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Fuel and Energy Security Study Preliminary Results

NYISO ICAPWG/MIWG/PRLWG

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Analysis Group

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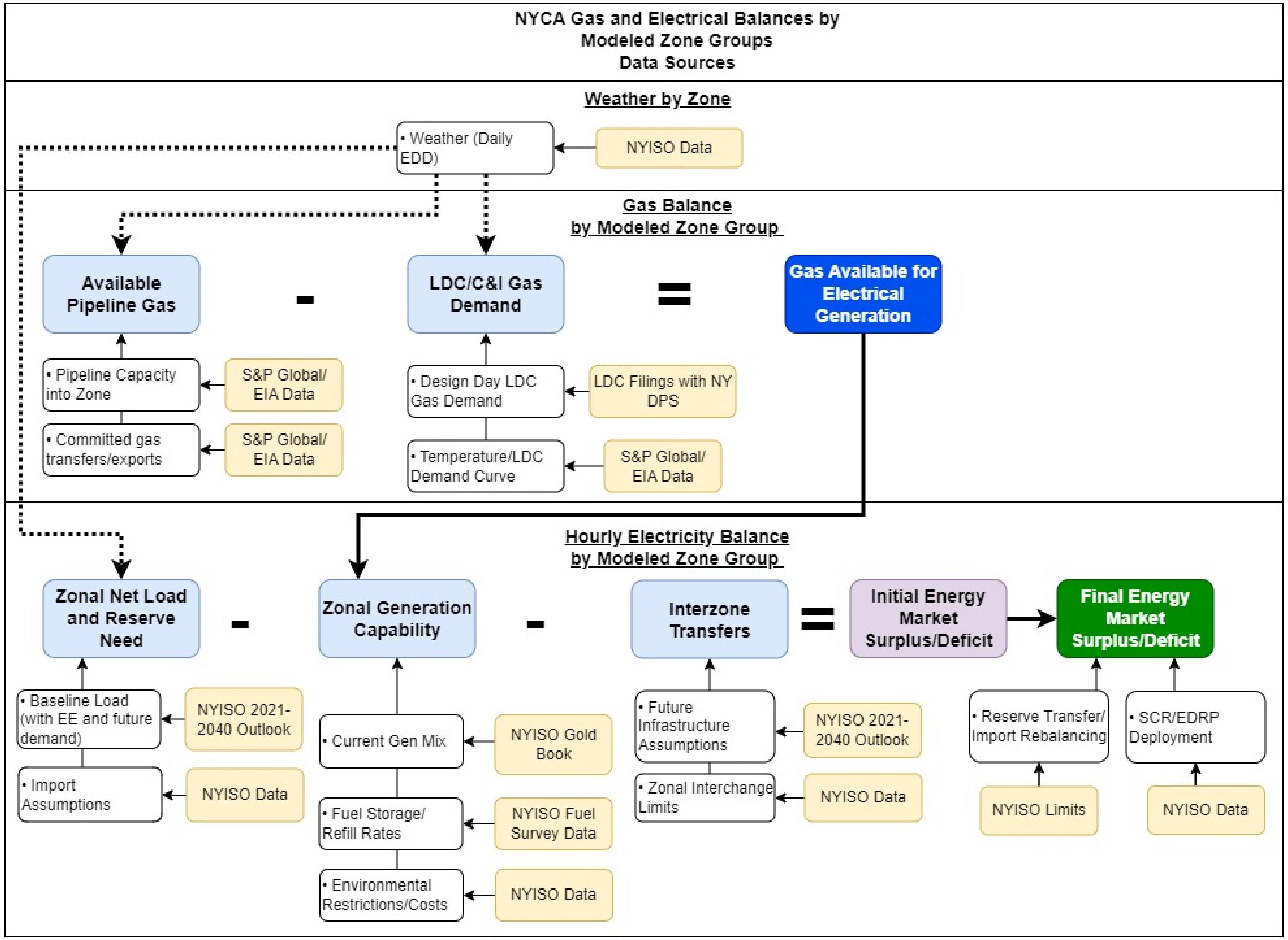
Context and Assignment

- Purpose of the study: assess winter fuel/energy security for NYISO over 17-day cold weather period under various combinations of system scenarios and disruptions
  - Studying winters 2023/2024, 2026/2027, and 2030/2031
    - Winter 2023/2024 was also the study period used for the 2019 study
  - Analyzing and identifying circumstances under which resources may be insufficient to meet load plus reserves absent emergency actions
- Analysis framing: not trying to predict the future; cases developed as an analytic tool to assess the implications of adverse weather conditions and the evolving landscape of electricity demand/supply for winter power system operations
- Discussions to-date:
  - Project purpose and goals
  - Modeling approach/methodology
  - Data inputs and assumptions
  - Proposed model "cases" (a case is a combination of a "scenario" [i.e., assumed system conditions] and a disruption(s) [i.e., event(s) impacting fuel/resource availability])
- Today:
  - Overview of cases
  - Initial results
  - Initial observations

Reminder - Model Setup Diagram: Gas and Electric Balance



- Focus on severe, extended (17 day) cold snap
- Gas and electric balance based on public data and NYISO input
- Deterministic, “stacking order” analysis, testing resources vs. demand under varying system conditions and disruptive events
- Focus on a broad range of conditions to assess potential impacts on reliability

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Key Output Metrics

- Two types of NYISO actions are modelled if otherwise applicable reserve requirements would be violated:
  - Reduction of energy-only exports to ISO-NE (up to 1,300 MW reduction)
  - Activation of Special Case Resources/Emergency Demand Response Program (SCR/EDRP)
    - Up to 4 hours per activation, and activations on no more than 5 days during the modelling period [by zone/region]

- Cases are analyzed based on number of:
  - Hours with required emergency actions [i.e., reduction of energy-only exports to ISO-NE and/or SCR/EDRP activations]
  - Hours with reserve violations after emergency actions
  - Hours with potential for loss of load

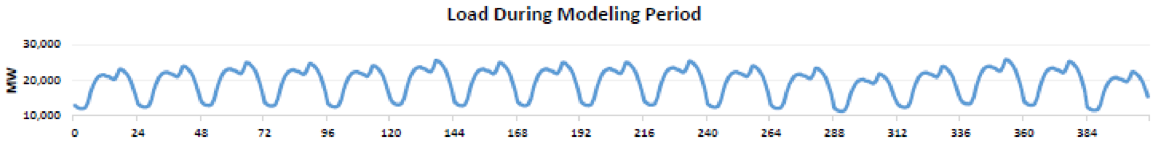
- And severity:
  - Magnitude of any identified reserve violations and/or potential loss of load
  - Duration and frequency of any identified reserve violations and/or potential loss of load

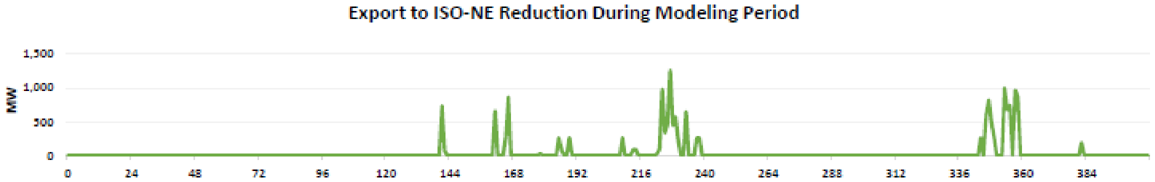
Sample Output Winter 2023/2024: Case with No Disruptions and ISO-NE Export Reductions

Hourly Results Summary

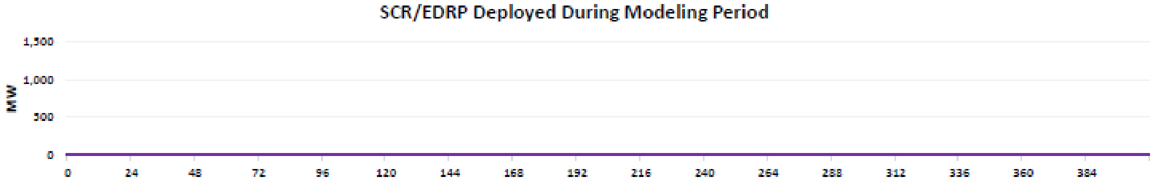
Case Name: Scenario 1 - PD 1 No Disruptions

Case Summary	
Derate (EFORd) Increase:	Off
Starting Storage:	Historical
Refill Contingency:	Off
Loss of Gas Fired Gen.	Off
Nuclear Contingency:	Off
Plant Outage:	None
Import Scenario:	All

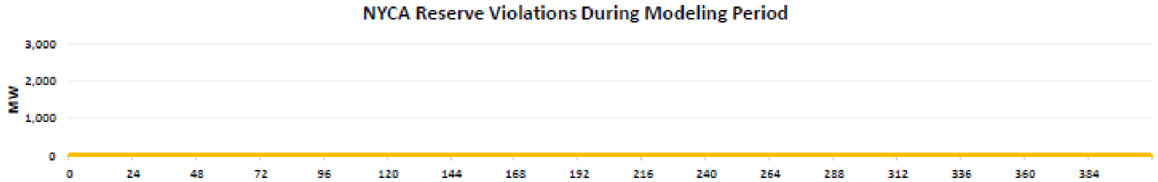




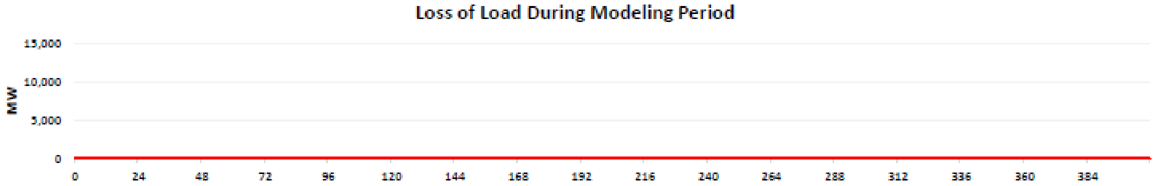
Export Reductions	
Total Hrs.	35
Total MWh	16,119
Avg. MW	39.5



SCR Deployment	
Total Hrs.	0
Total MWh	0
Avg. MW	0.0

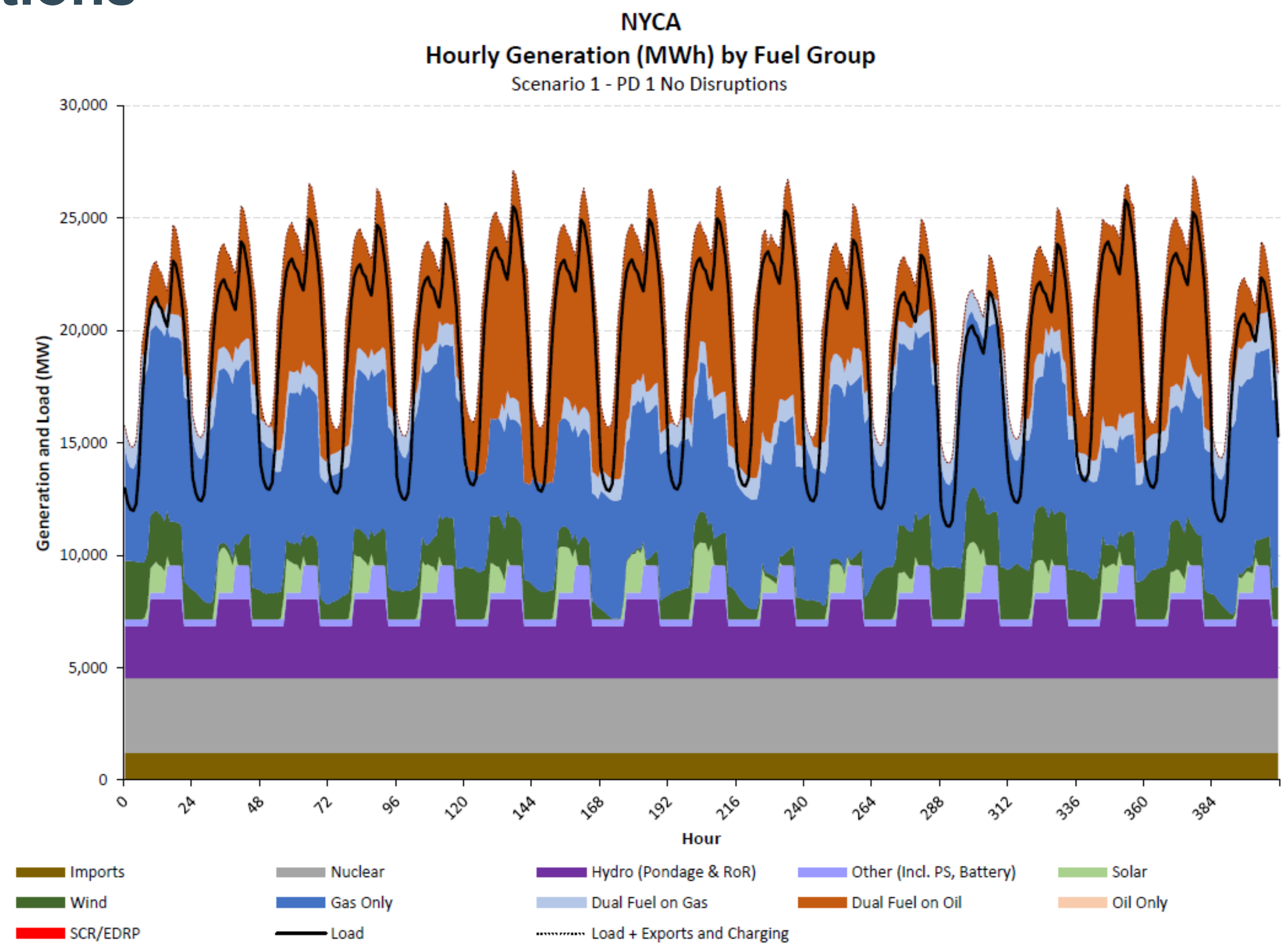


Reserve Violations	
Total Hrs.	0
Total MWh	0
Avg. MW	0.0
First Hour with Viol.	



Loss of Load	
Total Hrs.	0
Total MWh	0
Avg. MW	0.0
First Hour with Losses	

Sample Output Winter 2023/2024: Case with No Disruptions and ISO-NE Export Reductions



Load is met in every hour

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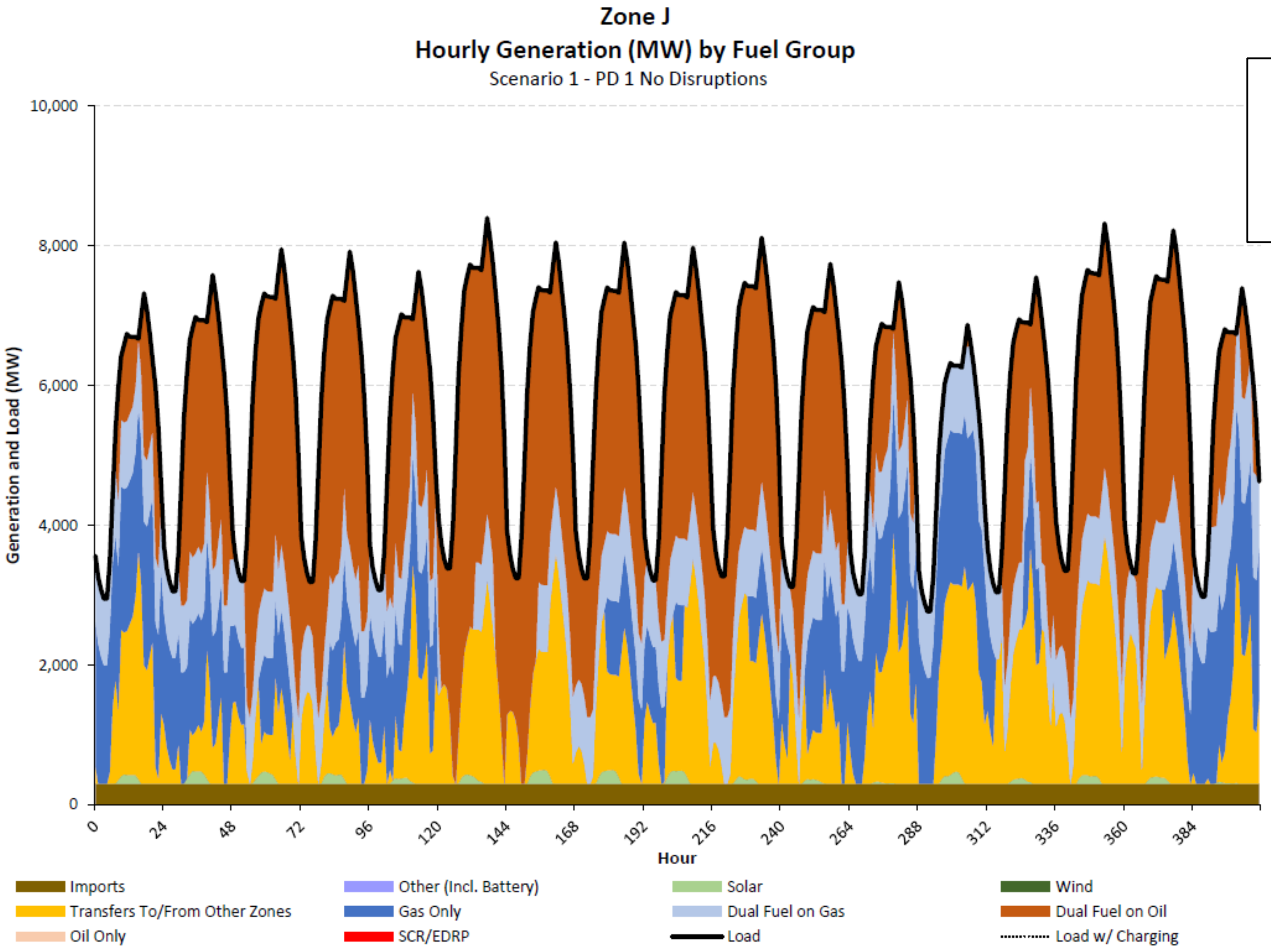
Sample Output Winter 2023/2024: Case with No Disruptions and ISO-NE Export Reductions



Load is met in every hour, significant reliance on oil generation and transfers from upstate is observed

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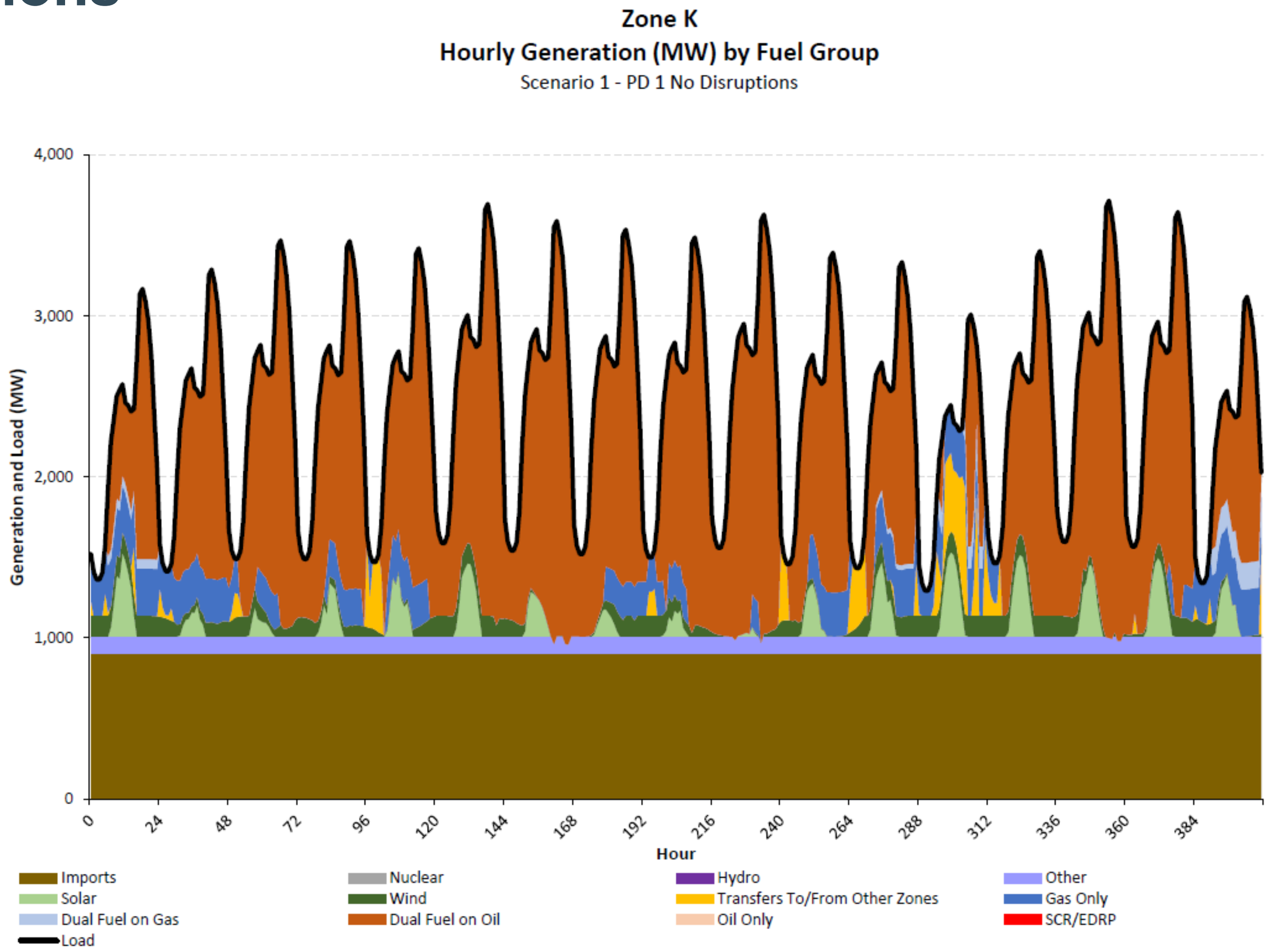
Sample Output Winter 2023/2024: Case with No Disruptions and ISO-NE Export Reductions



Load is met in every hour, significant reliance on oil generation and imports is observed

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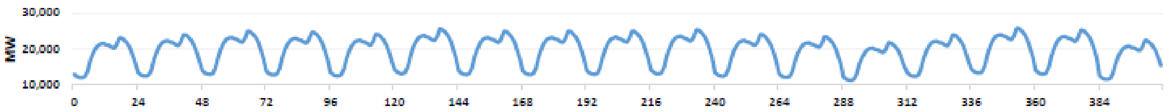
Sample Output Winter 2023/2024: Case with Severe Disruptions and Potential Loss of Load

