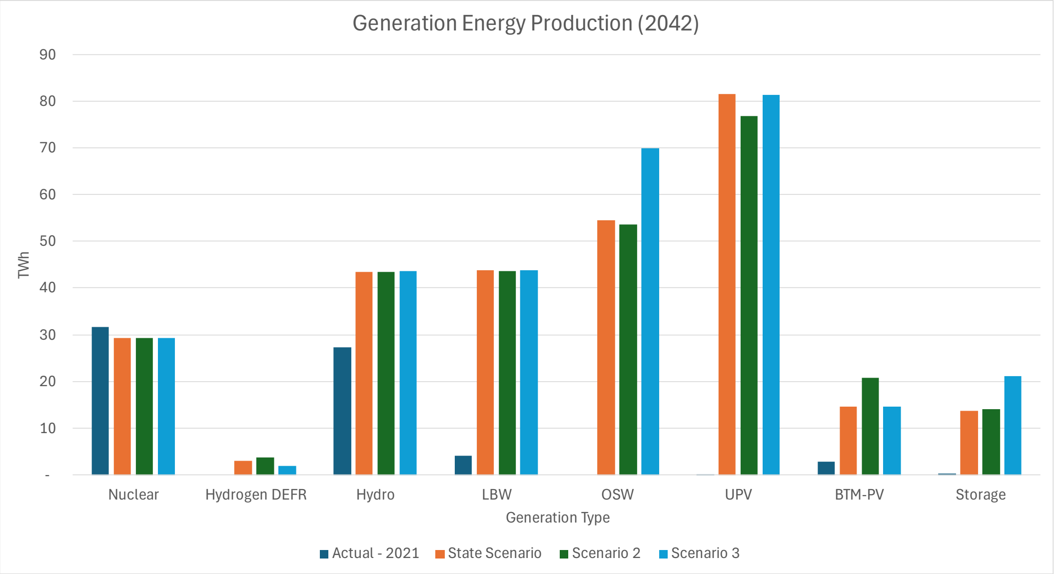
Key Findings: Statewide Energy

- **All CGPP scenarios assume no changes to energy available from nuclear generation beyond the reduction observed with the retirement of Indian Point**
- **LBW grows about four times in energy production compared to what is on the system today**
  - Most of the growth in LBW occurs between 2035-2040
  - By 2040, the energy output from LBW reaches near its maximum potential (based on NYSERDA model inputs), which by 2042 is around 43 TWh
- **OSW across all three CGPP scenarios shows similar energy production through 2035 (around 38 TWh)**
  - By 2042, the OSW ranges from about 55 TWh in the State Scenario and Scenario 2 and about 70 TWh in Scenario 3



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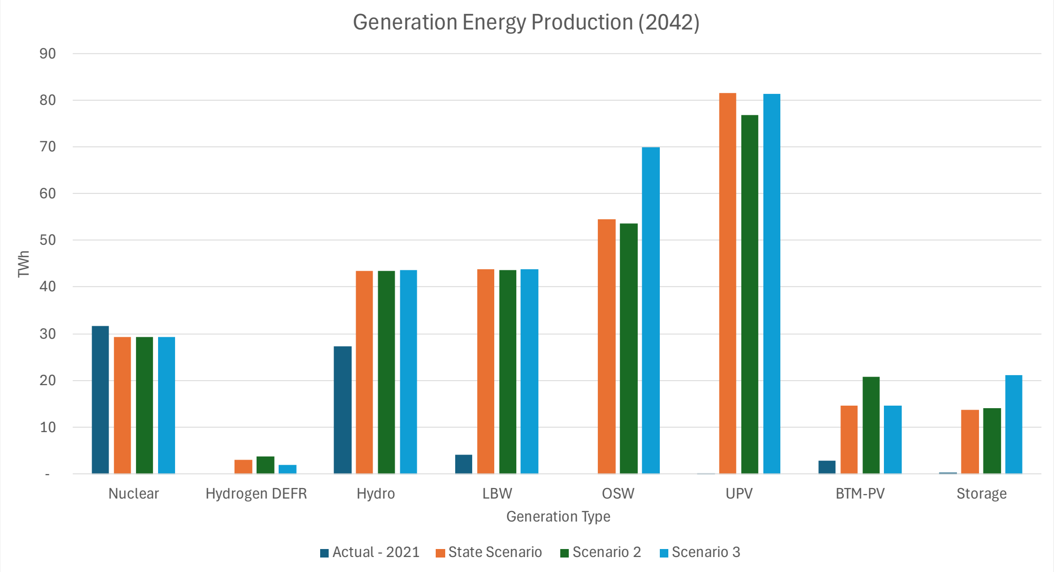
Key Findings: Statewide Energy