Hourly Results Summary

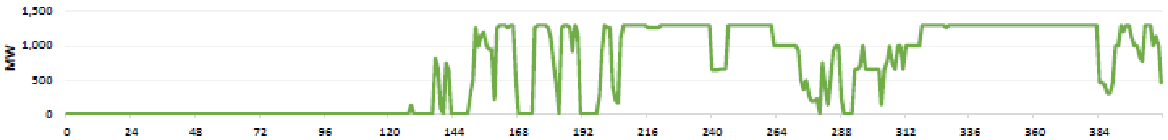
Case Name: Scenario 2 - PD 7 No Refill

Case Summary	
Derate (EFORd) Increase:	Off
Starting Storage:	Historical
Refill Contingency:	No Refill
Loss of Gas Fired Gen.	Off
Nuclear Contingency:	Off
Plant Outage:	None
Import Scenario:	Net Zero

Load During Modeling Period

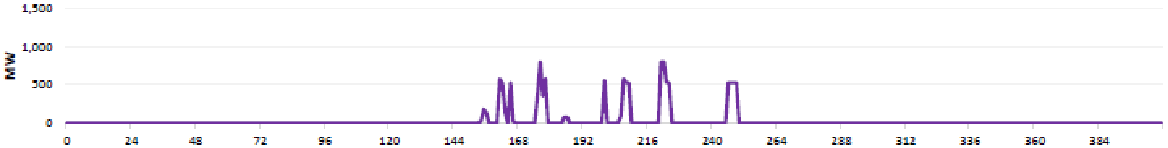


Export to ISO-NE Reduction During Modeling Period



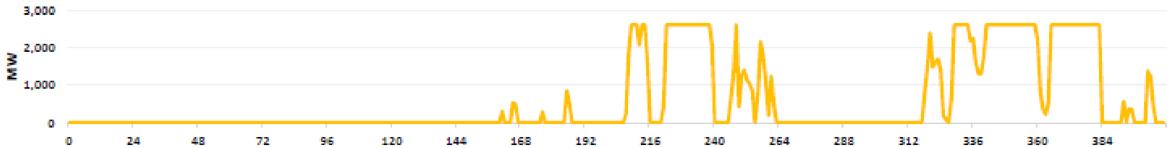
Export Reductions	
Total Hrs.	245
Total MWh	259,099
Avg. MW	635.0

SCR/EDRP Deployed During Modeling Period



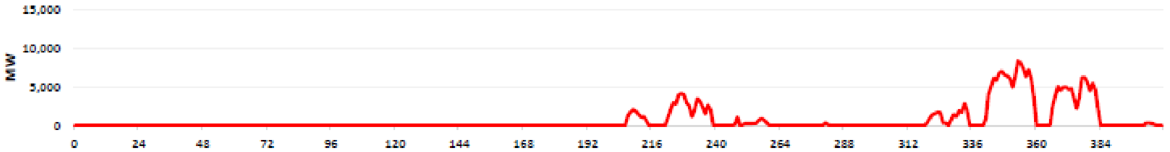
SCR Deployment	
Total Hrs.	27
Total MWh	11,371
Avg. MW	27.9

NYCA Reserve Violations During Modeling Period



Reserve Violations	
Total Hrs.	121
Total MWh	233,267
Avg. MW	571.7
First Hour with Viol.	157

Loss of Load During Modeling Period



Loss of Load	
Total Hrs.	99
Total MWh	276,029
Avg. MW	676.5
First Hour with Losses	161

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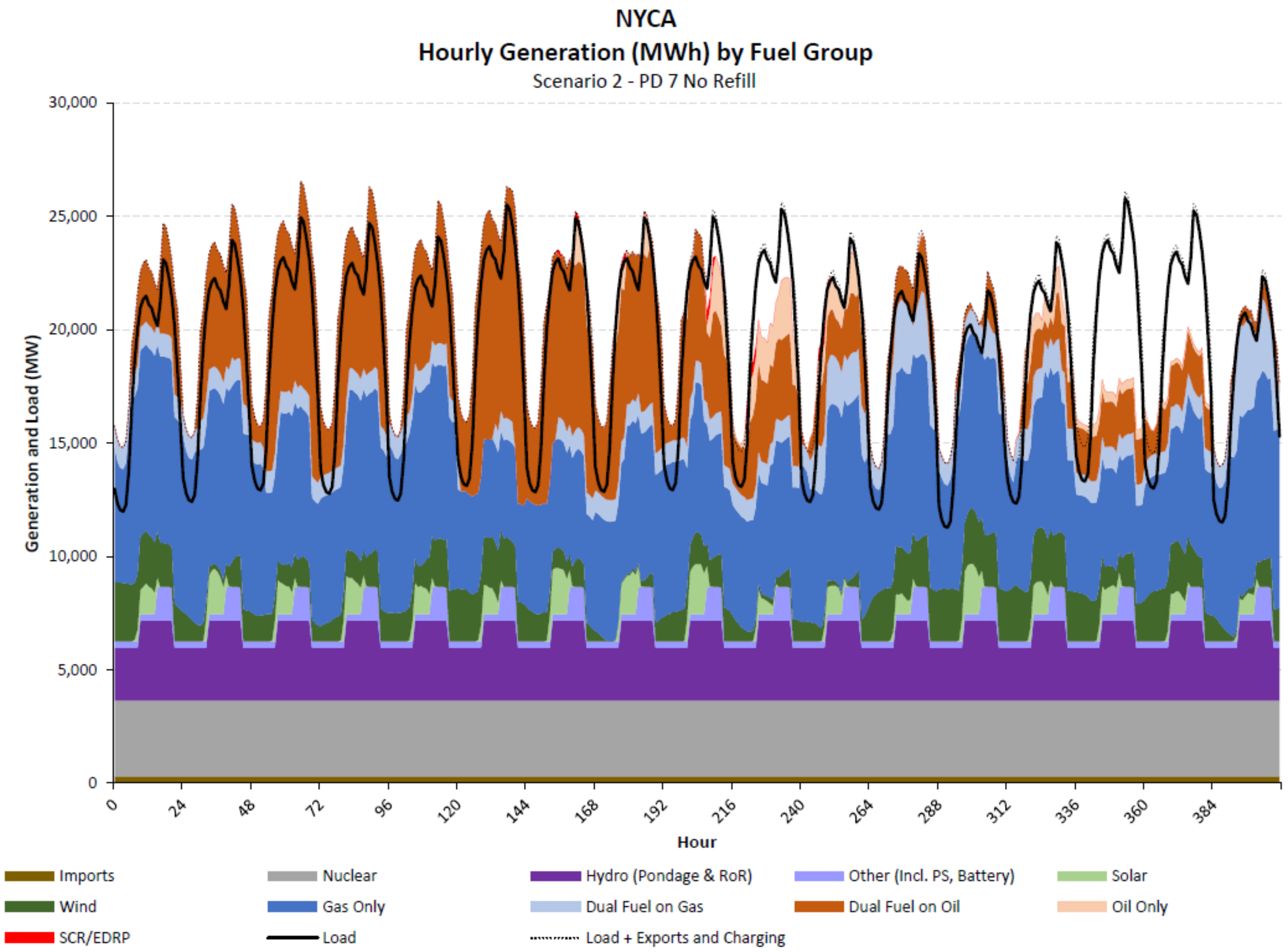
Sample Output Winter 2023/2024: Case with Severe Disruptions and Potential Loss of Load



Gap between load and generation represents potential for loss of load

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Summary of Scenarios, All Winters

	Imports	Oil	Infrastructure
Scenario Description	**IM All**: 1,200 MW capacity imports / minimum 300 MW capacity exports **IM Net0**: 300 MW capacity imports / minimum 300 MW capacity exports	**HFS**: Higher starting oil tank levels, 50% increase in starting storage levels	**REN**: Delayed construction of renewables as follows: *Winter 2026/2027:* 33% decrease of utility-scale solar and land-based wind capacity from 2021-2040 Outlook “Contract Case” additions *Winter 2030/2031:* 20% decrease of utility-scale solar, land-based wind, and offshore wind capacity from 2021-2040 Outlook “Policy Case 1” additions
Scenario 1	IM All		
Scenario 2	IM Net0		
Scenario 3	IM All	HFS	
Scenario 4	IM Net0	HFS	
Scenario 5	IM All		REN
Scenario 6	IM Net0		REN
Scenario 7	IM All	HFS	REN
Scenario 8	IM Net0	HFS	REN

- In Winter 2023/2024, only Scenarios 1-4 are applicable

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Summary of Disruptions, All Winters

Disruption Name	Description
1. Starting Conditions	No physical disruptions
2. High Outage	Double unit forced outage rate compared to historical averages
3. SENY Deactivation	Loss of significant capability (1,000 MW) in SENY (specifically, zones G-I)
4. Nuclear Station Outage	Loss of major nuclear facility upstate
5. No Truck Refill	Unavailability of truck oil fuel delivery based on historical events such as snow storms
6. No Barge Refill	Unavailability of barge oil fuel delivery based on historical events such as NYC rivers freezing
7. No Refill	Unavailability of any oil fuel delivery due to severe fuel limitations affecting both barge and truck refueling
8. Non-Firm Gas Unavailable F-K	No non-firm gas-fired generation capability available in zones F-K
9. Non-Firm Gas Unavailable NYCA	No non-firm gas-fired generation capability available anywhere in NYCA
10. Non-Firm Gas Unavailable 4 days	No non-firm gas-fired generation capability available anywhere in NYCA over the cold snap weekend, model days 6-9
11. Combination Disruption	50% gas available NYCA-wide + 50% increased lead time for oil refill + High Outage Disruption 2

- Disruptions apply to all three modeled winters
- Disruptions 1-9 are identical to 2019 study
- Disruptions 10-11 are new/revised for 2023 study
  - Disruption 10 is designed to address shorter-term gas availability concerns noted in stakeholder comments and the literature review
  - Disruption 11 is designed to be a slightly less severe and potentially more probable combination scenario than the 2019 version (i.e., 2019 version = Disruptions 3+7+9)

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Gas Pipeline Supply – Winter 2023/2024 (Updated)

- Compared to the data discussed at the 6/14/2023 ICAPWG/MIWG meeting (see Appendix), the updated information results in less overall gas available for generation in New York
- Update to New York design day LDC demand (item [E]) to account for storage capacity with firm interstate pipeline transportation used to meet retail gas demand
  - Based on conversations with LDCs
  - Results in increased pipeline utilization to serve LDC demand compared to prior data; reduces assumed gas available for generation
- Update to expected imports from Ontario (item [B])
  - Increase compared to data previously discussed
- Update to expected exports to New England (item [D])
  - Reduction compared to data previously discussed

Gas Supply/Demand	MMCF/d	Calculation	Source
Modeling Period Supply			
Max New York State Imports from PJM	10,186	[A]	EIA
Expected New York State Imports from Ontario	945	[B]	S&P Global
Gas Available within New York	*11,131*	*[C] = [A] + [B]*	
Modeling Period Demand			
Expected Exports to New England	(3,550)	[D]	S&P Global
New York Design Day LDC Demand from Pipeline Gas	(7,106)	[E]	NYDPS
Total Outflows/LDC Demand	*(10,656)*	*[F] = [D]+[E]*	
Max Gas Available for Electric Generation in New York	**475**	[G] = [C] + [F]	
Equivalent MW of Gas Generation Capacity each Hour at 9 MMBtu/MWh Heat Rate	**2,281**	[H] = [G] * 4.8	

Note:
[1] Design Day LDC Demand aggregated from Winter Supply forms for New York State LDCs.

Sources:
[1] EIA, State to State Pipeline Capacity, January 31, 2023.
[2] NYDPS/NYPSC, Case 22-M-0247 - Winter Supply 2022-2023 Forms, Table 1.
[3] S&P Global.

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Summary of Key Observations

- Unchanged from 2019 Study:
  - Disruptions to oil availability presents challenges
  - Disruptions to gas availability causes challenges
  - Renewable buildout, particularly offshore wind, provides reliability support (however, wind lulls are an important consideration)
- New/Changed from 2019 Study:
  - Cases leading to potential loss of load events and emergency actions are concentrated in Load Zone J in winter 2023/2024

Winter 2023/2024 – Initial Observations

- Initial conditions with no disruptions in all scenarios show reductions of assumed ISO-NE exports
- Reported increases to oil delivery lead time for certain resources compared to 2019 study assumptions reduce refill capability during the modeled cold weather event
- Potential loss of load events and emergency actions are focused in Load Zone J
- Reduced electric imports paired with historical starting oil inventory results in the most severe potential loss of load across cases (Scenario 2)
- Cases with few potential loss of load events across all scenarios:
  - High Outage (Disruption 2)
  - SENY Deactivation (Disruption 3)
- Cases with material potential loss of load events in certain scenarios:
  - Nuclear station outage [Nine Mile Point 1 and 2] (Disruption 4)
- Cases with material potential loss of load events across all scenarios:
  - Oil disruptions (Disruptions 5-7)
  - Gas disruptions (Disruptions 8-10)
  - Combination Disruption (Disruption 11)

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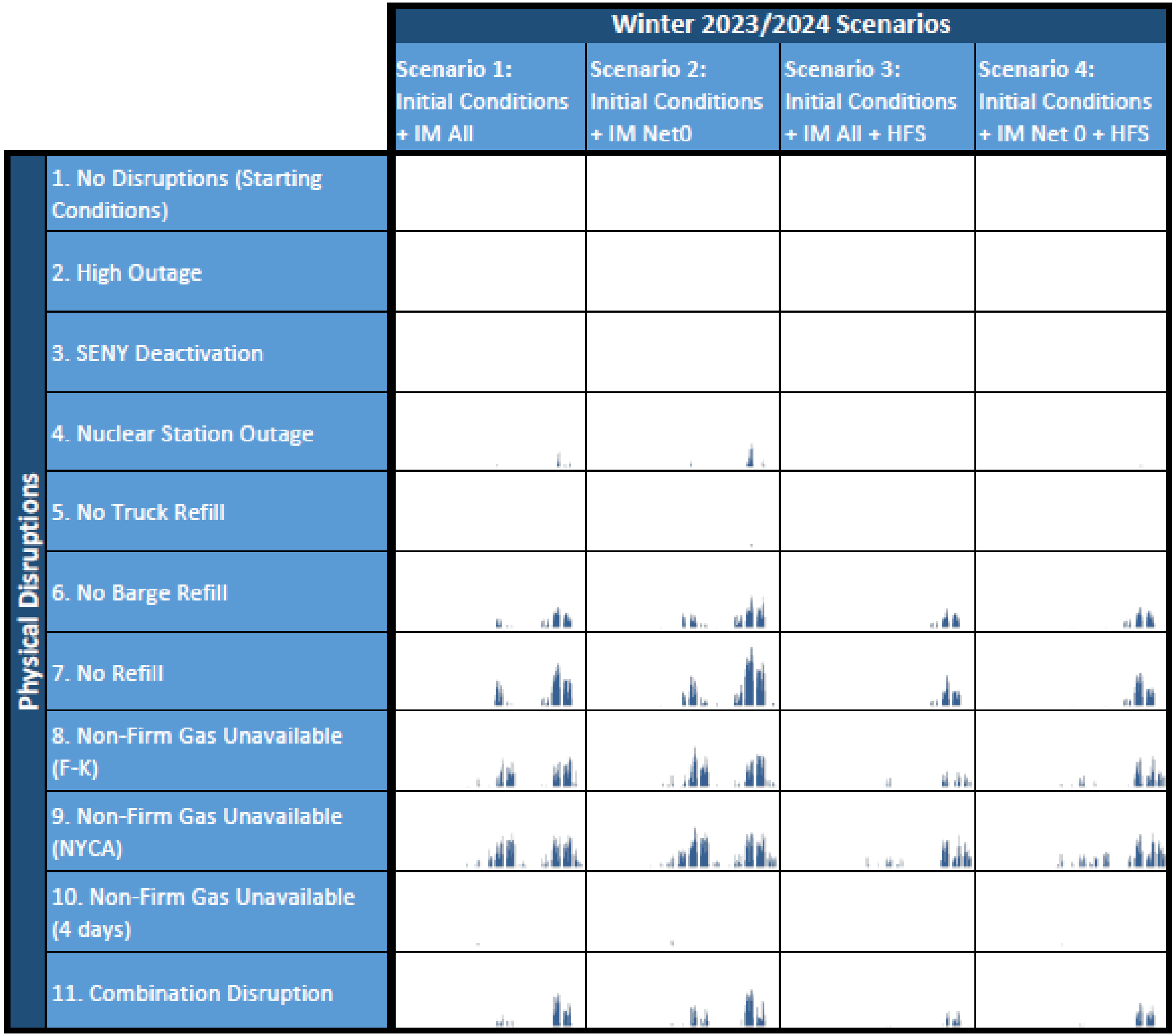
Winter 2023/2024 – Cross-Case Comparison: Hourly Potential Loss of Load (MW) by Case



Note: The scale of the axes are equal in all cells. The y-axis is set to have a maximum of 10,000 MW

Scenario Key:

IM All = 1,200 MW capacity imports / minimum 300 MW capacity exports

IM Net0 = 300 MW capacity imports / minimum 300 MW capacity exports

HFS = Higher starting oil tank levels, 50% increase in starting storage levels

Combination Disruption = 50% gas available NYCA-wide + 50% increased lead time for oil refill + High Outage (Disruption 2)

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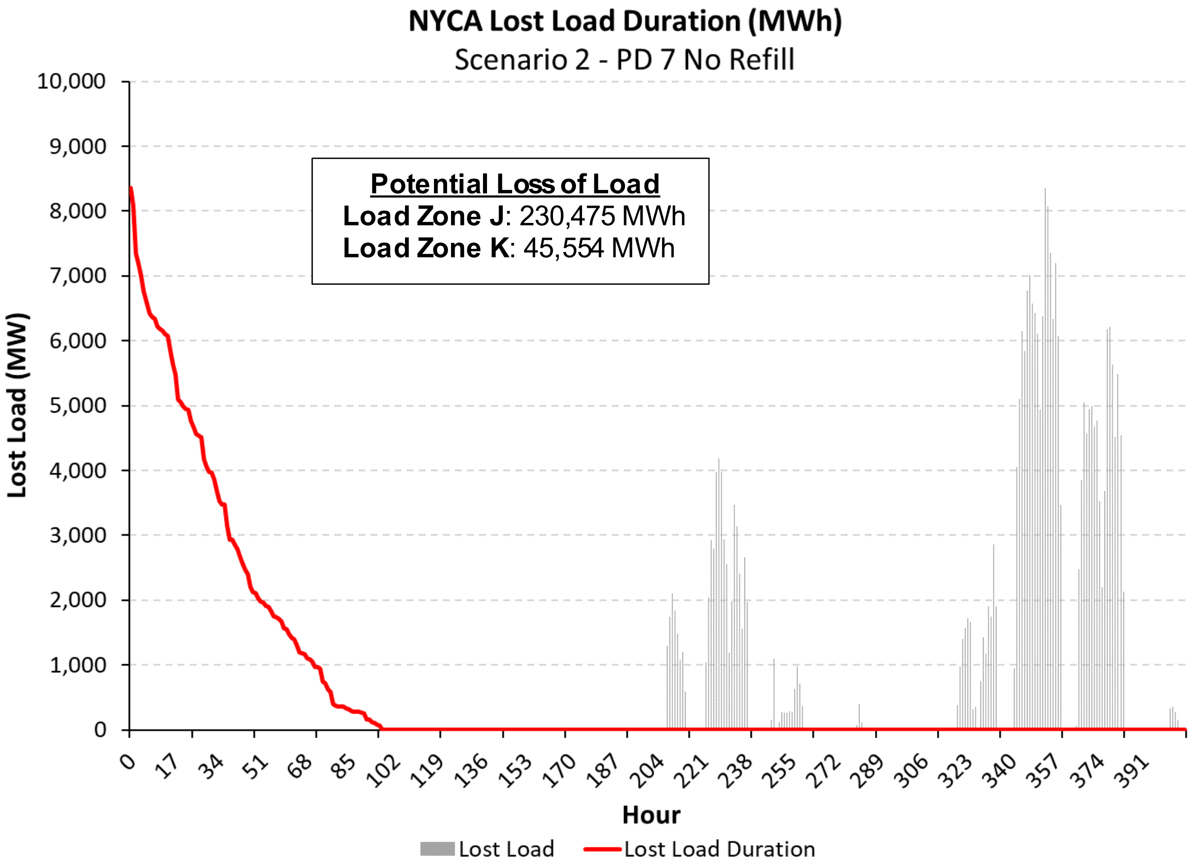
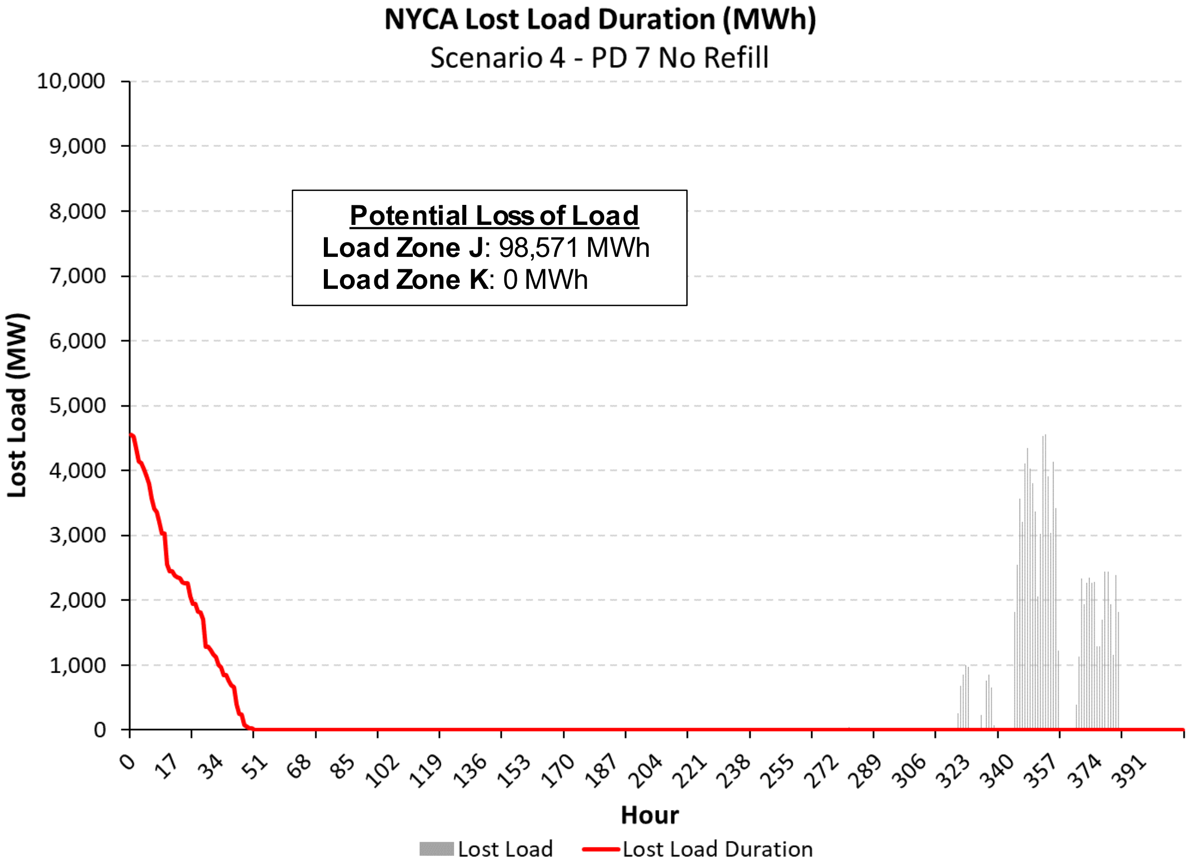
Winter 2023/2024 Selected Case Comparison: No Refill (Disruption 7), Scenario 2 (IM Net0) and Scenario 4 (IM Net0 + HFS)