- **The energy output from hydro resources increases after the addition of the CHPE project to a little more than 40 TWh**
- **UPV and BtM-PV grow many times over in energy production compared to what is on the system today**
  - Most of the growth of solar occurs between 2035-2040
  - By 2040, the energy output from solar reaches near its maximum potential (based on NYSERDA model inputs), which by 2042 is near 100 TWh
- **Battery storage across all three CGPP scenarios has little energy production until 2040**
  - By 2042, the energy production from storage is around 15 TWh for the State Scenario and Scenario 2 but reaches a little over 20 TWh in Scenario 3



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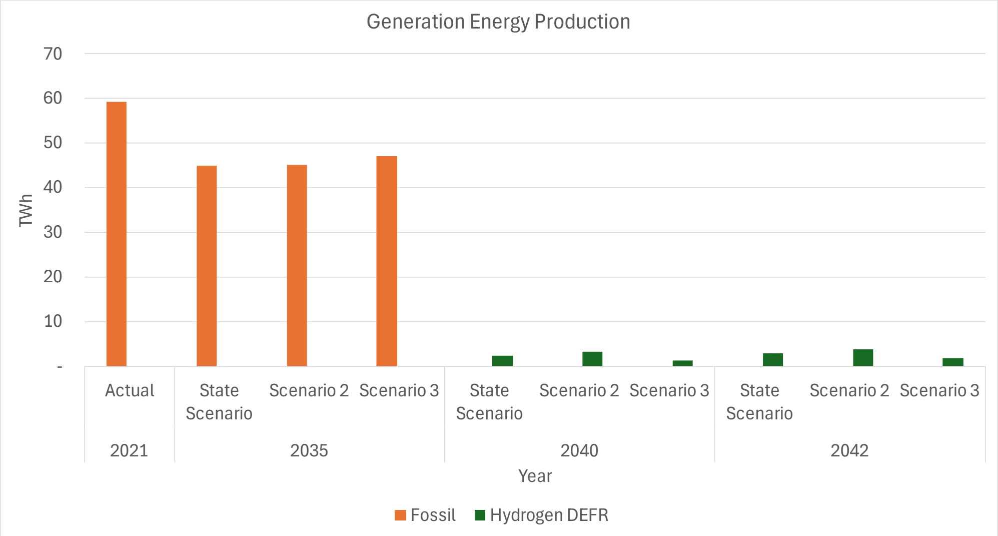
Key Findings: Statewide Energy

- Through 2035, fossil generation produces the most amount of energy compared to other generation resources at about 45 TWh
  - In 2035, there is no energy contribution of DEFR resources
- By 2040, hydrogen DEFR produce relatively small energy compared to other generation resources
  - This demonstrates that these resources are primarily being built/retrofit to meet capacity needs for installed reserve margin/locational capacity requirements
- The State Scenario results in the most DEFR capacity by 2042 with about 7 GW more compared to Scenario 3; however, Scenario 2 produces the most energy (about twice that of Scenario 3)



Key Findings: Zonal

Key Findings: Zonal Capacity

- **UPV**
  - Over 90% of the UPV is built upstate (Zones A-F), as determined by the capacity expansion model
  - Each scenario results in a similar amount of UPV built in each zone
    - About a third of the total UPV is built in Zone E
- **LBW**
  - All of the LBW is built in Zones A-F, with approximately a third of the total LBW built in Zone E
  - Each scenario results in a similar amount of LBW built in each zone
- **OSW**
  - In the State Scenario and Scenario 2, about 60% of the OSW is built in Zone J with 40% in Zone K; Scenario 3 splits the OSW about even between Zones J and K

Key Findings: Zonal Capacity & Headroom

- **Battery Storage**
  - All CGPP scenarios have a near-even split between the total storage built upstate and downstate
    - About 70% of the storage statewide are 4-hour batteries with the remaining 30% being 8-hour batteries
    - Most of the 4-hour batteries are built downstate
    - The state scenario built no 8-hour batteries downstate while the other scenarios have a relatively even split between upstate and downstate
  - In all scenarios, about 40-50% of the storage is primarily built in Zone J primarily to help satisfy locational capacity requirements
- **Hydrogen DEFR**
  - In all CGPP scenarios, the majority (if not all) of DEFR generation is built downstate
    - 70-90% is downstate in the State Scenario and Scenario 2; Scenario 3 has 100% of the hydrogen DEFR generation built downstate
  - For the combustion-based DEFR capacity in the State Scenario and Scenario 2, about 80% of the DEFRs built are retrofits while 20% are new hydrogen combined combustion
  - In all CGPP scenarios, roughly a third to half of the DEFR capacity is built in Zone J
- **Headroom**
  - Local transmission limitations, as observed through the headroom implementation in the CGPP, significantly impact the spread of renewable resources through the upstate zones
  - Statewide, the incremental headroom buildout doubles what is existing today

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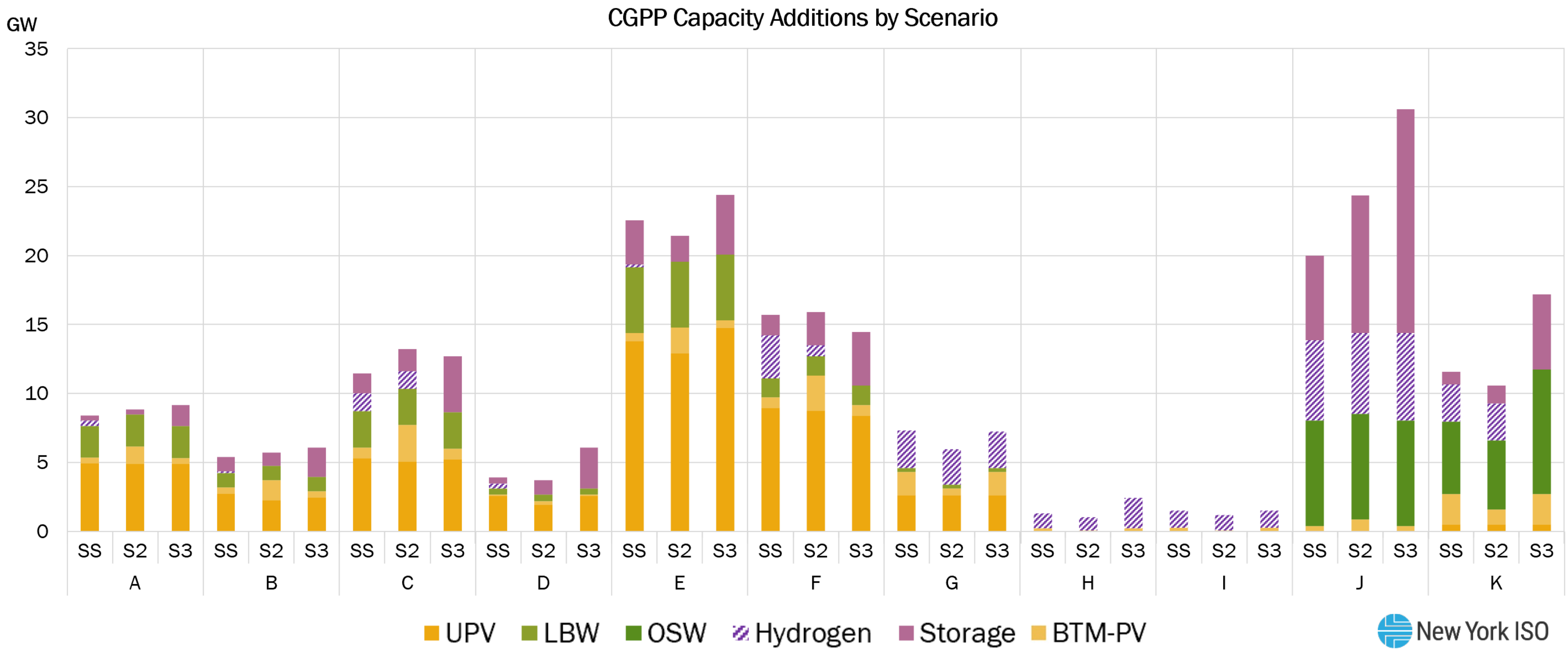
Zonal Comparison – 2042