- Higher fuel storage inventories in Scenario 4 mitigate impact of a "No Refill" disruption and eliminate potential loss of load in Load Zone K





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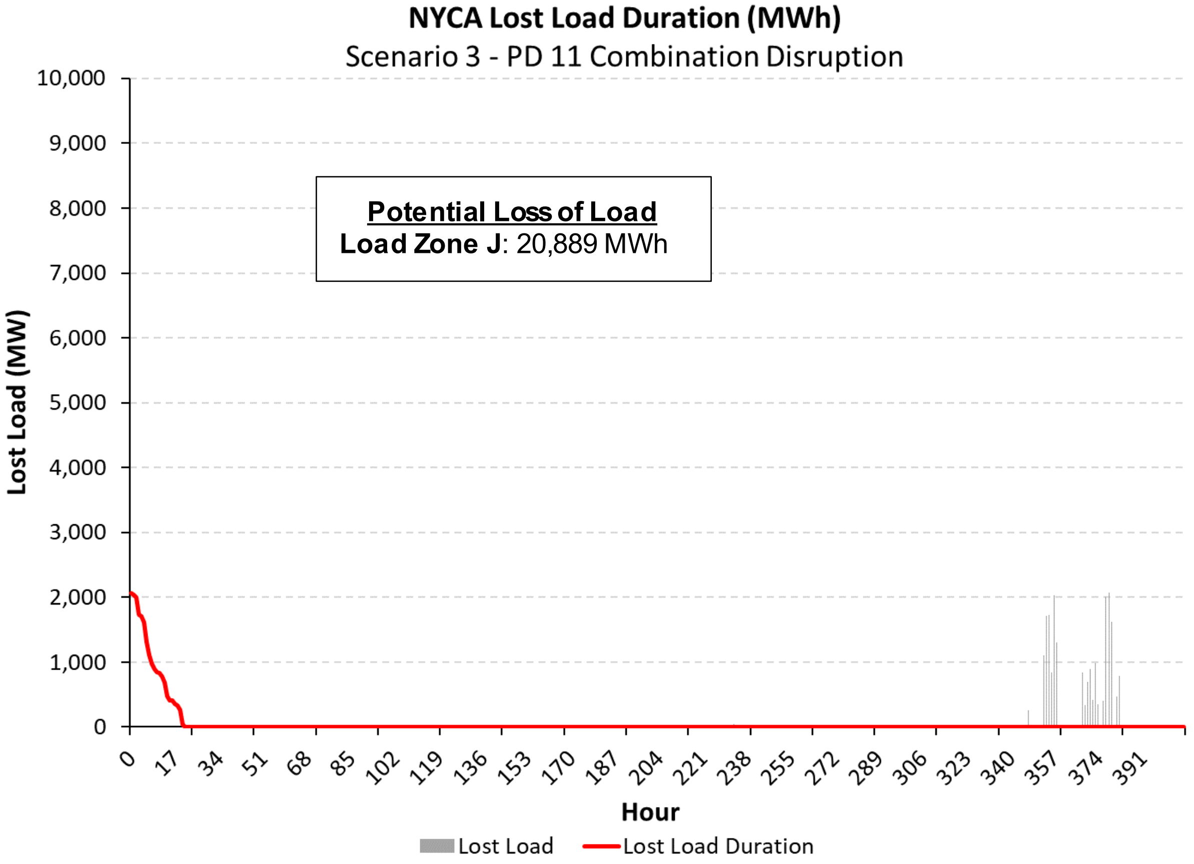
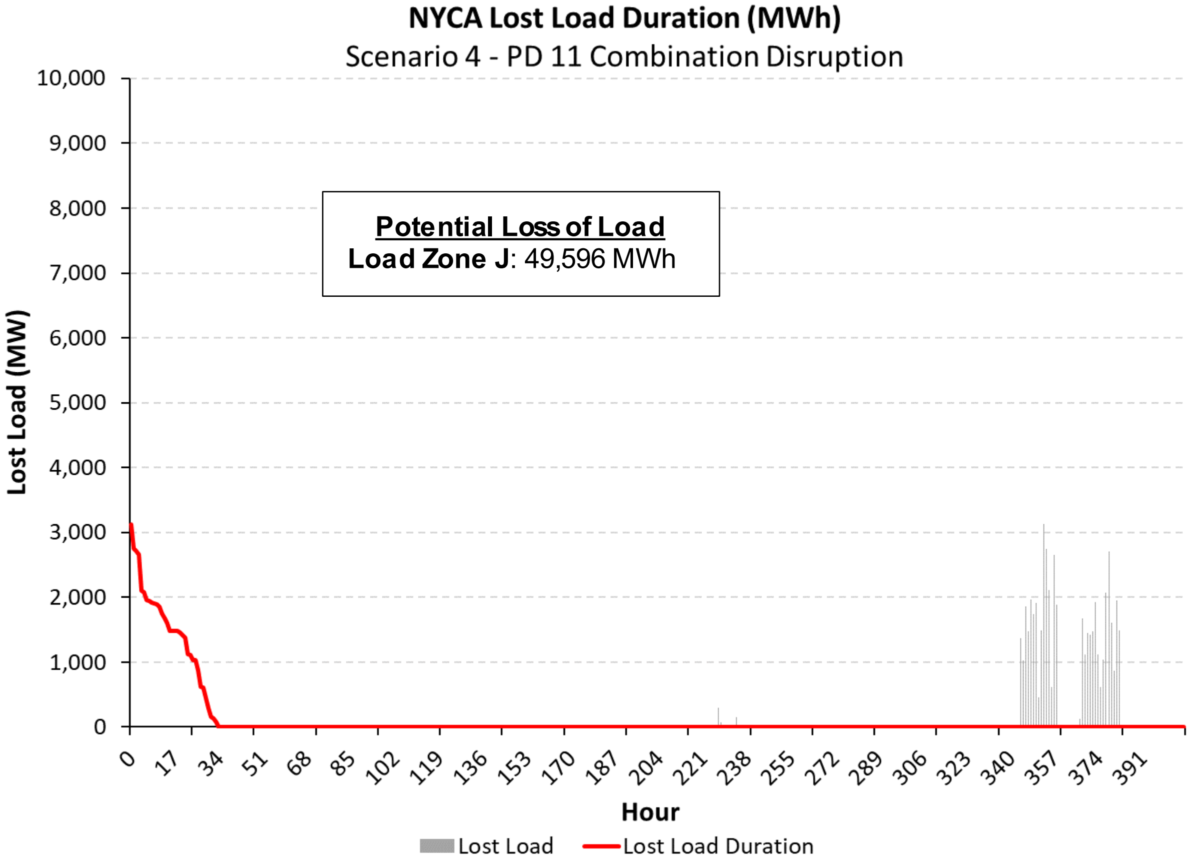
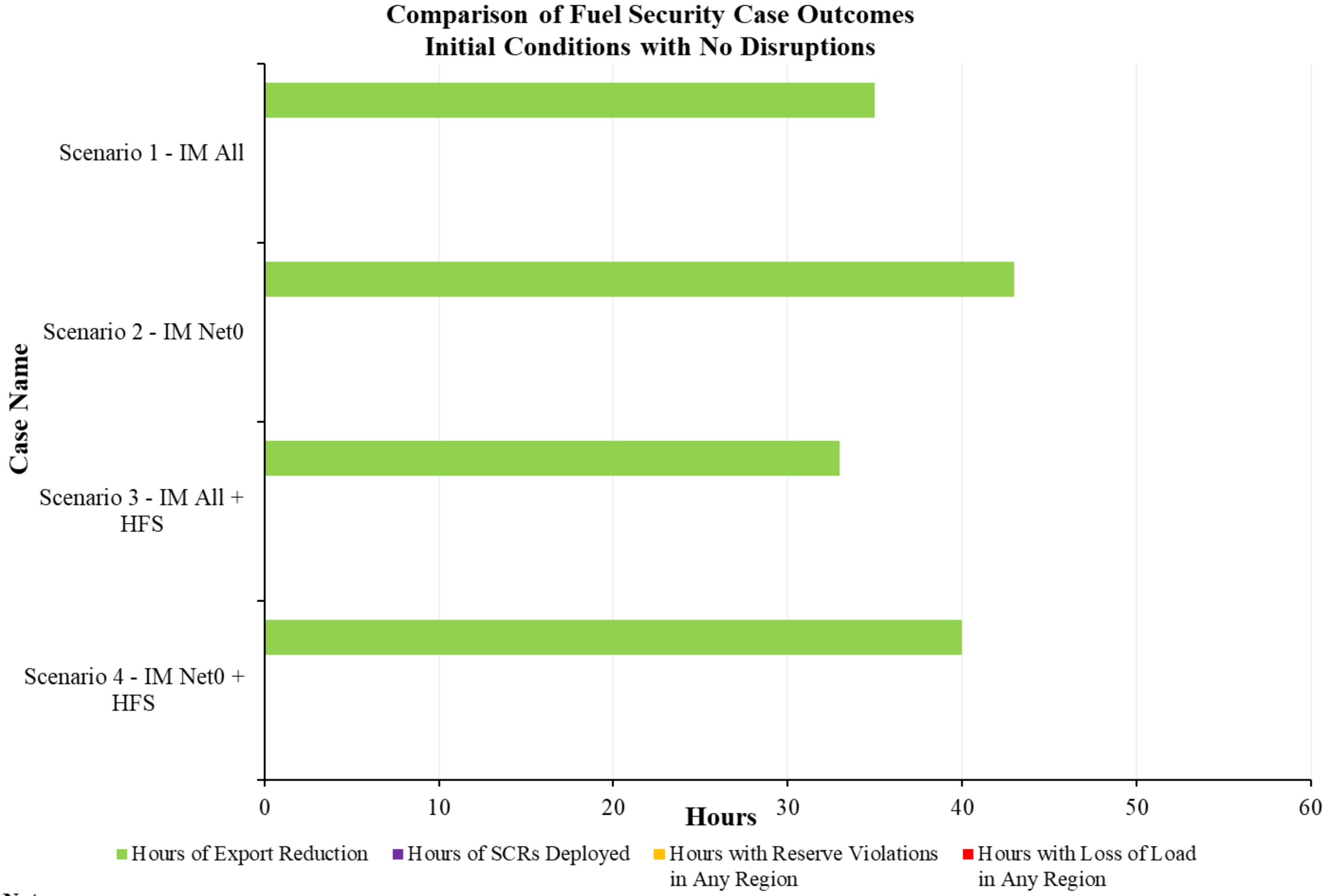
Winter 2023/2024 Selected Case Comparison: Combination Disruption (Disruption 11), Scenario 3 (IM All + HFS) and Scenario 4 (IM Net0 + HFS)

- Reduction in electric imports in Scenario 4 exacerbates impact of the combination disruption





Winter 2023/2024 – Initial Case Results



Note:
[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels.

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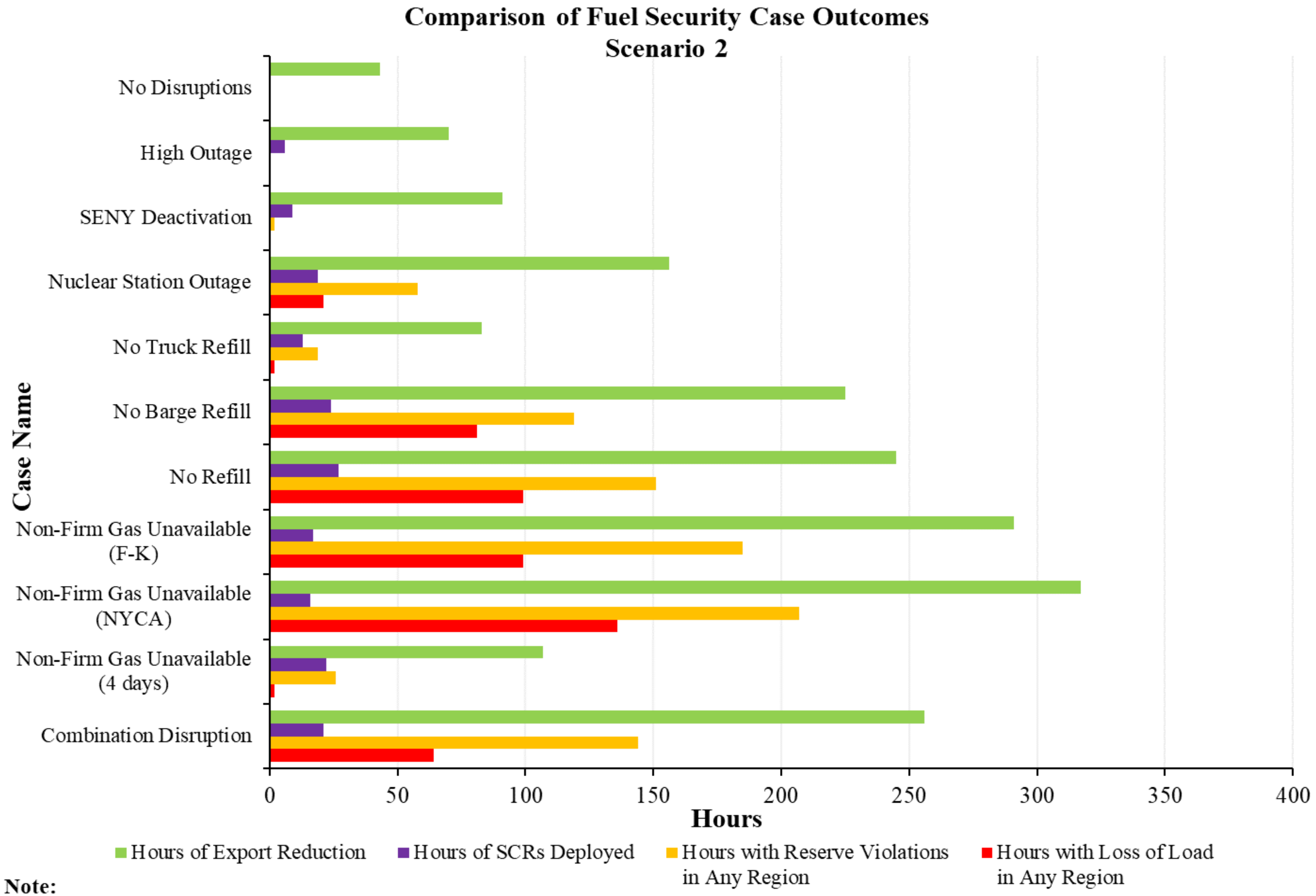
Winter 2023/2024 – Initial Case Results



Note:

[1] Scenario 2 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports.

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Winter 2026/2027 – Initial Observations

- Observe minor potential loss of load events in two “No Disruptions” (Starting Conditions) cases
- Observe an increase in potential loss of load events compared to Winter 2023/2024
- Assumed imports to Long Island plus injections from offshore wind in Load Zone K means less oil draw down, and minimal to no potential loss of load events on Long Island
- Higher starting oil inventory helps alleviate emergency actions and potential loss of load events relative to scenarios with historical starting oil inventory
- Modeled delay in renewable capacity exacerbates potential loss of load events

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Winter 2026/2027 – Cross-Case Comparison: Hourly Potential Loss of Load (MW) by Case

Scenario Key:

IM All = 1,200 MW capacity imports / minimum 300 MW capacity exports

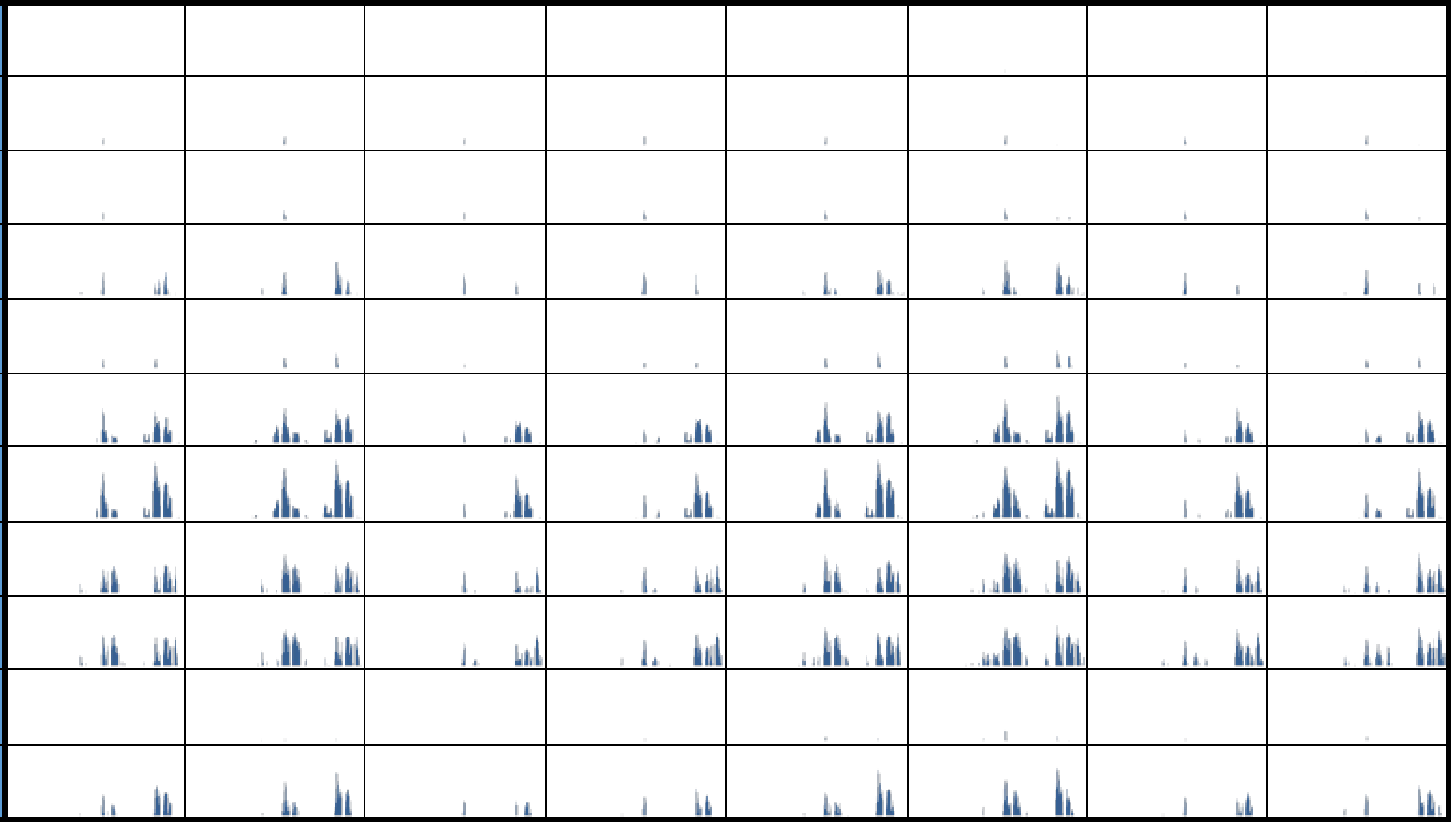
IM Net0 = 300 MW capacity imports / minimum 300 MW capacity exports

HFS = Higher starting oil tank levels, 50% increase in starting storage levels

REN = 33% decrease of utility-scale solar and land-based wind capacity 2021-2040 Outlook Contract Case Additions

Combination Disruption = 50% gas available NYCA-wide + 50% increased lead time for oil refill + High Outage (Disruption 2)

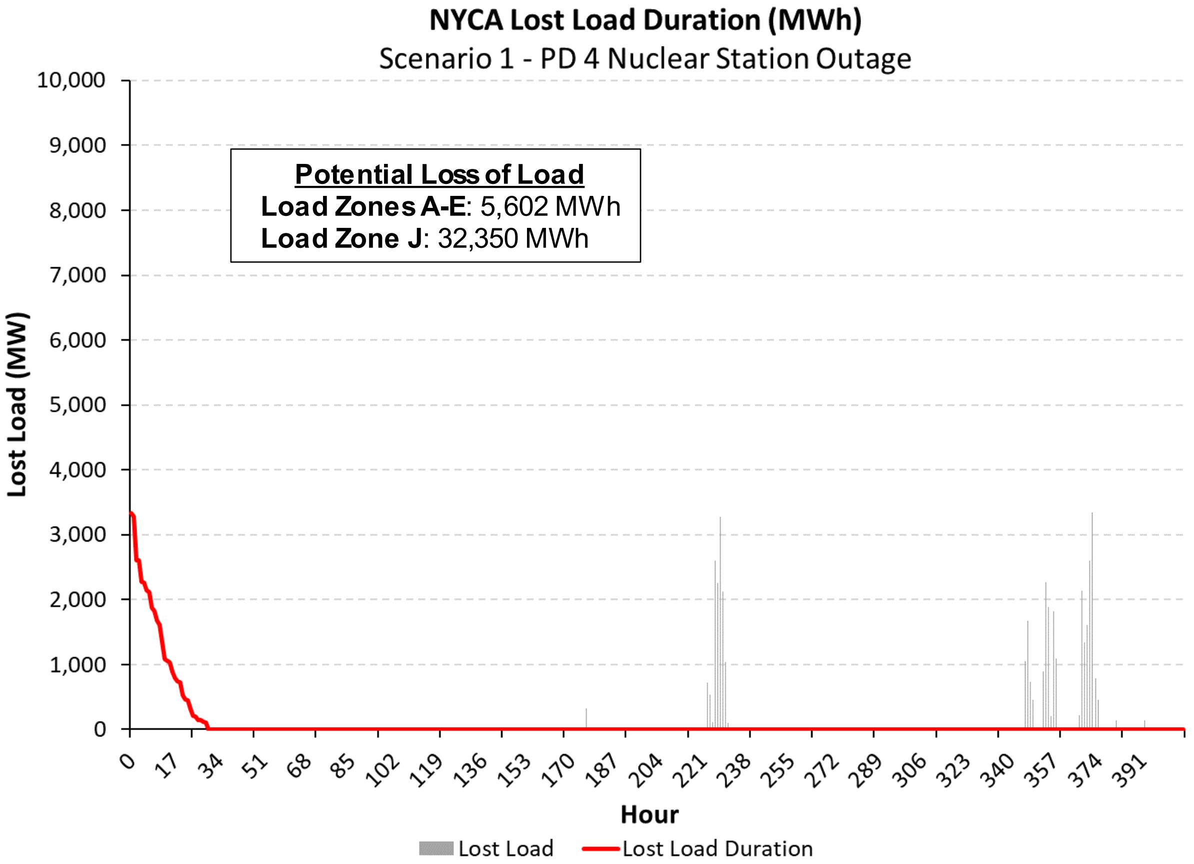
	Winter 2026/2027 Scenarios							
Physical Disruptions	Scenario 1: Initial Conditions + IM All	Scenario 2: Initial Conditions + IM Net0	Scenario 3: Initial Conditions + IM All + HFS	Scenario 4: Initial Conditions + IM Net 0 + HFS	Scenario 5: Initial Conditions + IM All + REN	Scenario 6: Initial Conditions + IM Net0 + REN	Scenario 7: Initial Conditions + IM All + HFS + REN	Scenario 8: Initial Conditions + IM Net0 + HFS + REN
1. No Disruptions (Starting Conditions)								
2. High Outage								
3. SENY Deactivation								
4. Nuclear Station Outage								
5. No Truck Refill								
6. No Barge Refill								
7. No Refill								
8. Non-Firm Gas Unavailable (F-K)								
9. Non-Firm Gas Unavailable (NYCA)								
10. Non-Firm Gas Unavailable (4 days)								
11. Combination Disruption								