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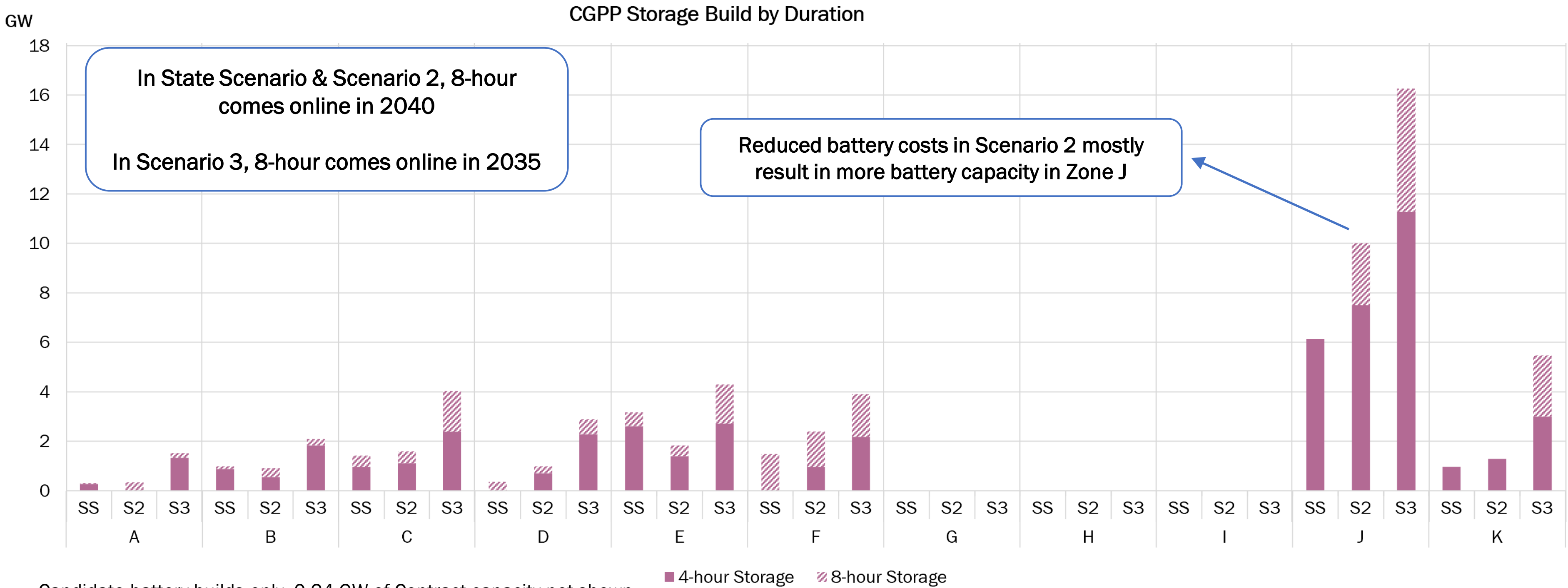
Storage by Type - 4-hour vs. 8-hour (2042)