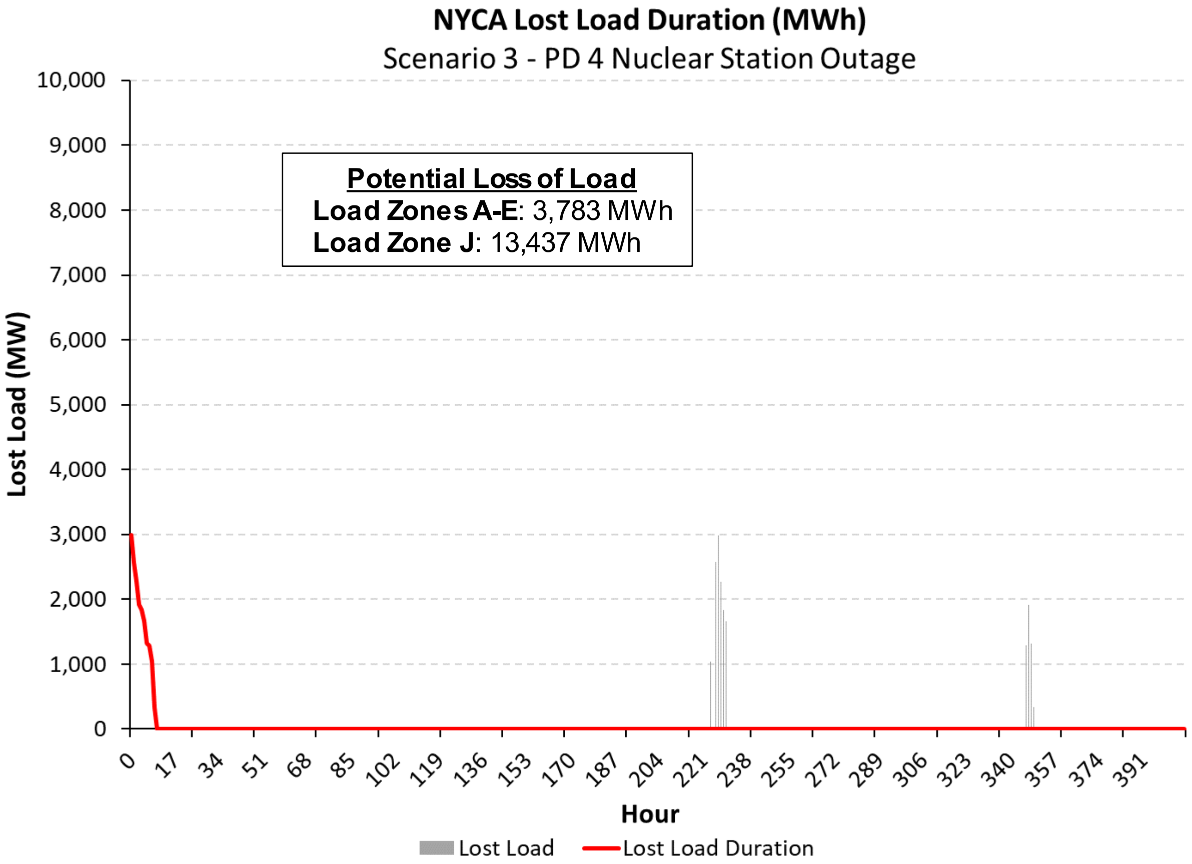


Note: The scale of the axes are equal in all cells. The y-axis is set to have a maximum of 10,000 MW

Winter 2026/2027 Selected Case Comparison: Nuclear Station Outage (Disruption 4), Scenario 1 (IM All) and Scenario 3 (IM All + HFS)

- Nuclear station outage results in potential loss of load upstate; higher starting fuel storage inventories mitigate the impact





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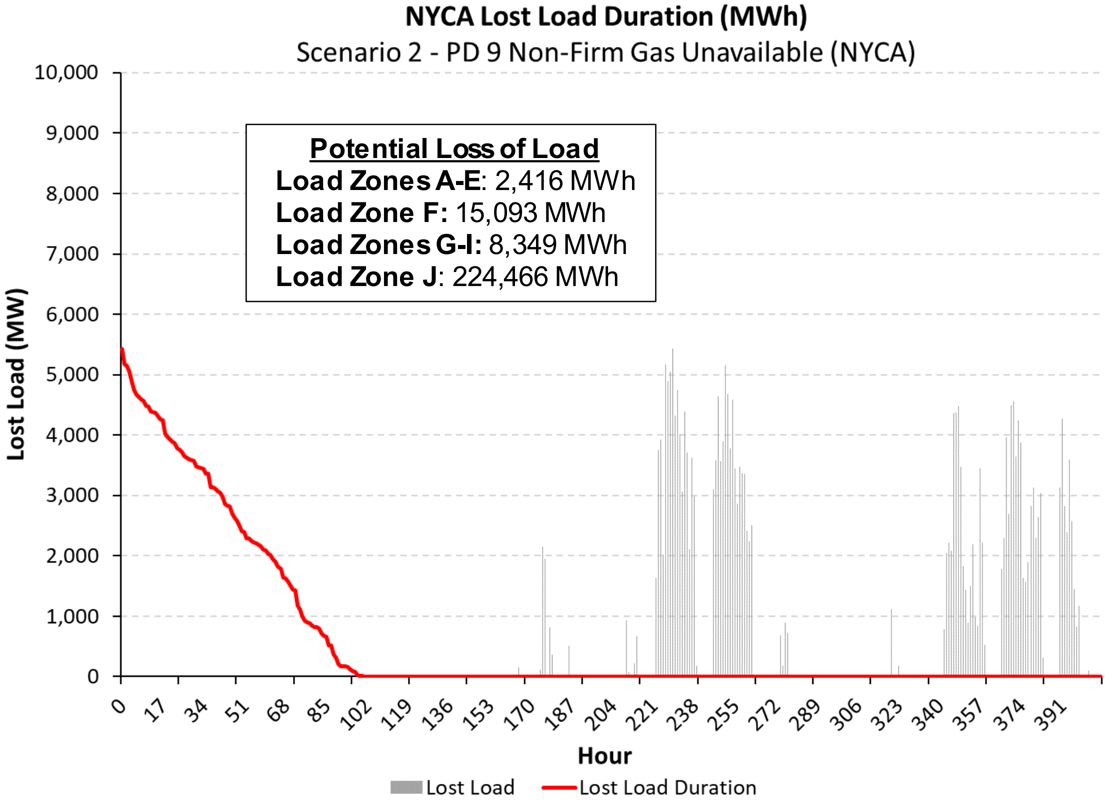
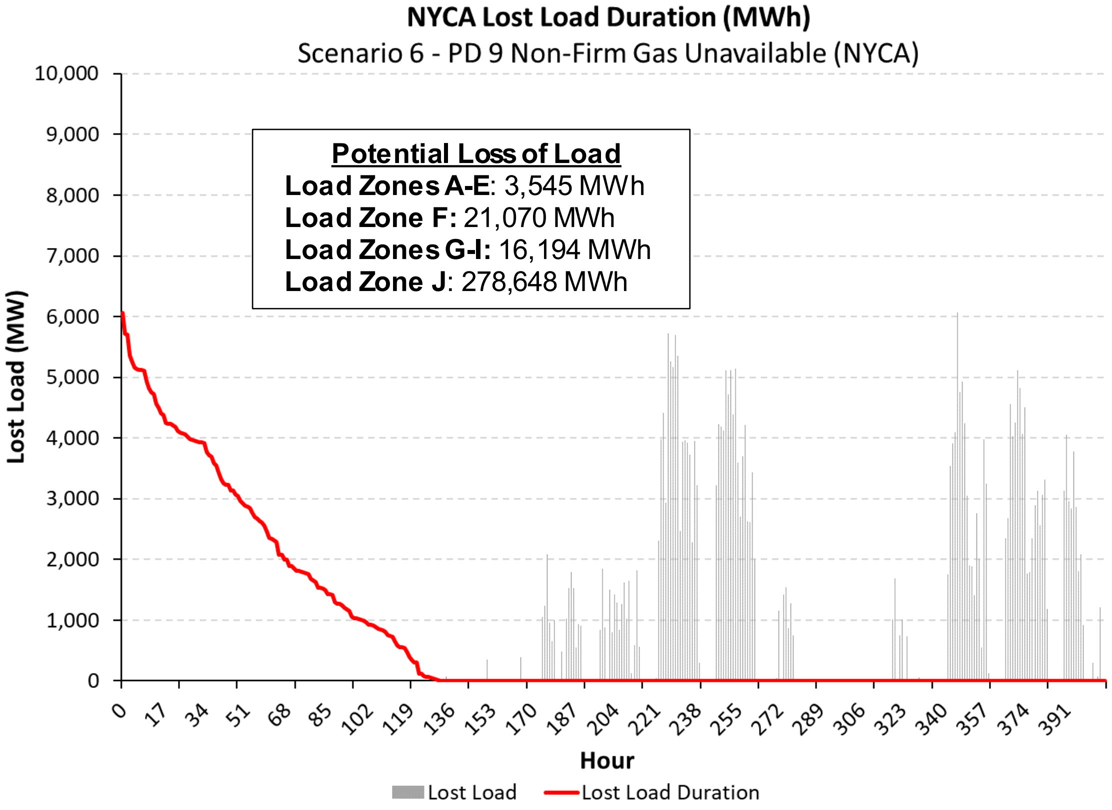
Winter 2026/2027 Selected Case Comparison: Non-Firm Gas Unavailable Statewide (Disruption 9), Scenario 2 (IM Net0) and Scenario 6 (IM Net0 + REN)

- Unavailability of non-firm gas throughout the modeled cold weather event leads to substantial potential loss of load across load zones; modeled delay in renewables in Scenario 6 exacerbates the impact





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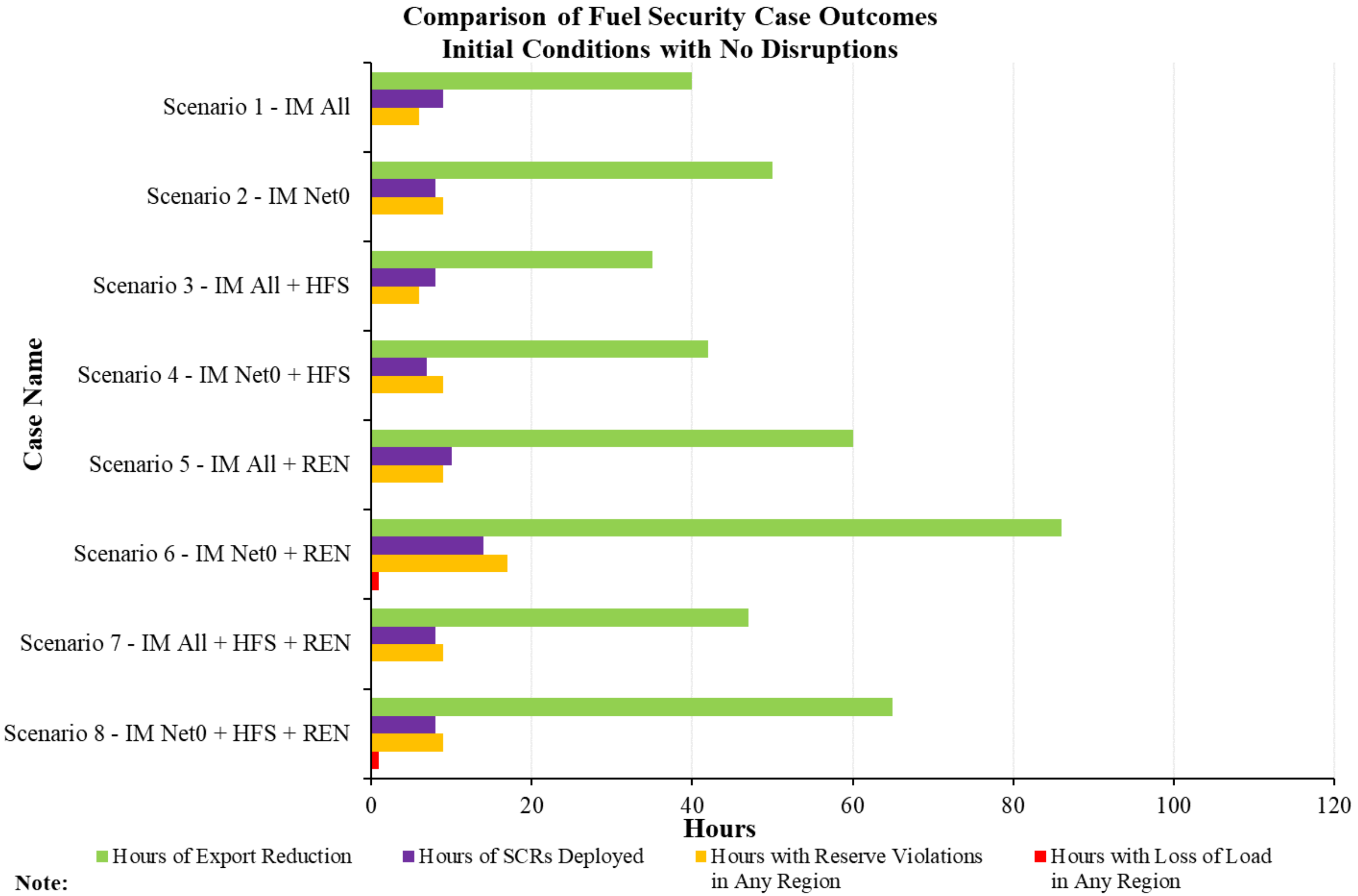
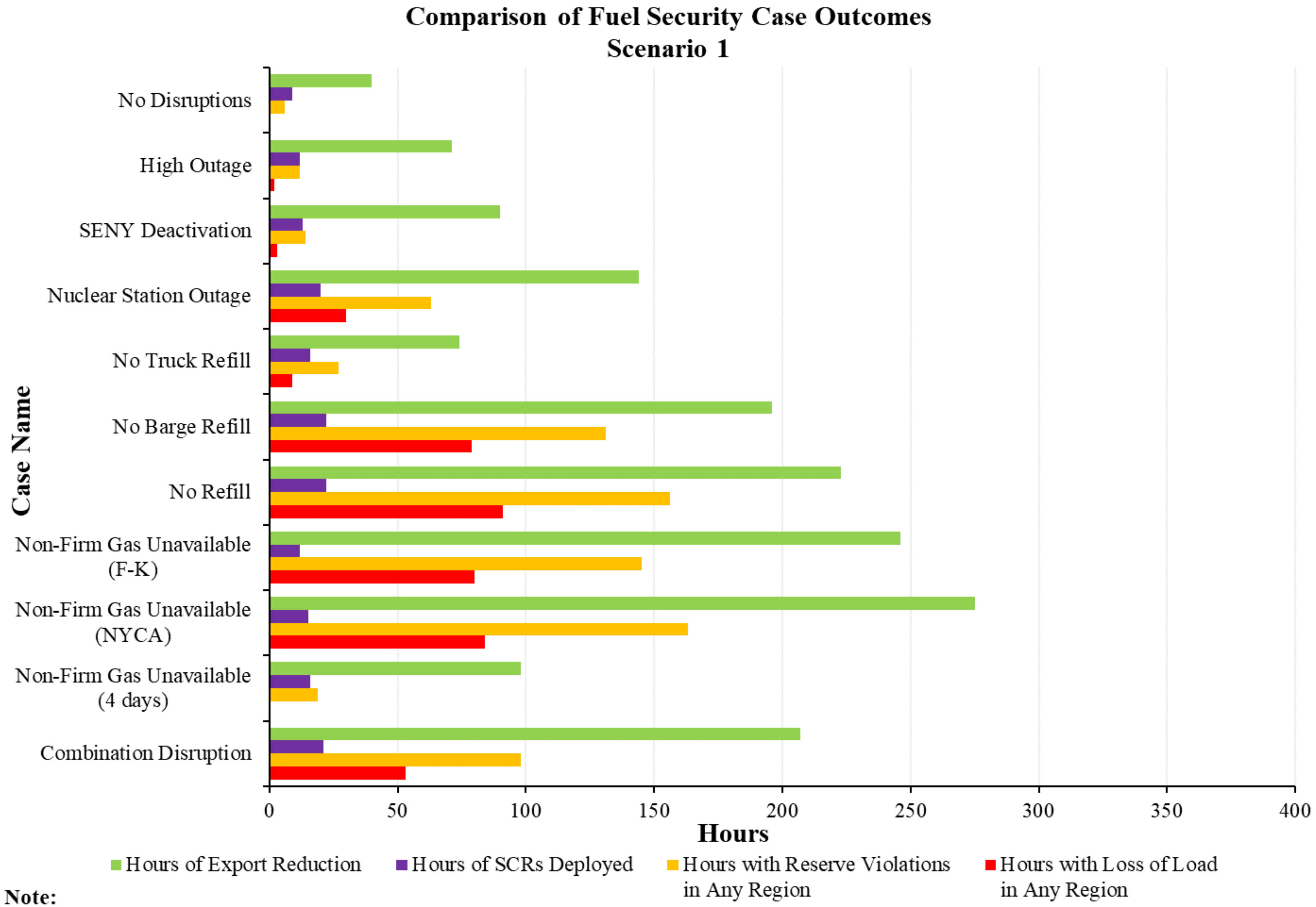
Winter 2026/2027 – Initial Case Results



Note:

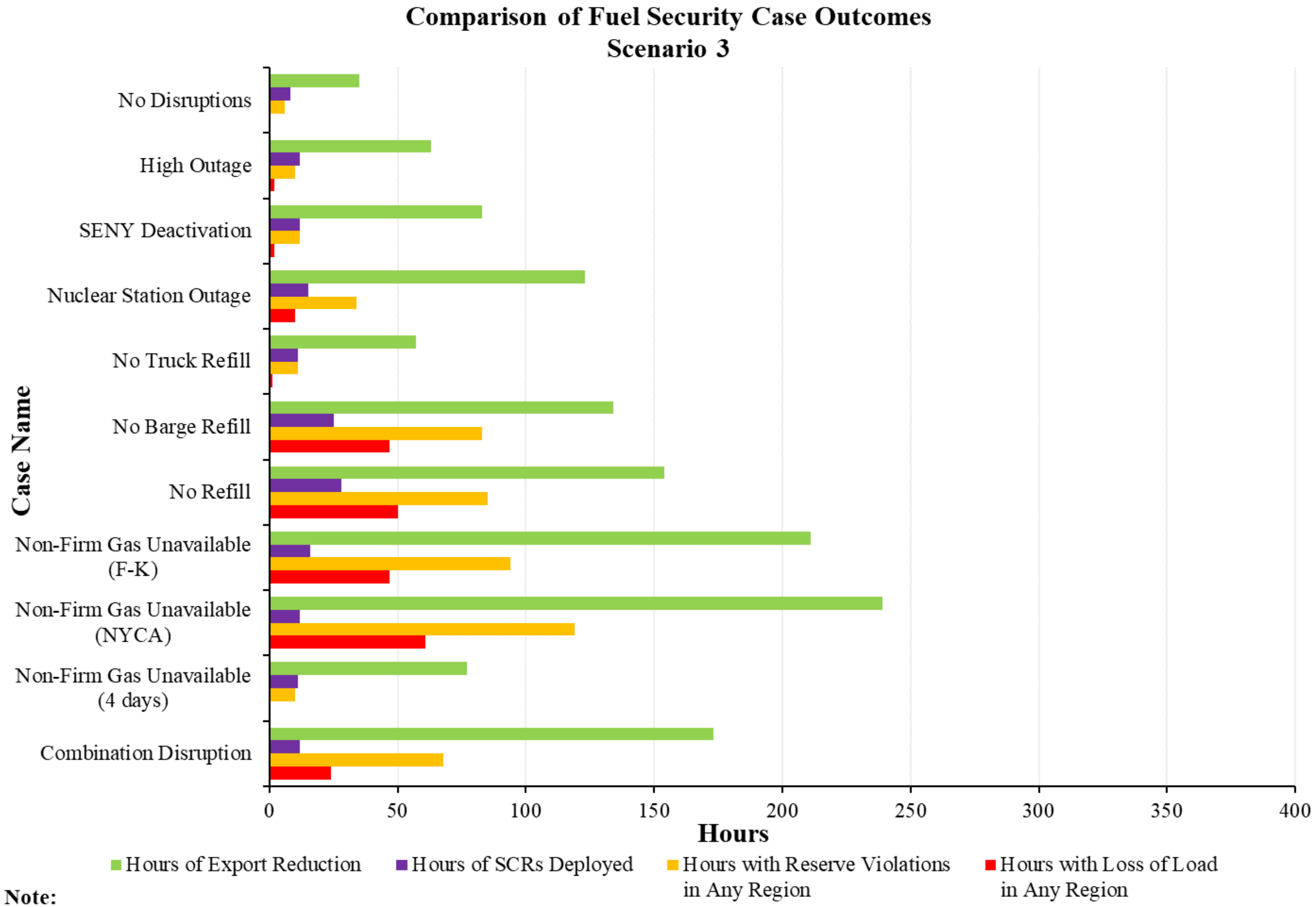
[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels, REN = 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

Winter 2026/2027 – Initial Case Results



Note:
[1] Scenario 1 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports.

Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 3 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

Winter 2030/2031 – Initial Observations

- Potential loss of load events observed in all cases, including "No Disruptions" (Starting Conditions)
- Observe substantial increase in potential loss of load events compared to Winter 2023/2024
- Potential loss of load events primarily driven by limited transfers from upstate to NYC, greater reliance on offshore wind, projected increased electricity demand (see Appendix) and limited excess renewable supply to charge batteries
- Initial observation themes from winters 2023/2024 and 2026/2027 remain applicable:
  - Potential loss of load events continue to have highest magnitude in Load Zone J, but all zones experience potential loss of load events
  - Scenarios with net positive energy imports (Scenarios 1, 3, 5 and 7) help decrease the severity of potential loss of load events
  - Higher starting oil inventory helps alleviate emergency actions and potential loss of load events relative to scenarios with historical starting oil inventory
  - The addition of offshore wind production in NYC and Long Island provides reliability support, however, wind lulls are critical to consider

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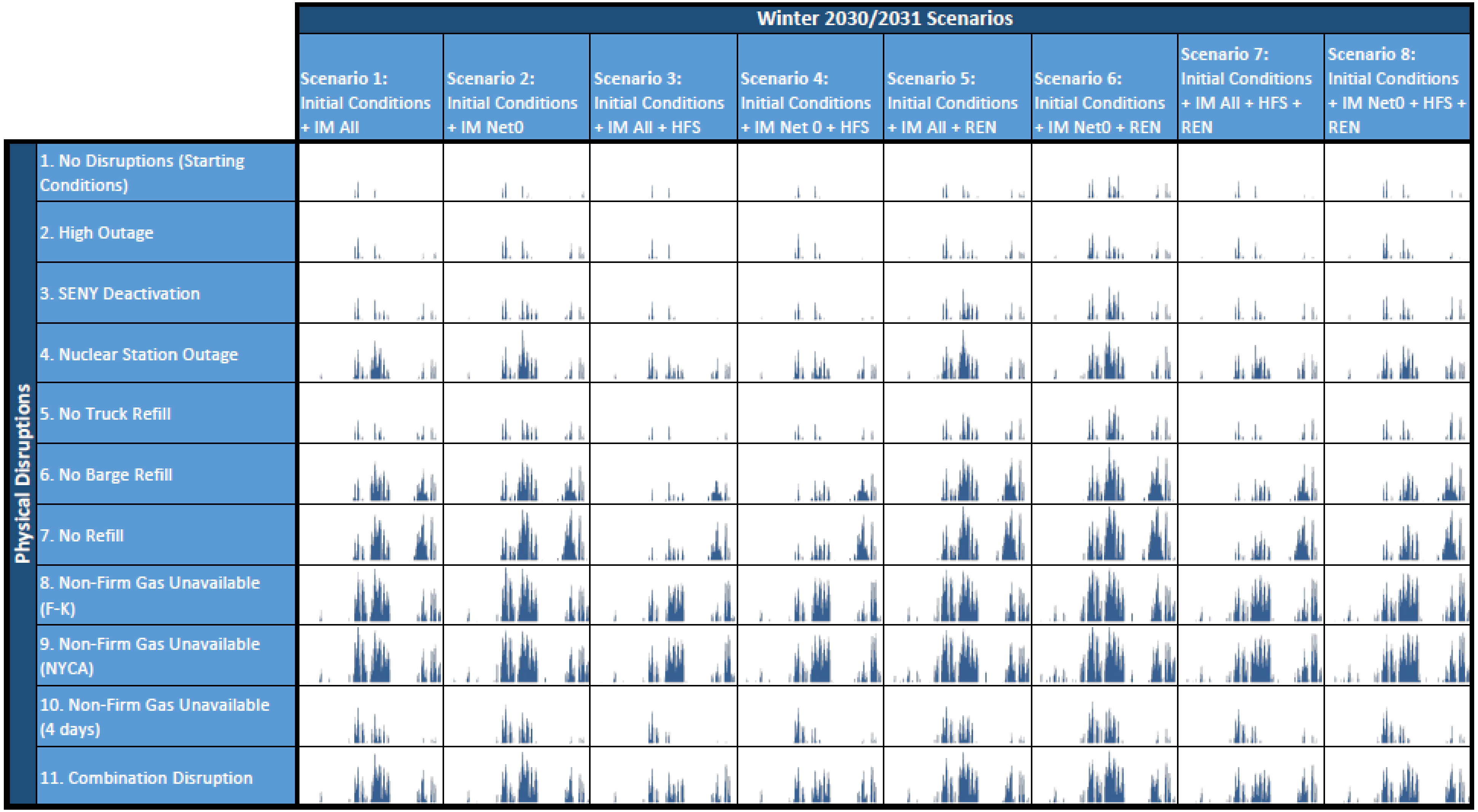
Winter 2030/2031 – Cross-Case Comparison: Hourly Potential Loss of Load (MW) by Case



Note: The scale of the axes are equal in all cells. The y-axis is set to have a maximum of 10,000 MW

Scenario Key:

IM All = 1,200 MW capacity imports / minimum 300 MW capacity exports

IM Net0 = 300 MW capacity imports / minimum 300 MW capacity exports

HFS = Higher starting oil tank levels, 50% increase in starting storage levels

REN = 20% decrease of utility-scale solar, land-based wind, and offshore wind capacity 2021-2040 Outlook Policy Case 1 Additions

Combination Disruption = 50% gas available NYCA-wide + 50% increased lead time for oil refill + High Outage (Disruption 2)

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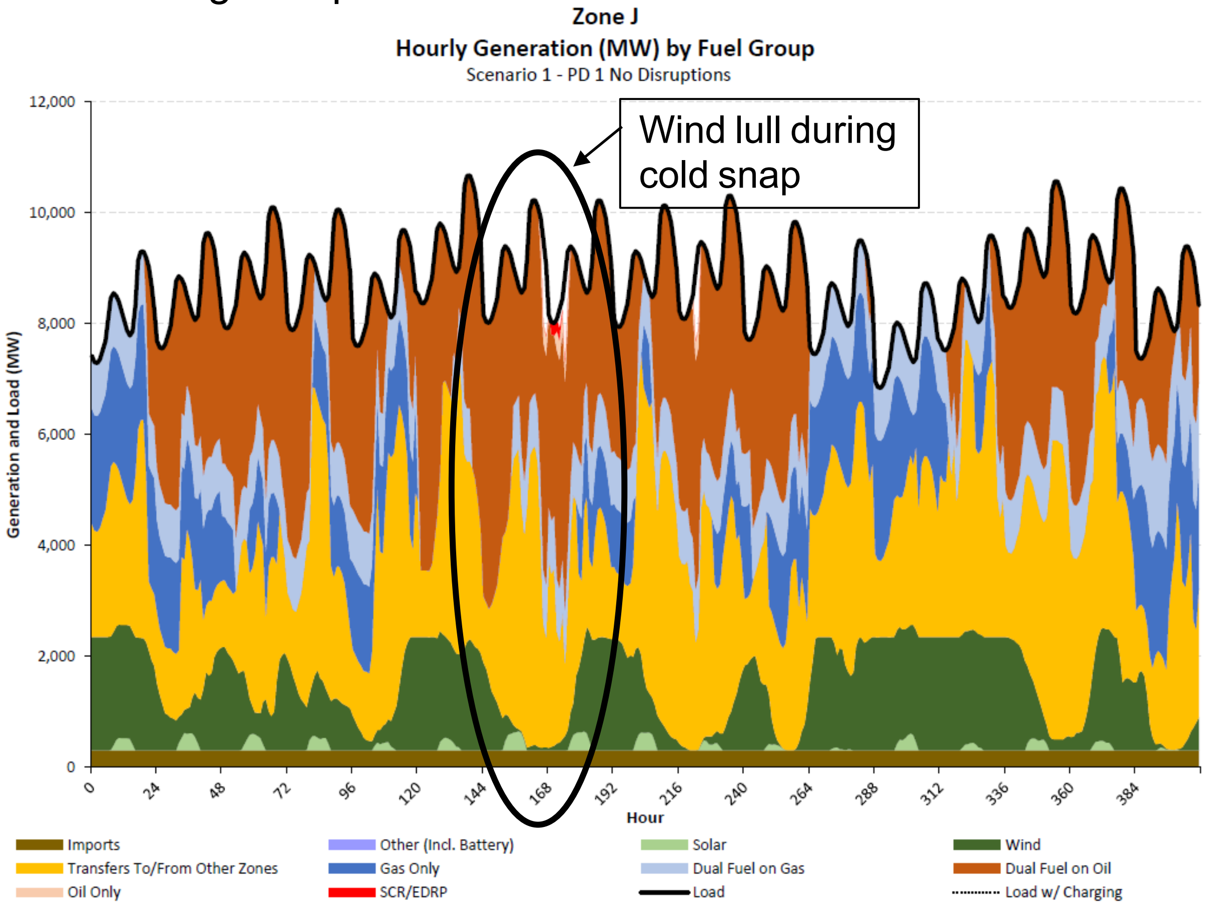
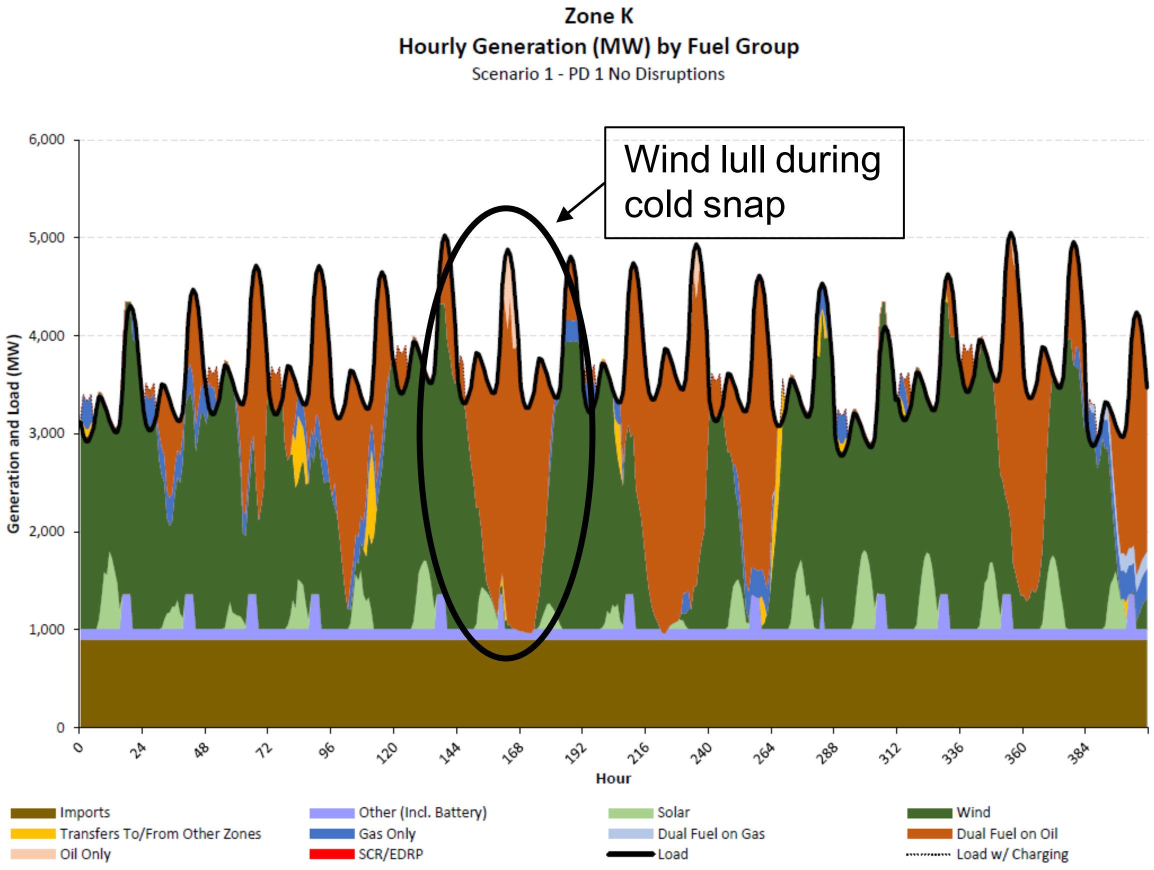
Winter 2030/2031 Wind Lull Example: Scenario 1, No Disruptions (Initial Conditions + IM All)

- A lull in the offshore wind production occurs during the modeled cold snap, limiting the contribution of offshore wind to meet load during that period in Load Zones J and K





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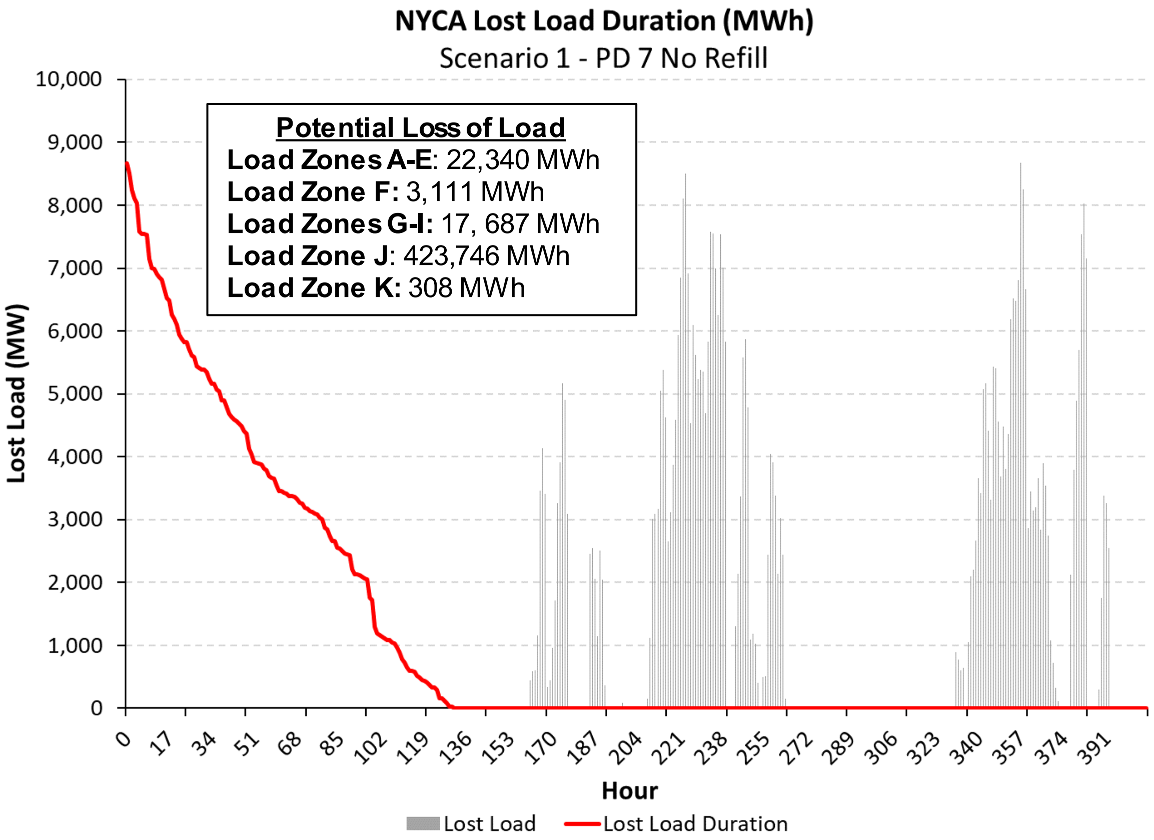
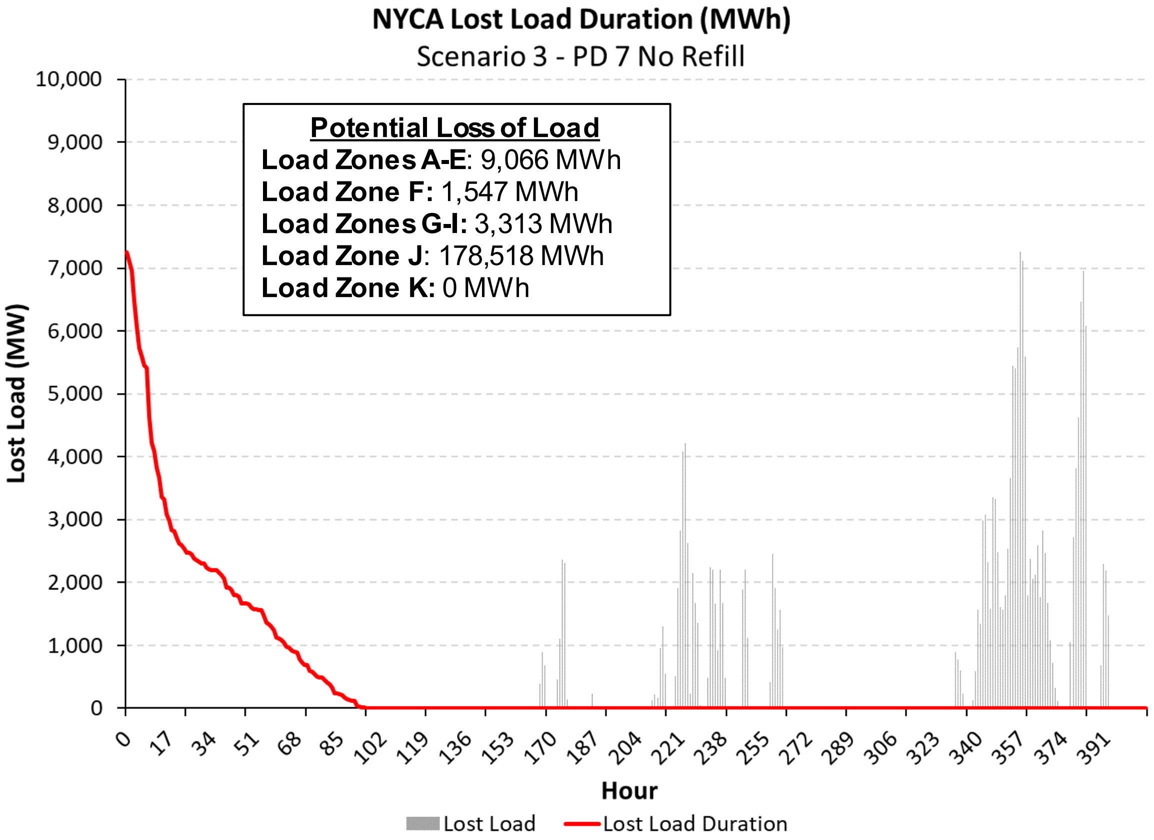
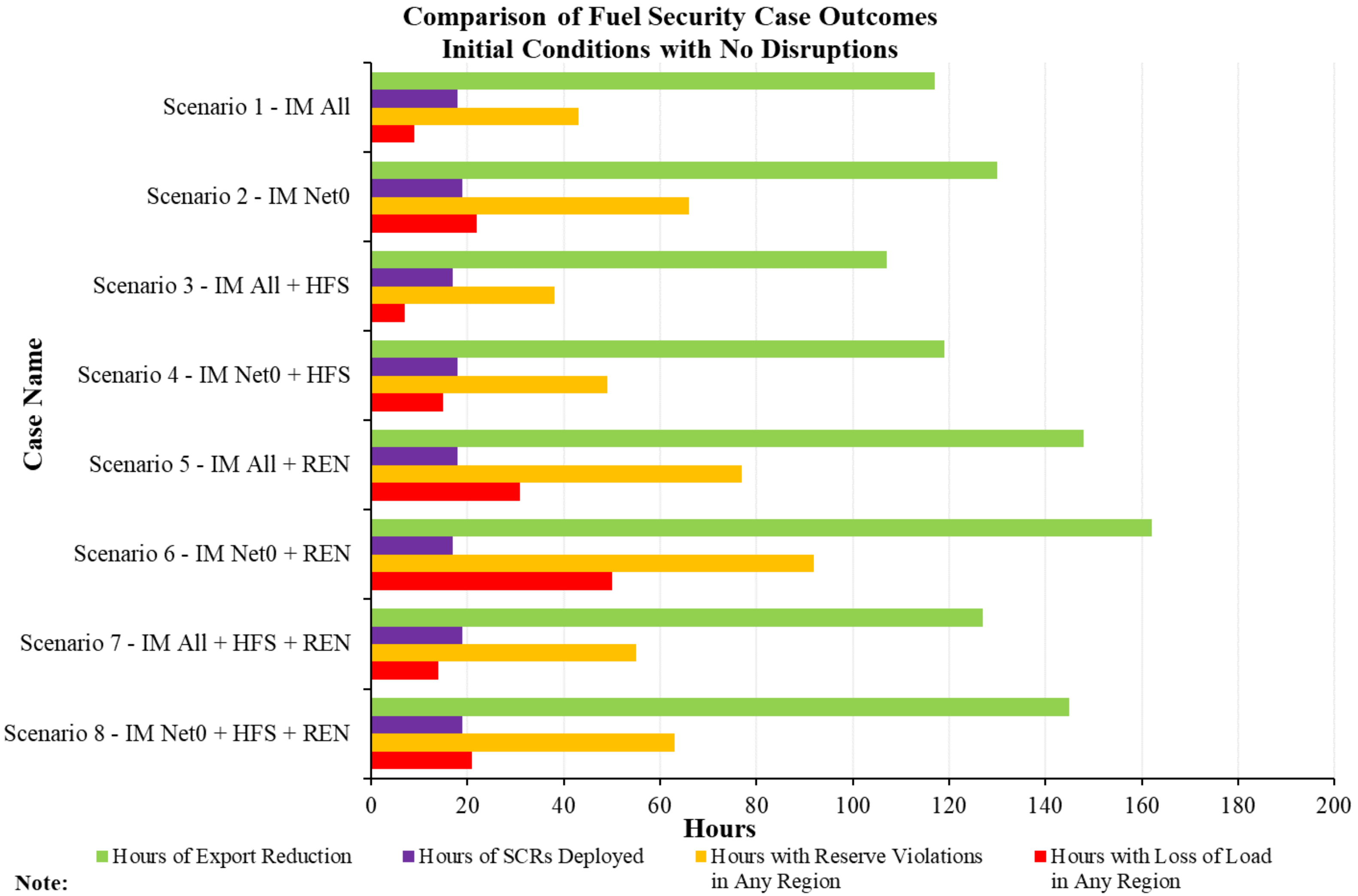
Winter 2030/2031 Selected Case Comparison: No Refill (Disruption 7), Scenario 1 (IM All) and Scenario 3 (IM All + HFS)

- No refill disruption under these conditions causes potential loss of load in all load zones; as shown in previous winters, higher fuel storage inventories mitigates the impact





Winter 2030/2031 – Initial Case Results



Note:

[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels, REN = 20% decrease in 2021-2040 Outlook Policy Case 1 utility-scale solar, land-based wind, and offshore wind additions.