Candidate battery builds only, 0.24 GW of Contract capacity not shown here

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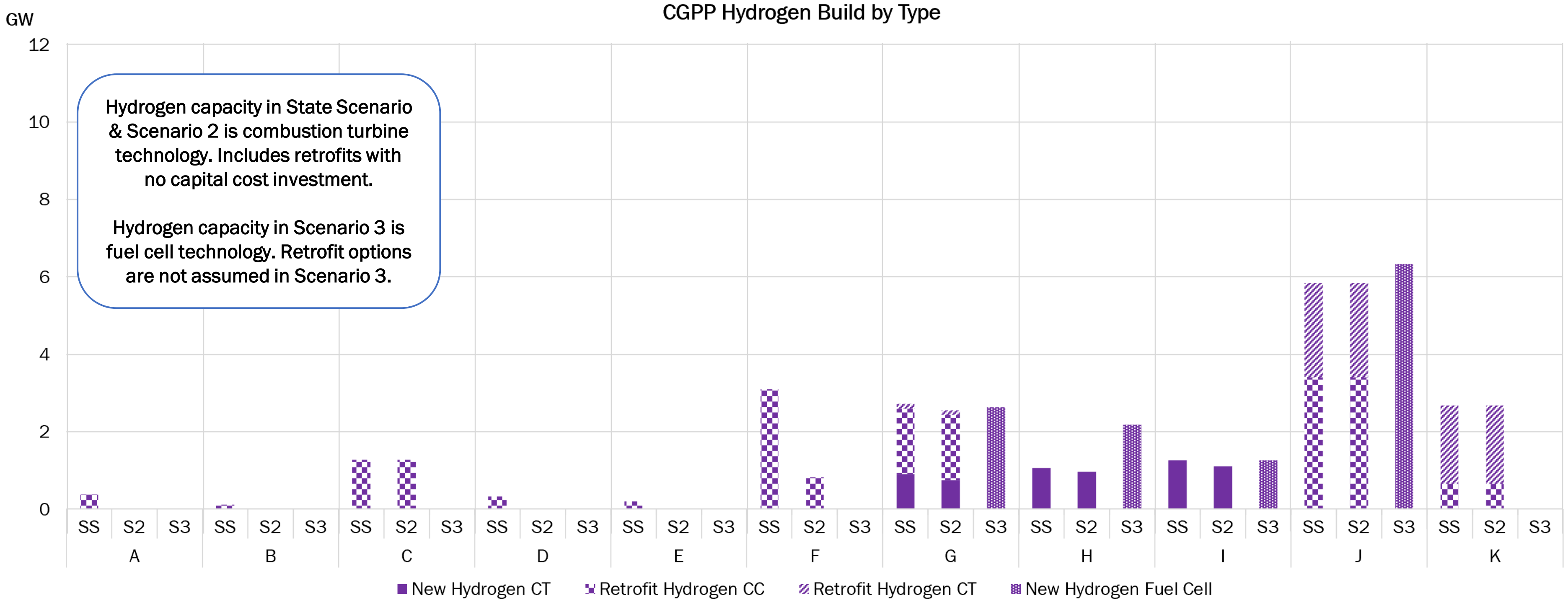
Zonal Hydrogen Build by Type (2042)



Candidate builds only, no Contract builds in model

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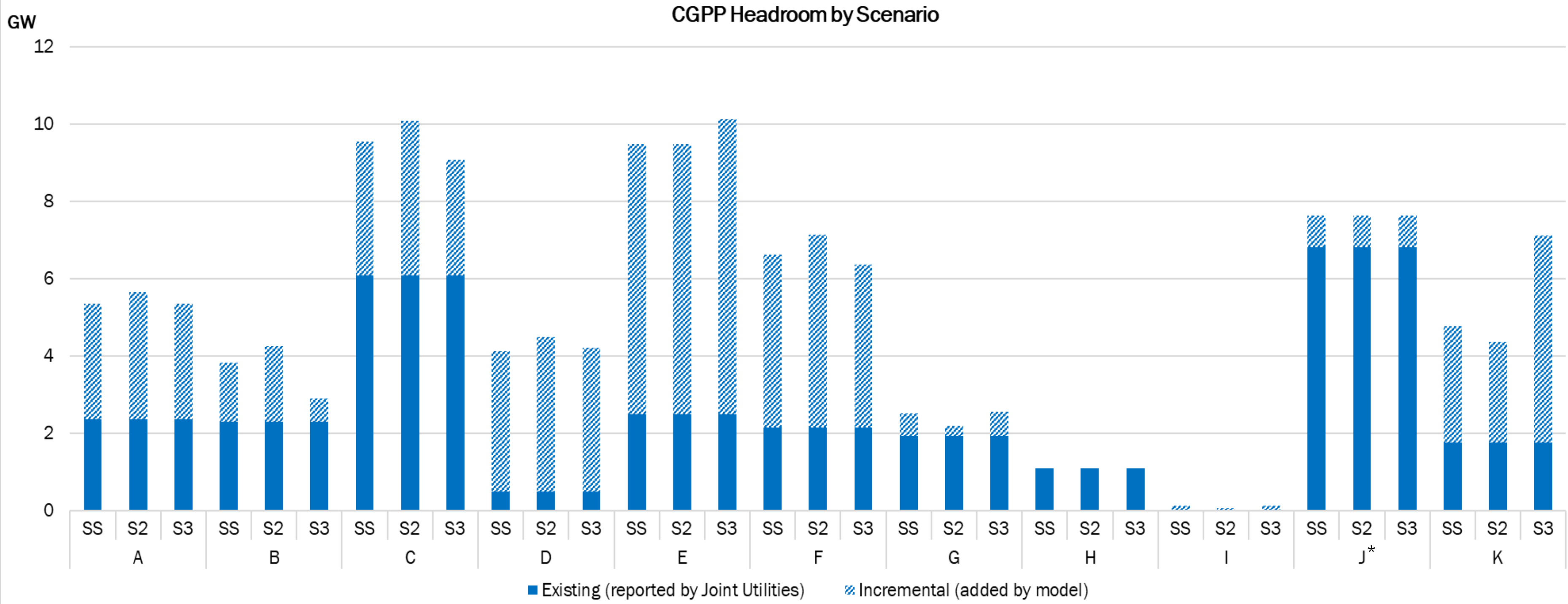
Headroom Existing vs. Incremental



*Headroom within zone J represents incremental installed OSW capacity

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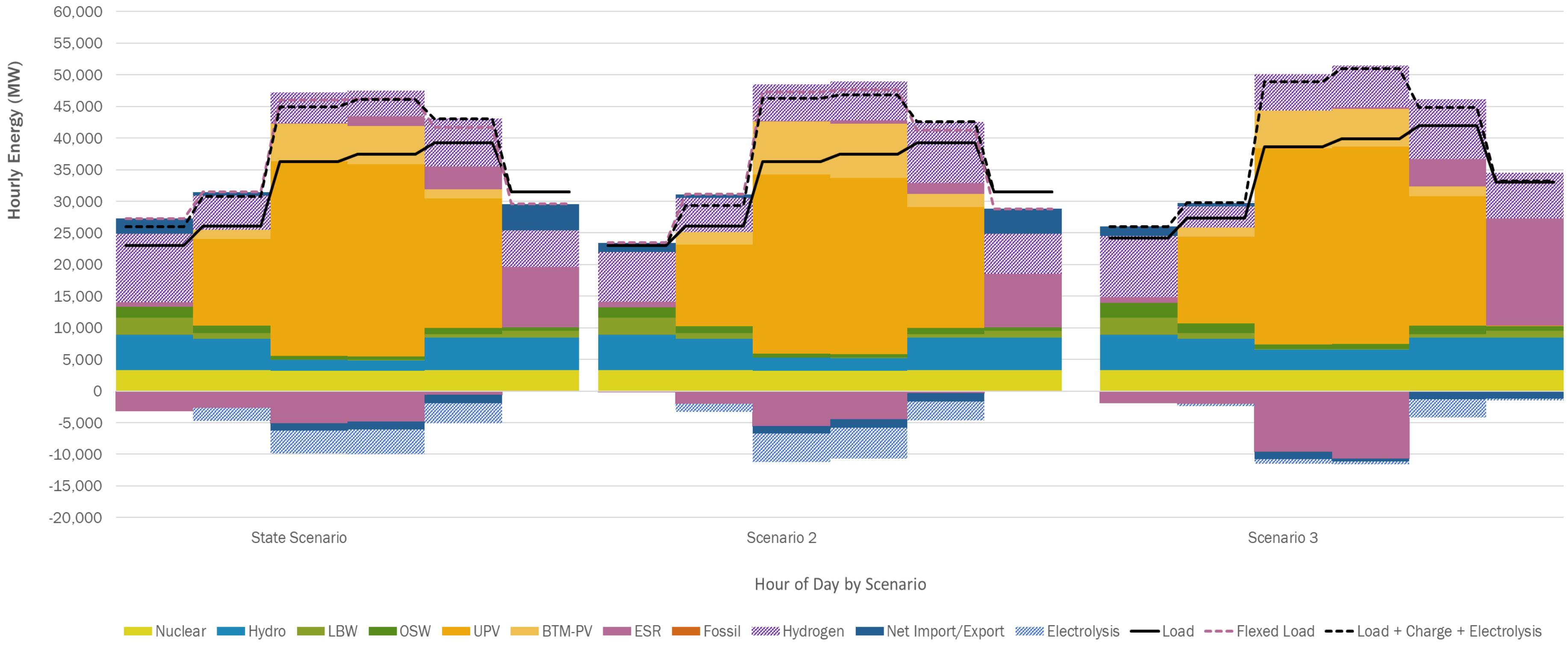
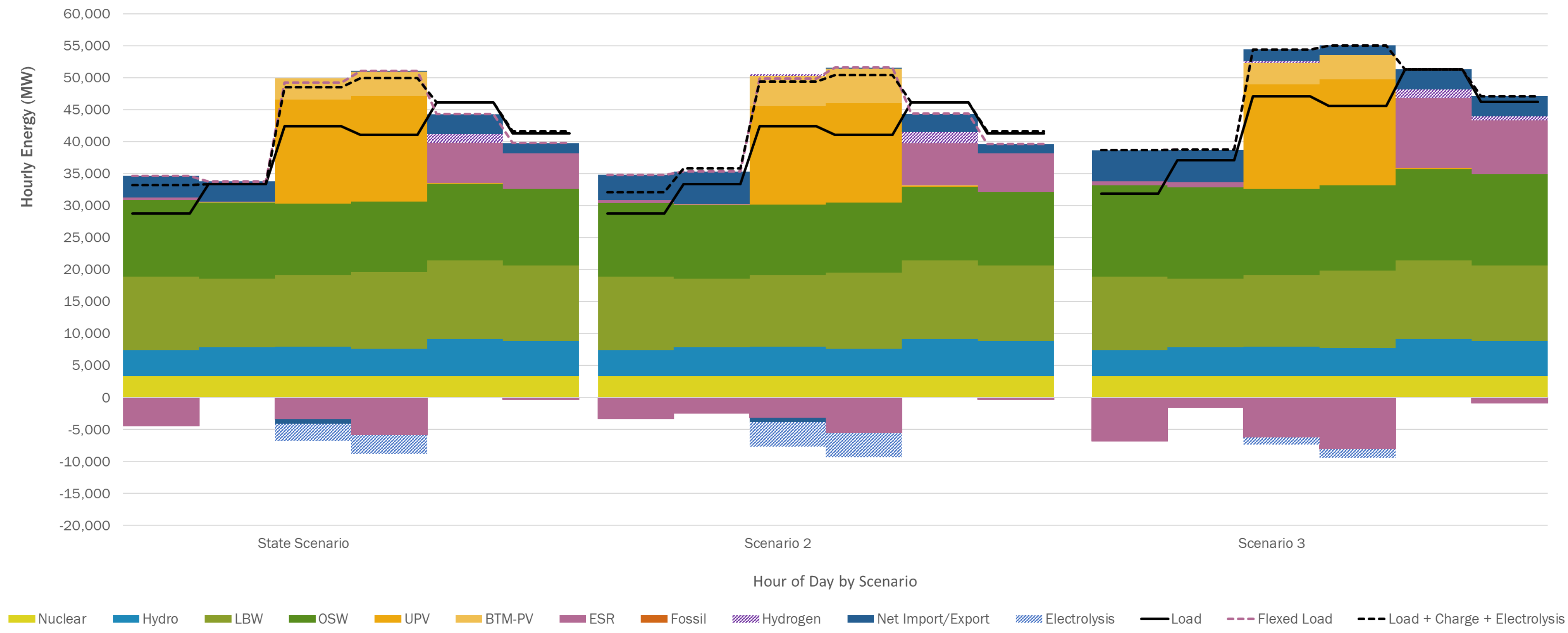
Summer Peak Generation Comparison (2042)



Winter Peak Generation Comparison (2042)



Questions?

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Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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