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Next Steps

- Tentative Schedule
  - Develop key takeaways and recommendations based on study results
  - August/September 2023: AG presentation of study report, including key observations and recommendations

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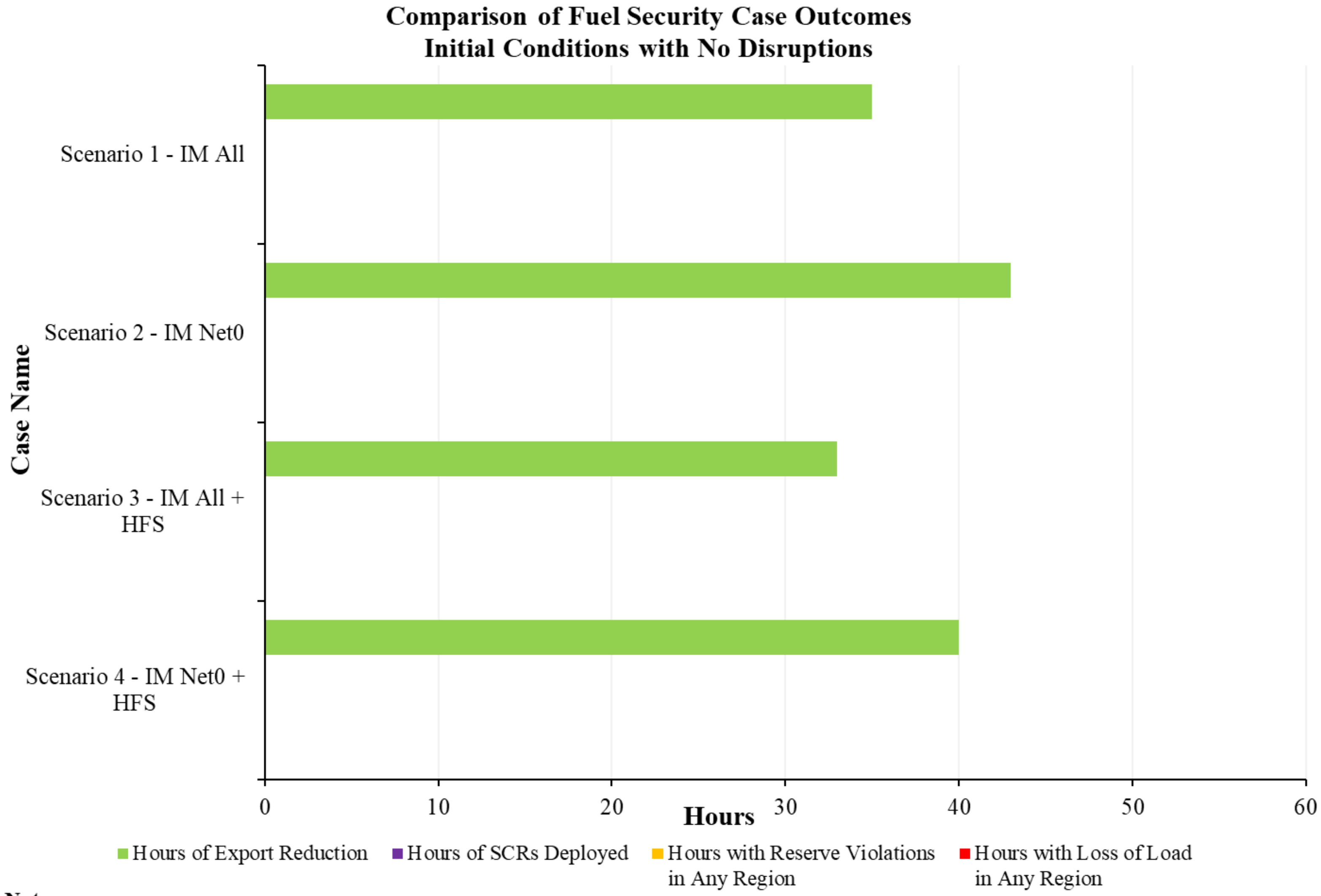
Initial Case Results by Winter

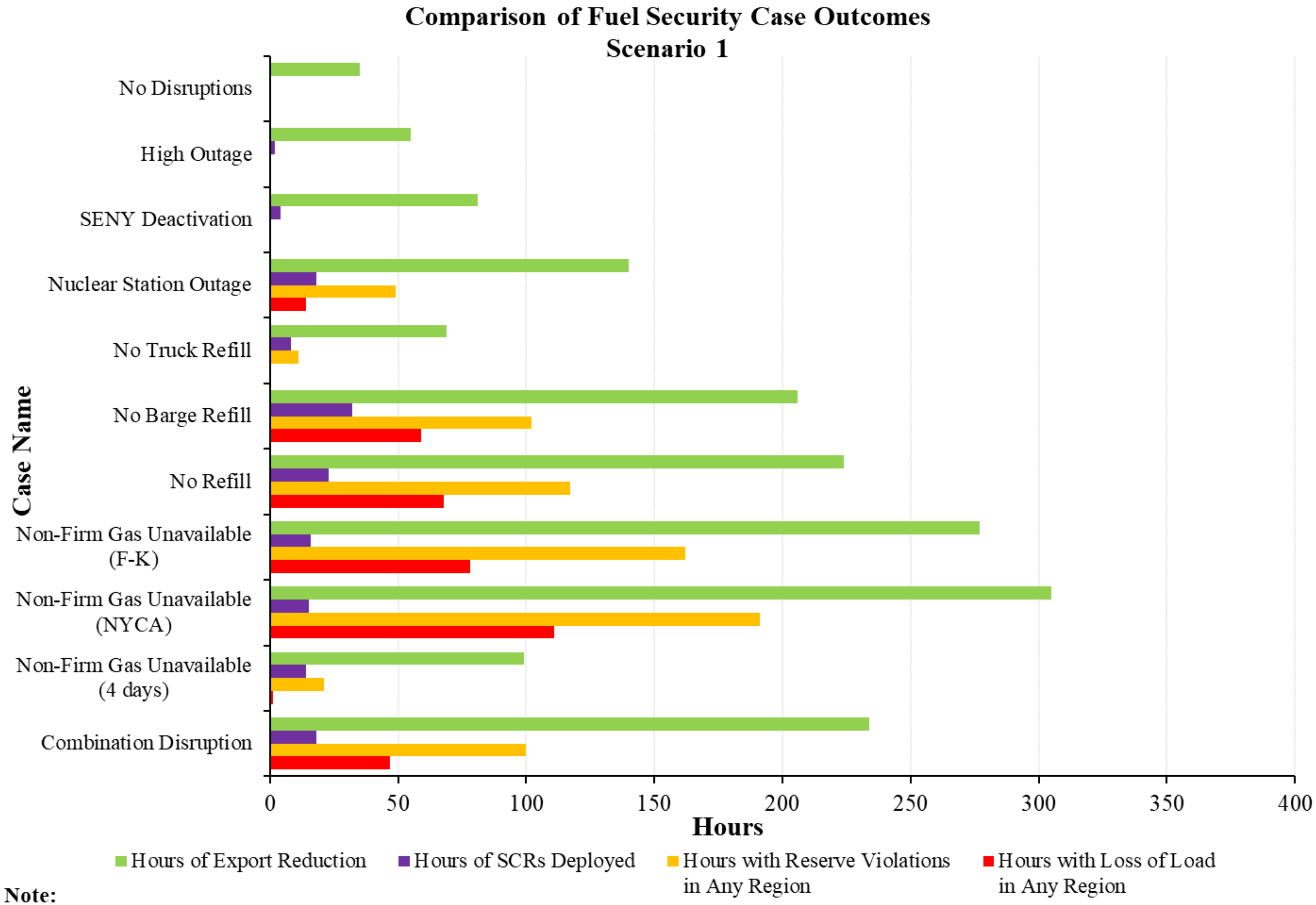
Winter 2023/2024

Winter 2023/2024 – Initial Case Results



Note:
[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels.

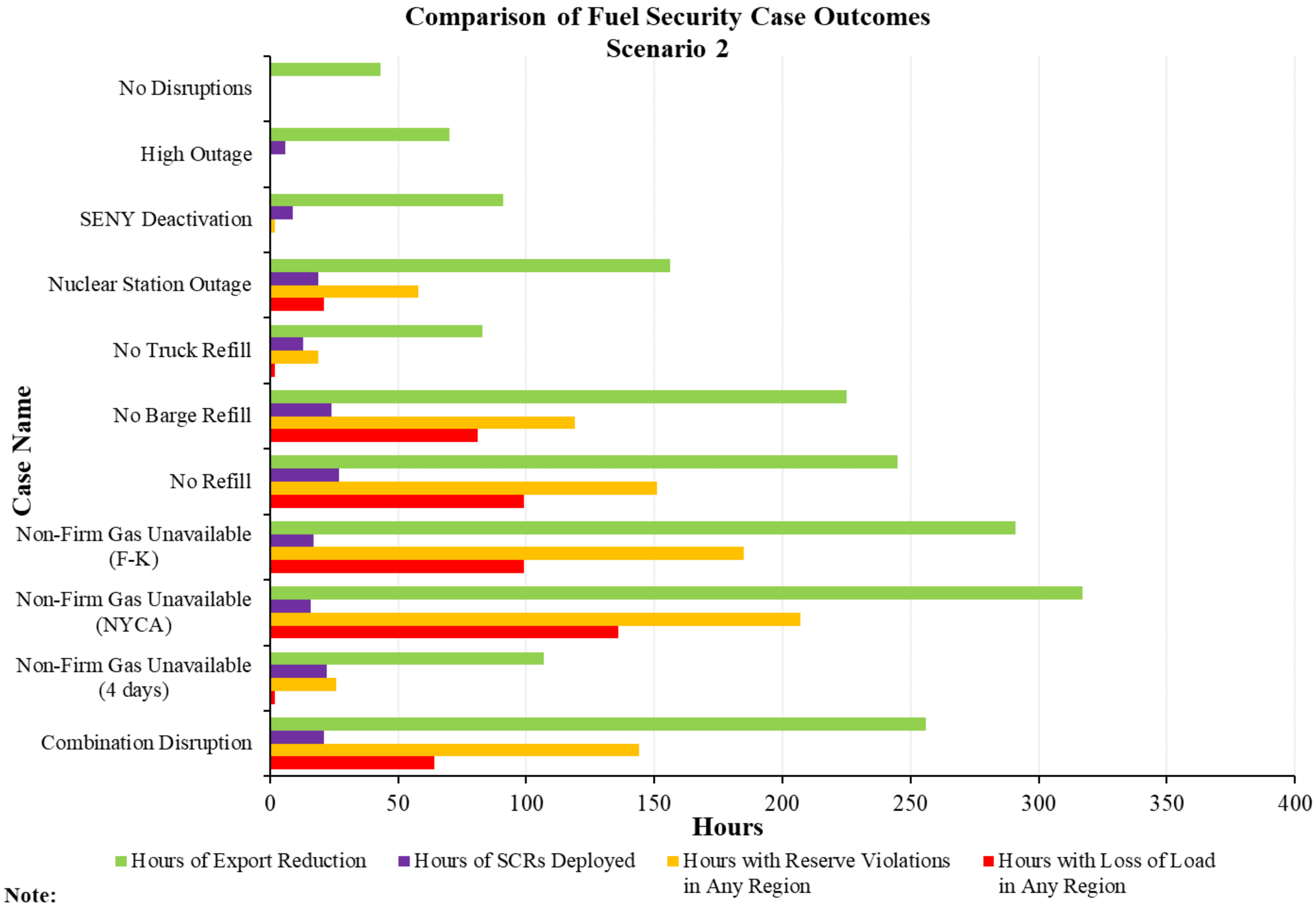
Winter 2023/2024 – Initial Case Results



Note:

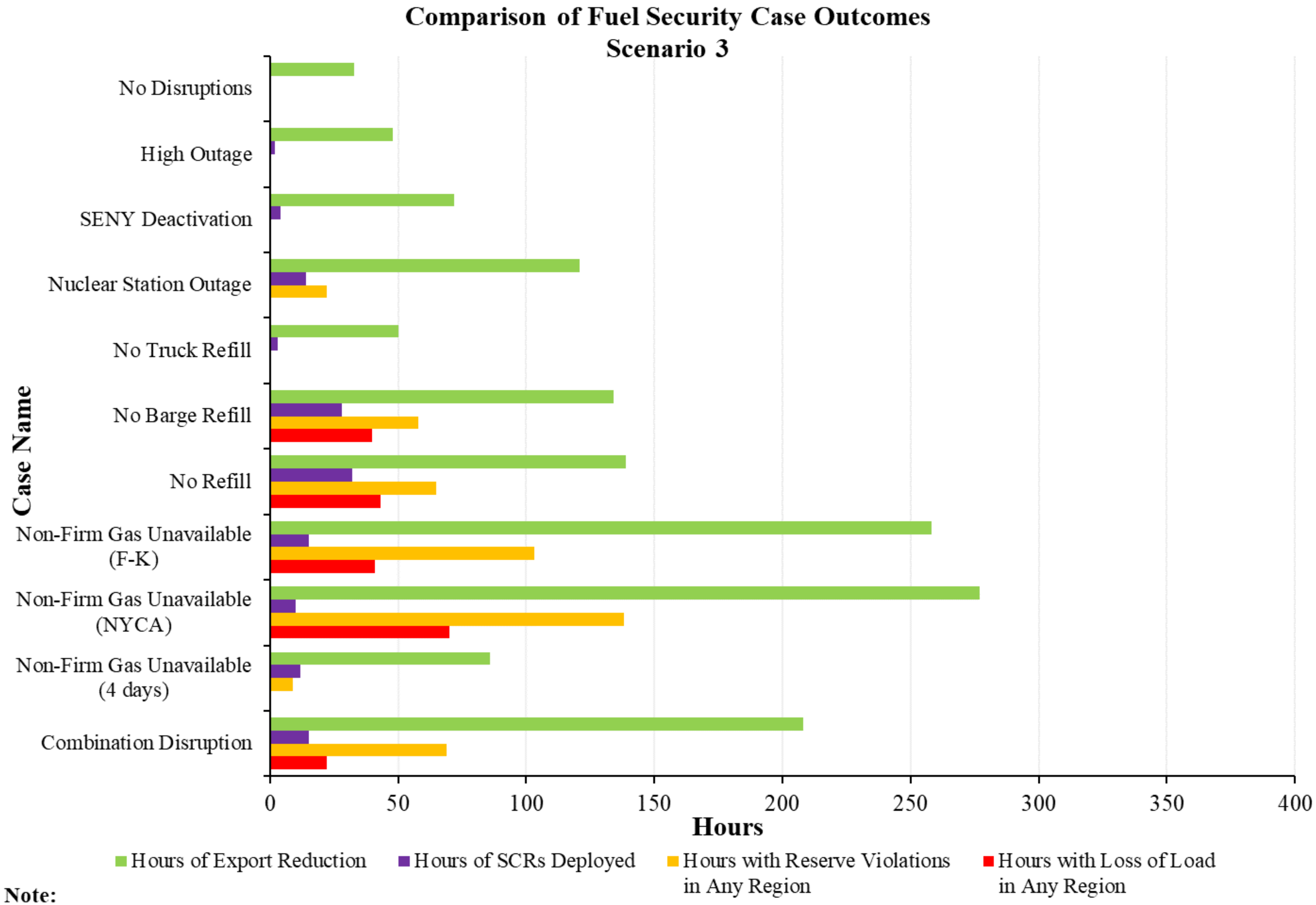
[1] Scenario 1 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports.

Winter 2023/2024 – Initial Case Results



Note:
[1] Scenario 2 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports.

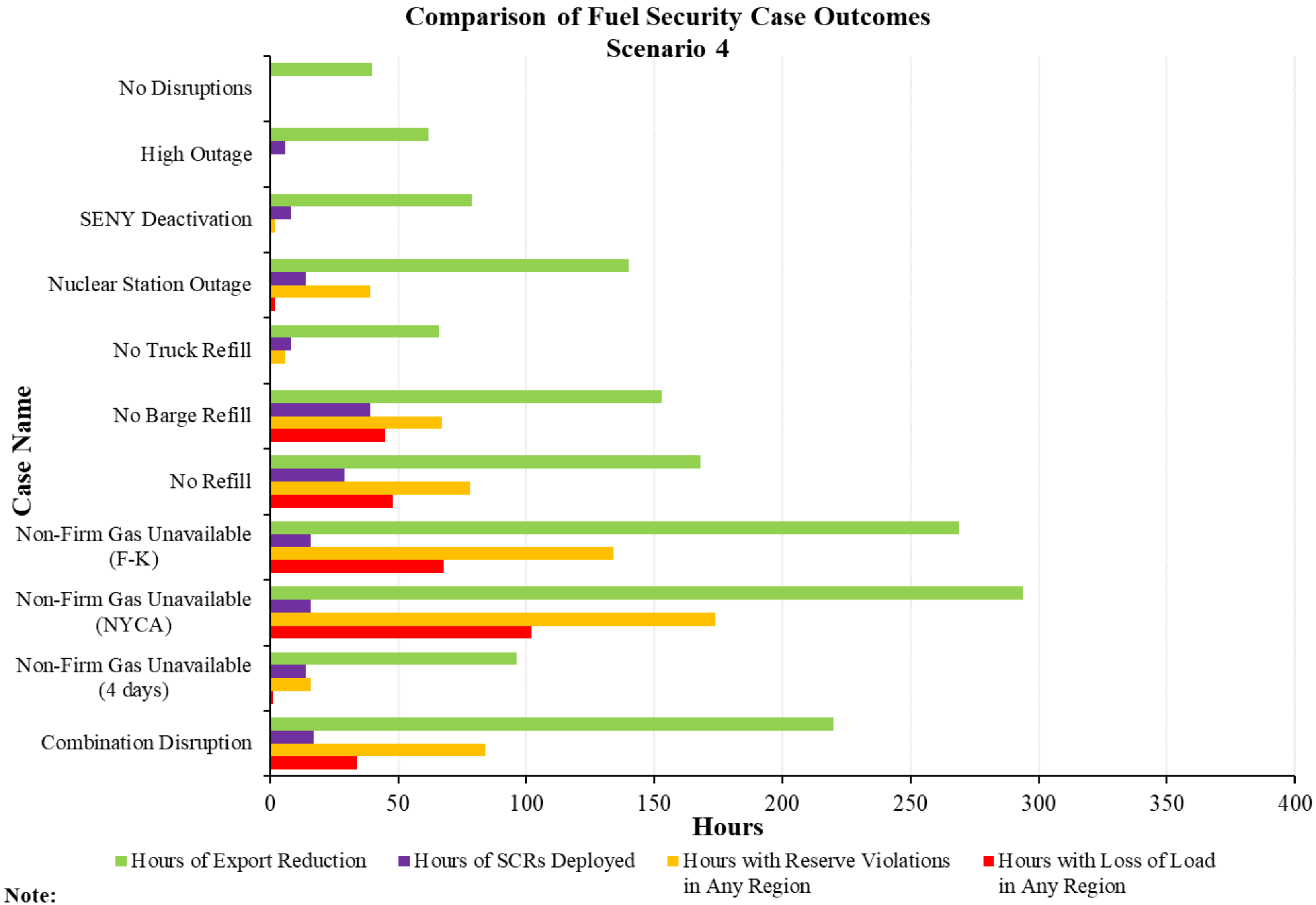
Winter 2023/2024 – Initial Case Results



Note:

[1] Scenario 3 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

Winter 2023/2024 – Initial Case Results



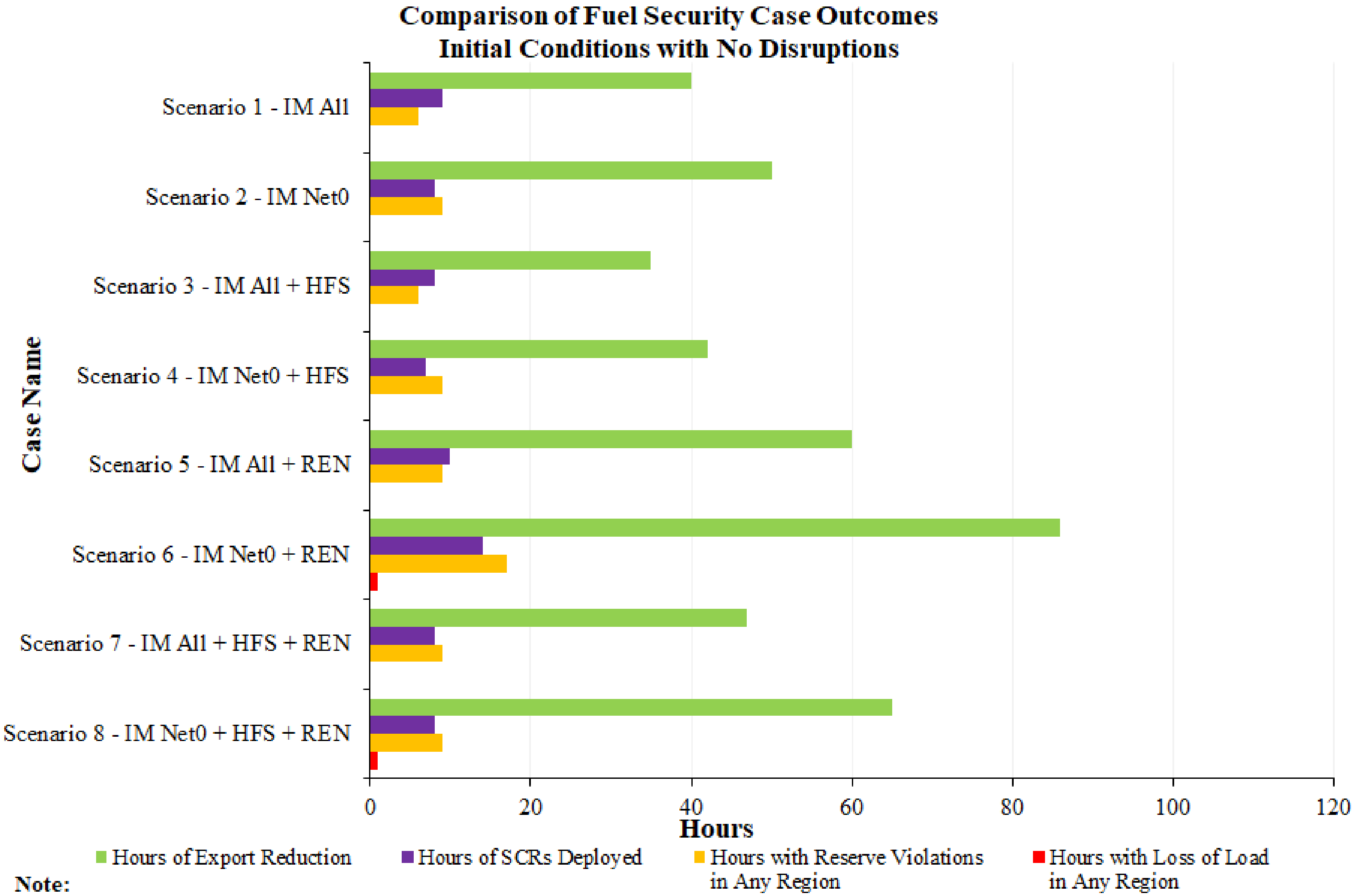
Note:

[1] Scenario 4 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

Initial Case Results by Winter

Winter 2026/2027

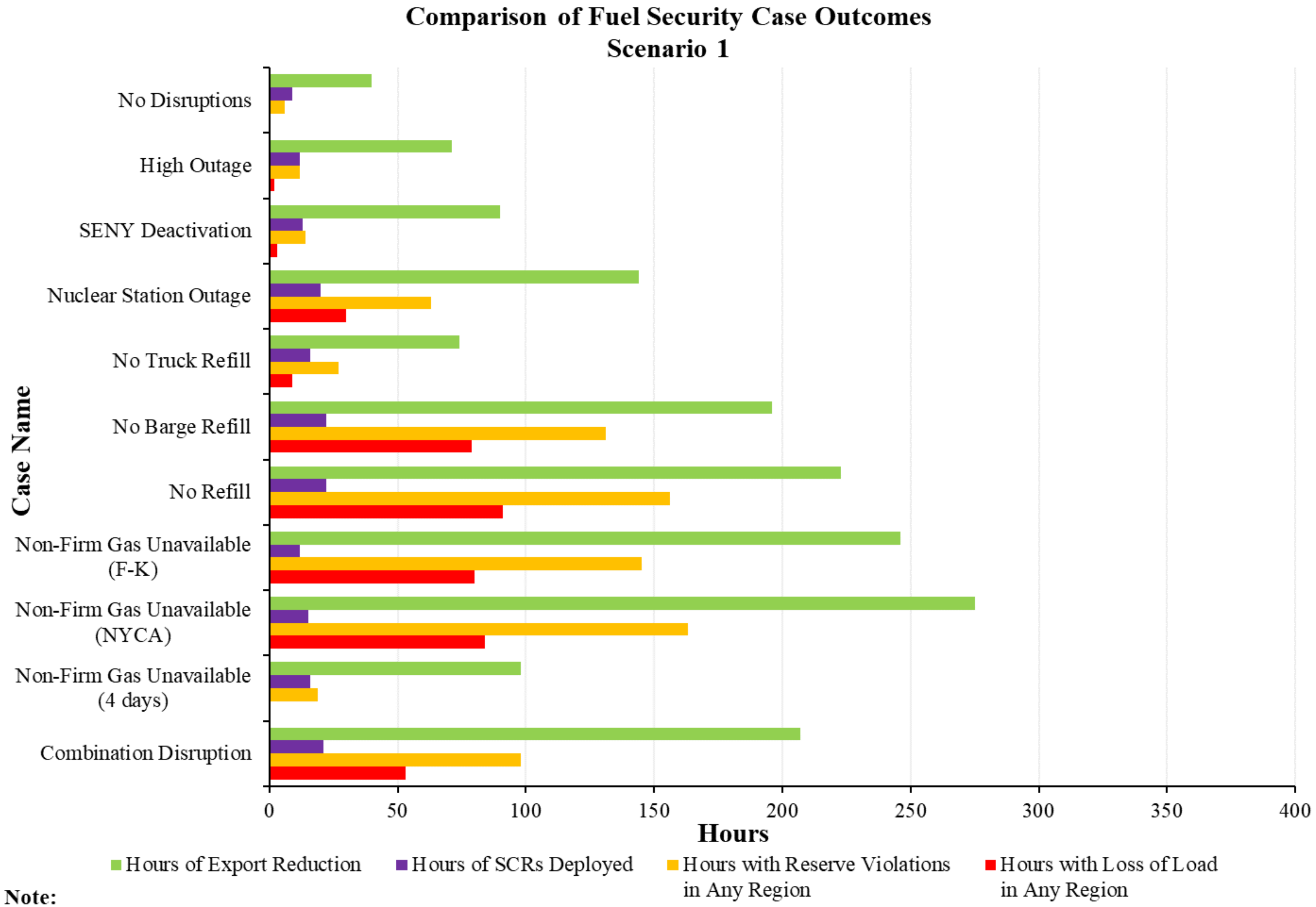
Winter 2026/2027 – Initial Case Results



Note:

[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels, REN = 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 1 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports.

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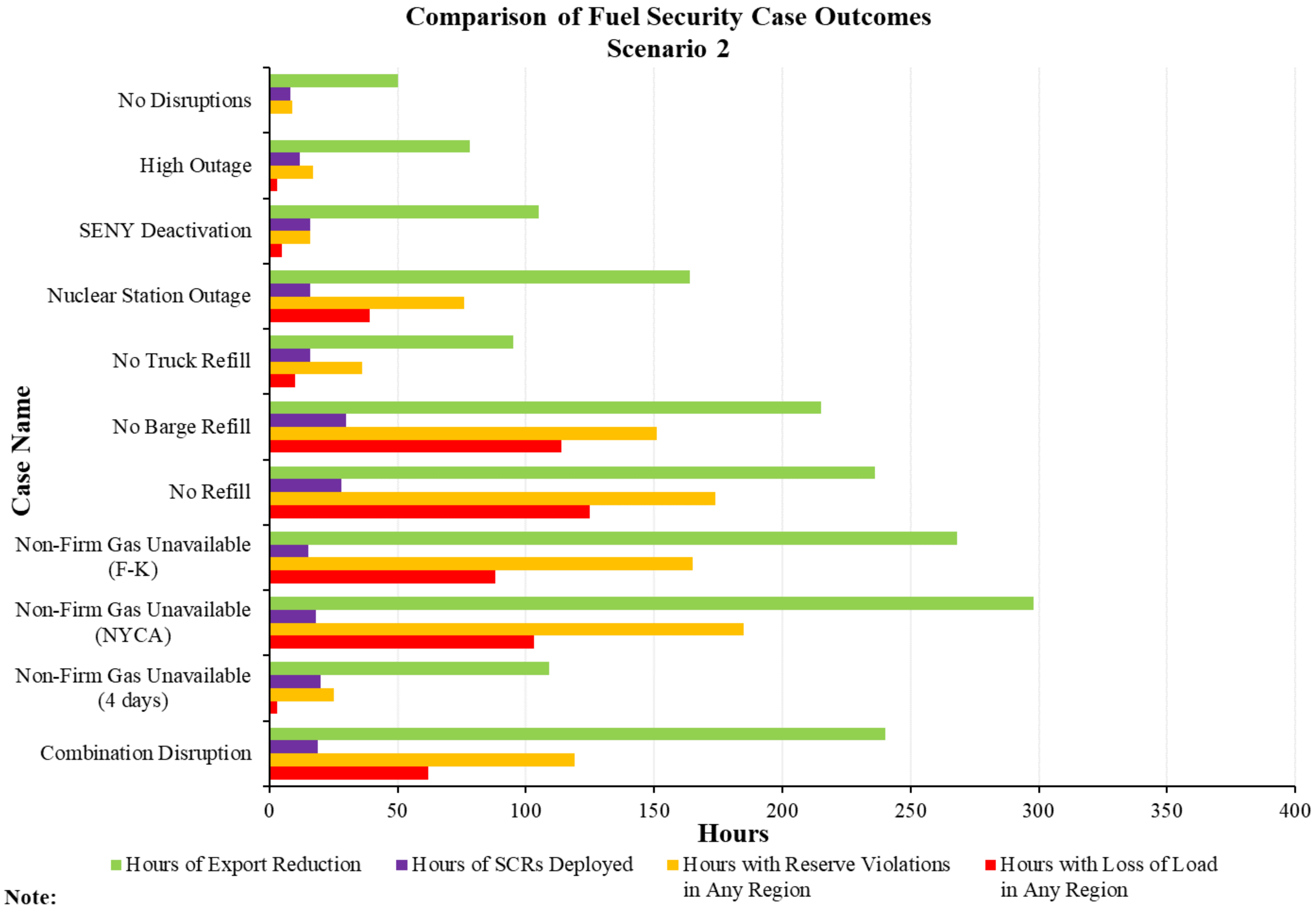
Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 2 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports.

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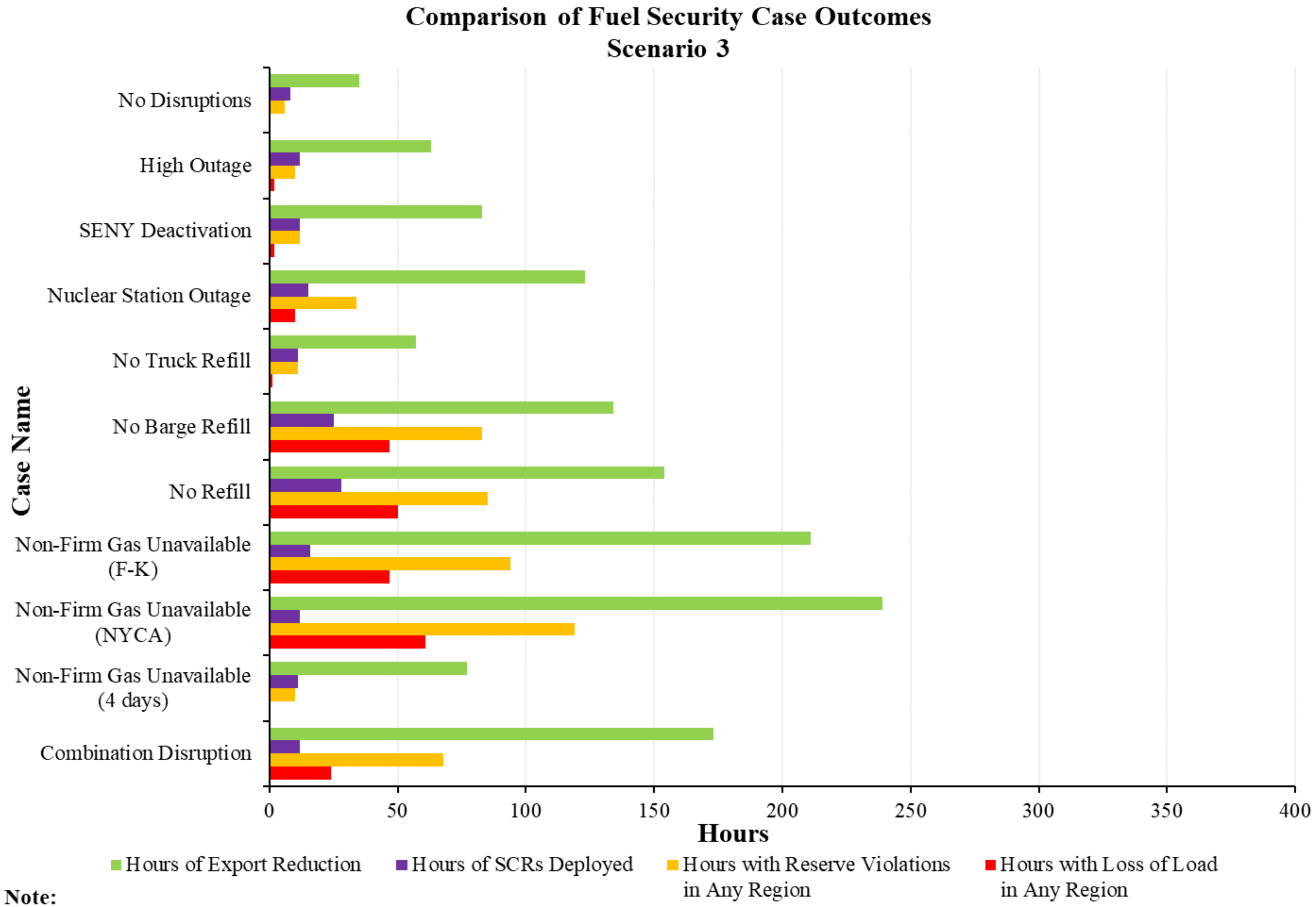
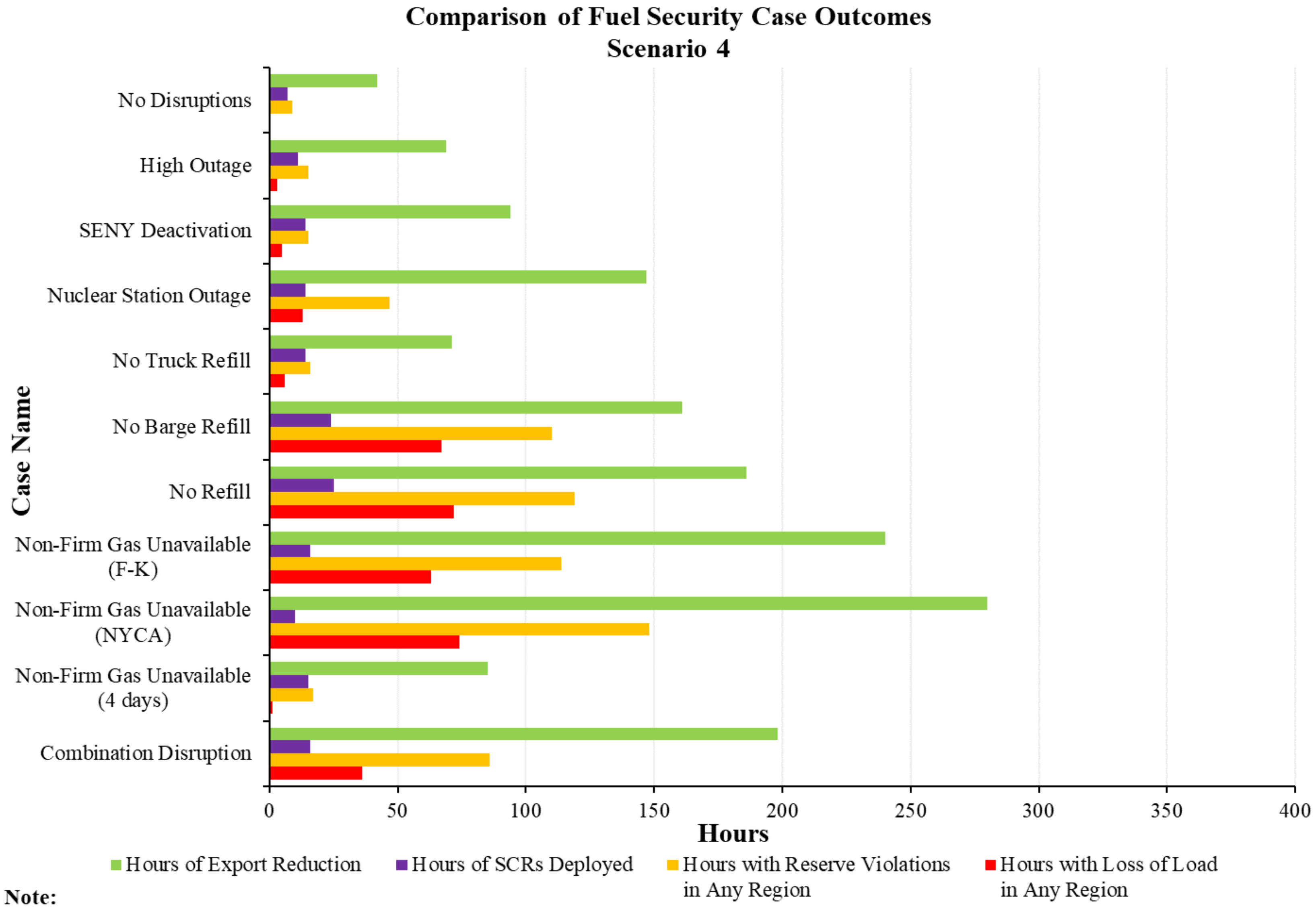
Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 3 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 4 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

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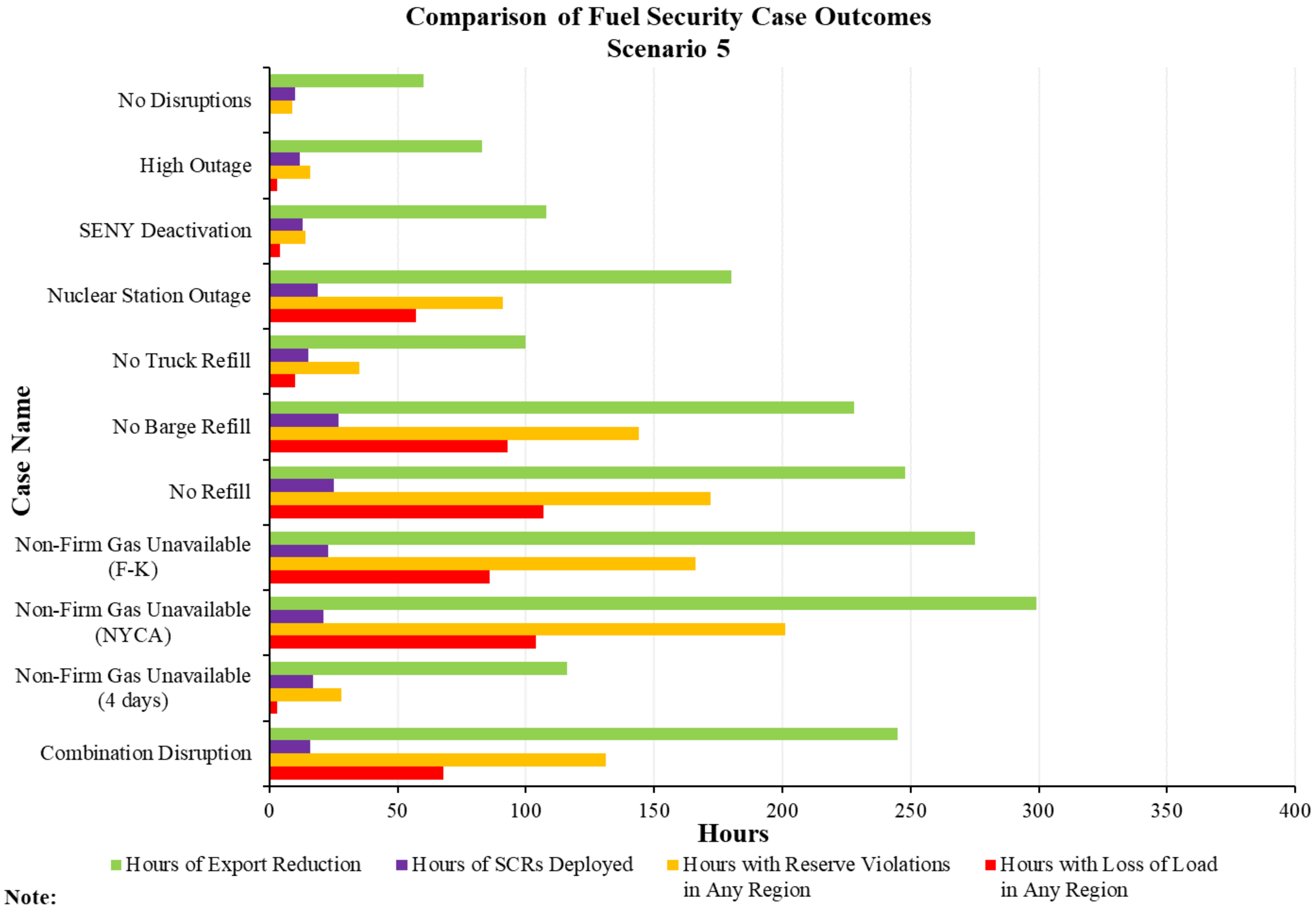
Winter 2026/2027 – Initial Case Results



Note:

[1] Scenario 5 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and a 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

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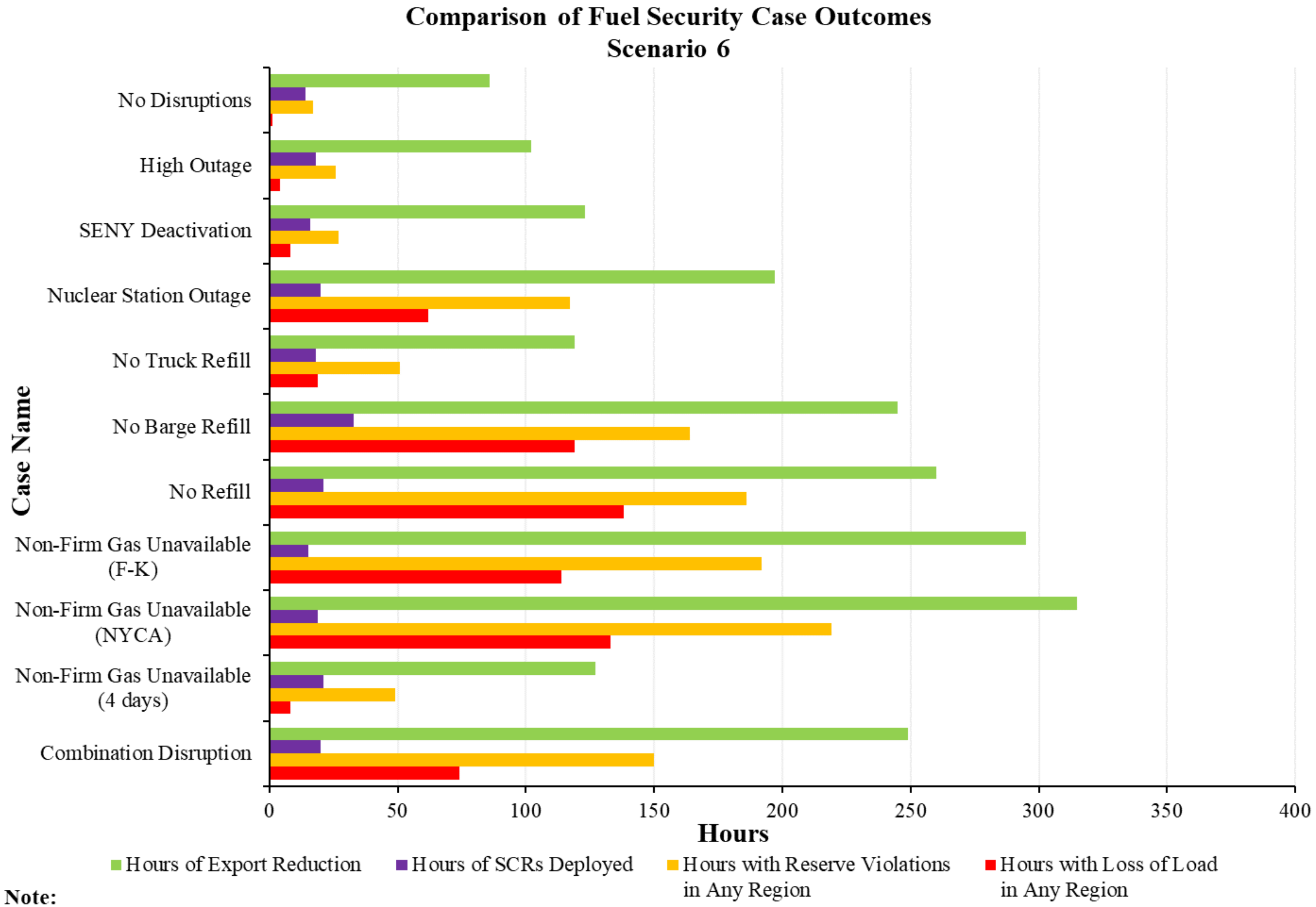
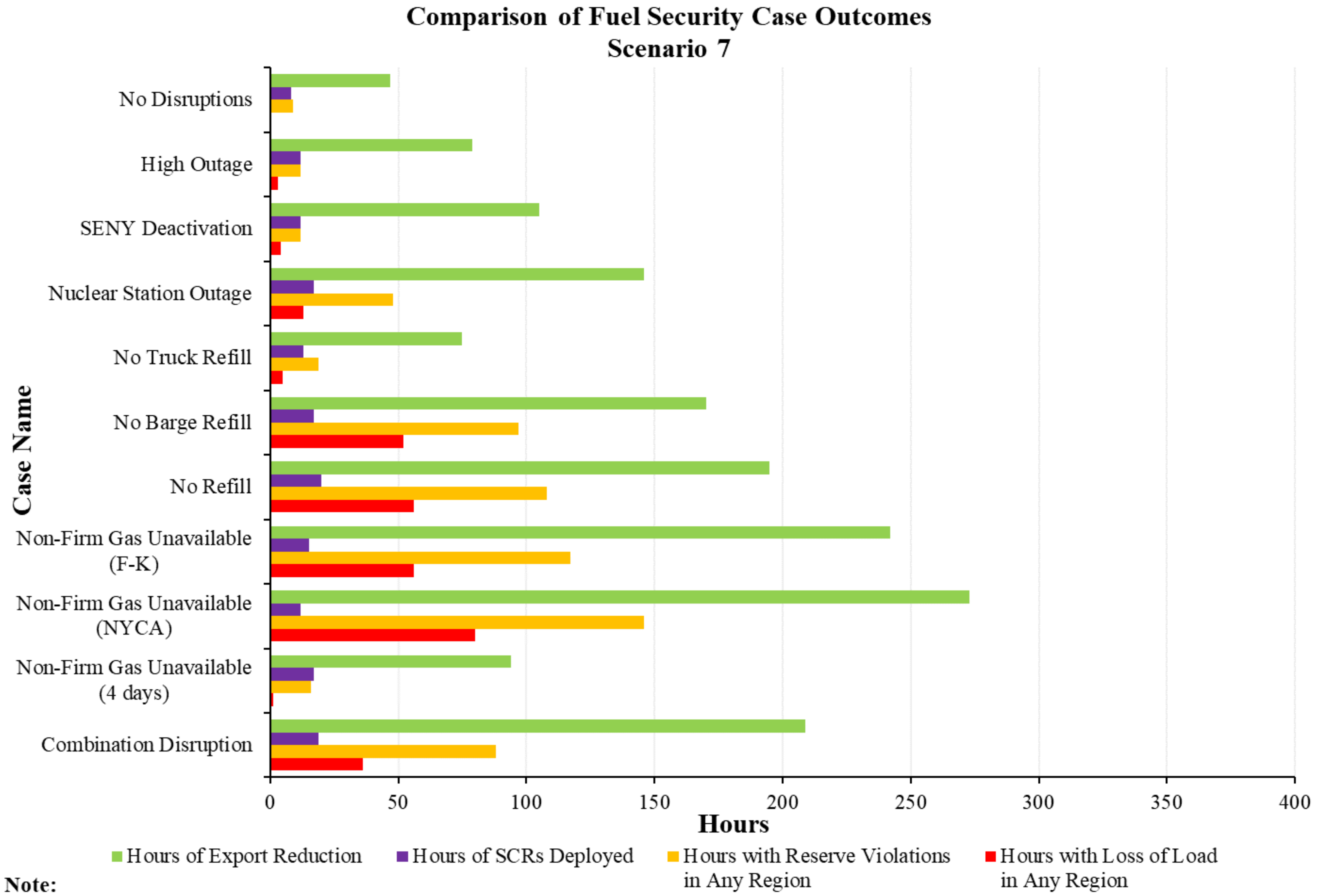
Winter 2026/2027 – Initial Case Results



Note:

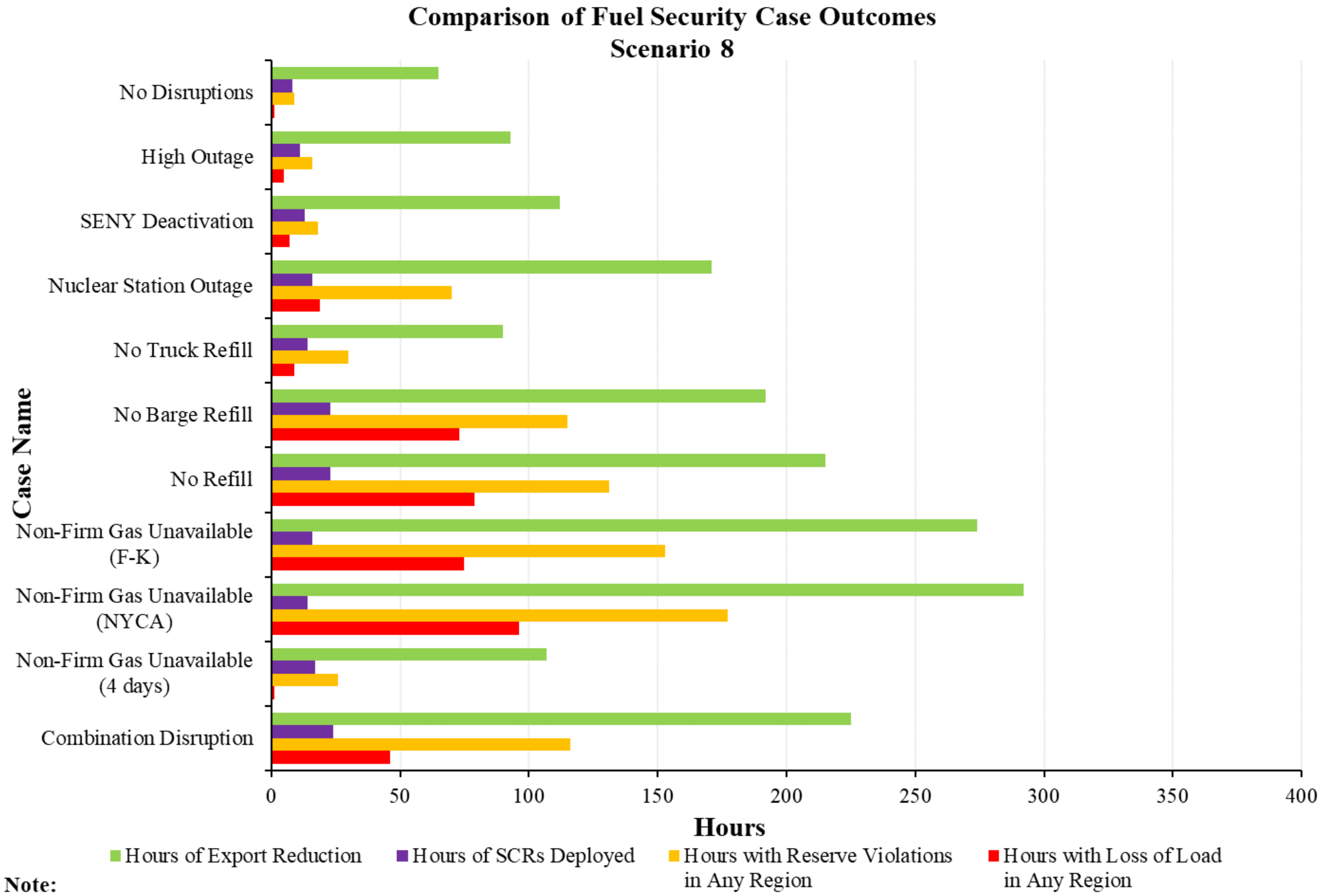
[1] Scenario 6 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, and a 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

Winter 2026/2027 – Initial Case Results



Note:
[1] Scenario 7 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, high starting fuel storage assumptions (50% increase in starting storage levels), and a 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

Winter 2026/2027 – Initial Case Results

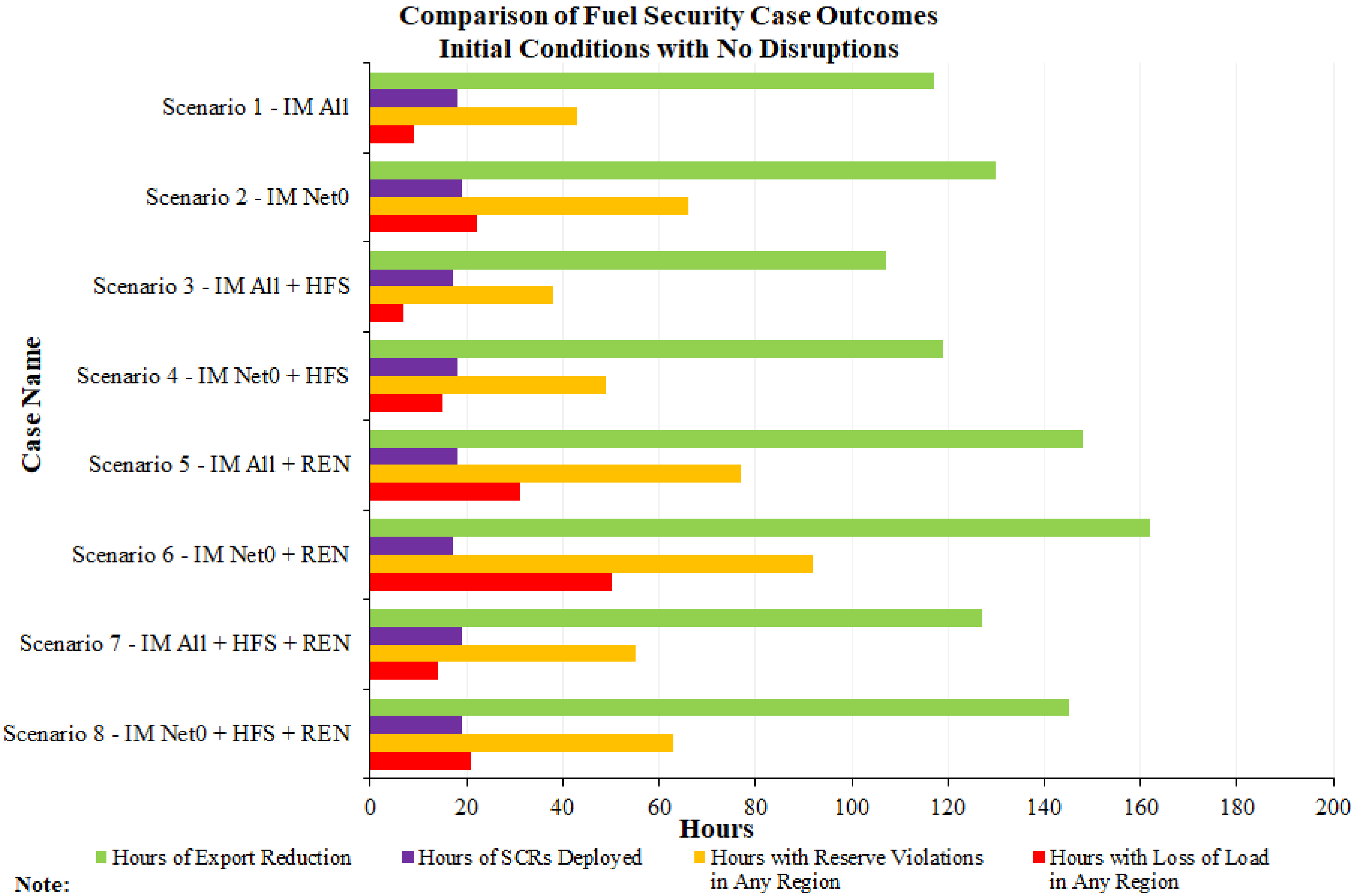


Note:
[1] Scenario 8 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, high starting fuel storage assumptions (50% increase in starting storage levels, and a 33% decrease in 2021-2040 Outlook Contract Case utility-scale solar and land-based wind additions.

Initial Case Results by Winter

Winter 2030/2031

Winter 2030/2031 – Initial Case Results



Note:
[1] IM All = 1,200 MW capacity imports and a minimum of 300 MW capacity exports, IM Net0 = 300 MW capacity imports and a minimum of 300 MW capacity exports, HFS = 50% increase in starting storage levels, REN = 20% decrease in 2021-2040 Outlook Policy Case 1 utility-scale solar, land-based wind, and offshore wind additions.

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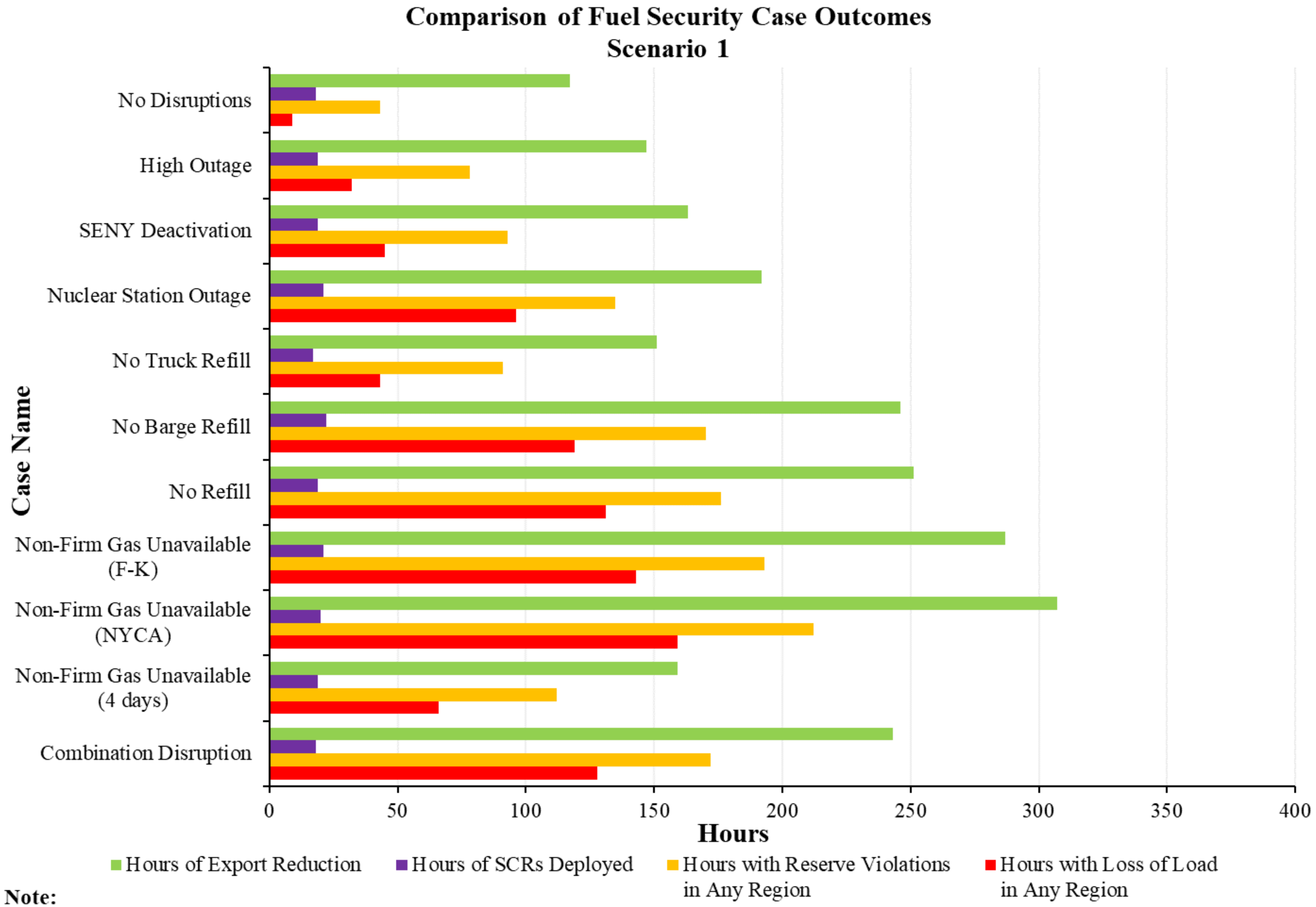
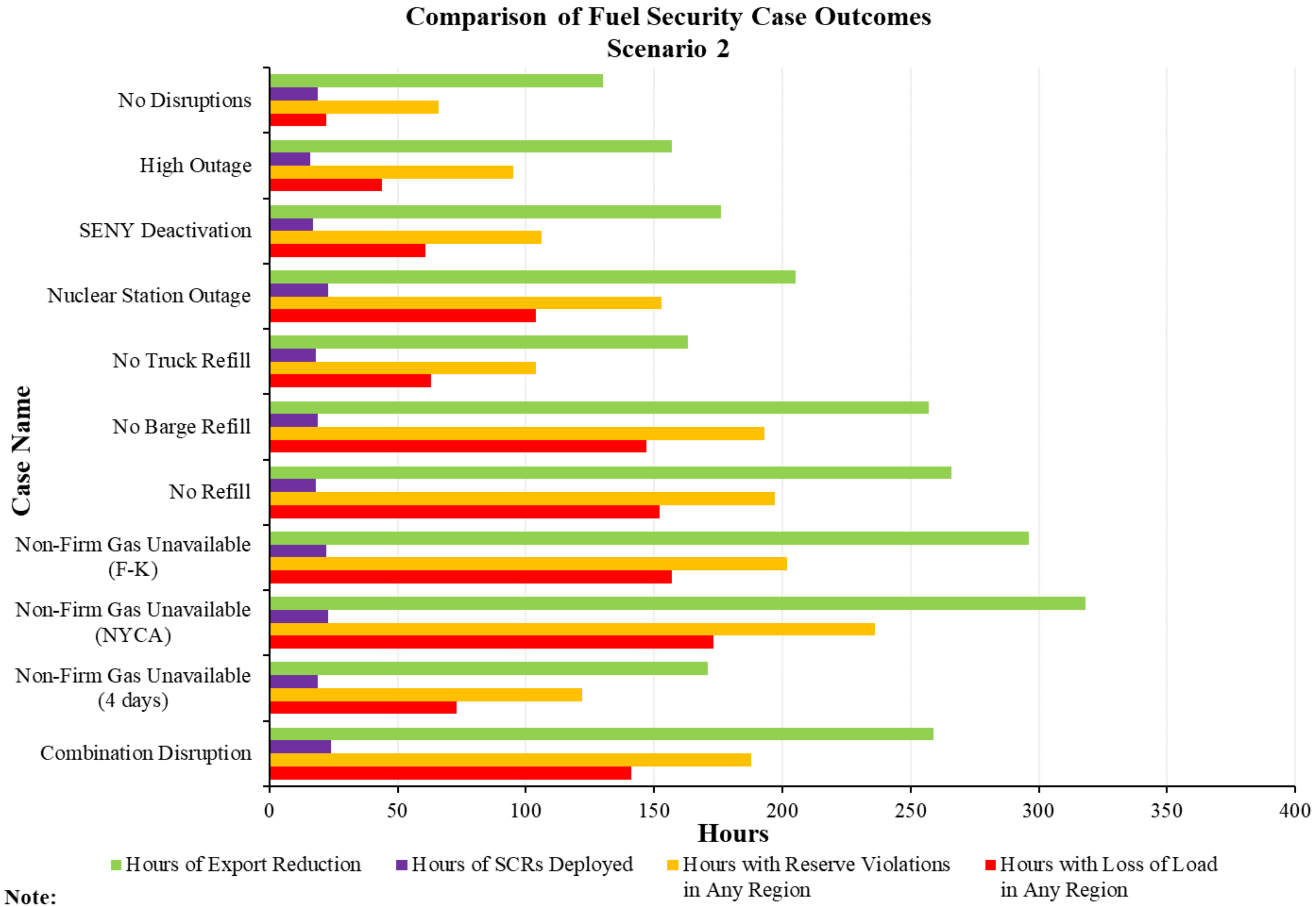
Winter 2030/2031 – Initial Case Results



Note:

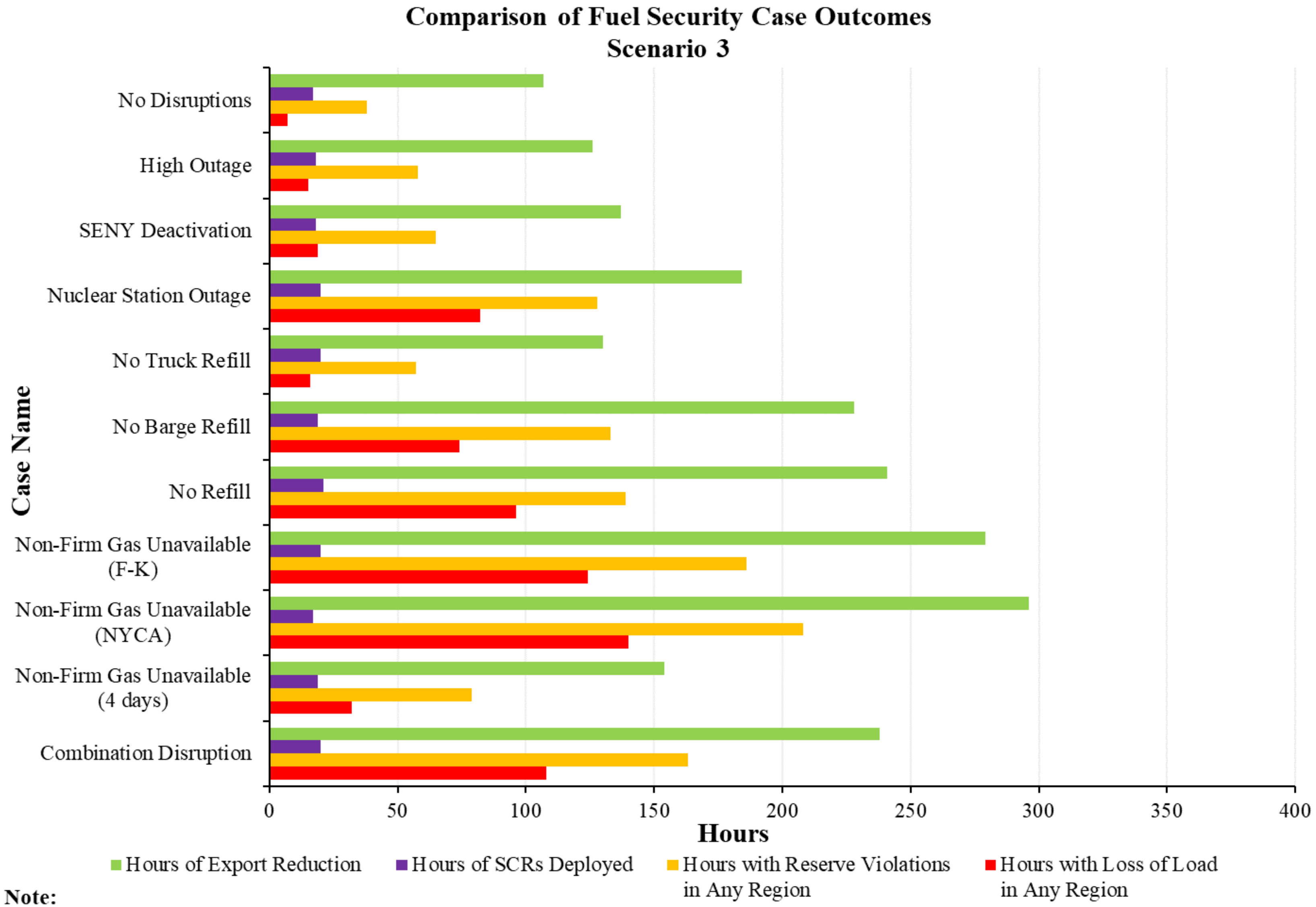
[1] Scenario 1 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports.

Winter 2030/2031 – Initial Case Results



Note:
[1] Scenario 2 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports.

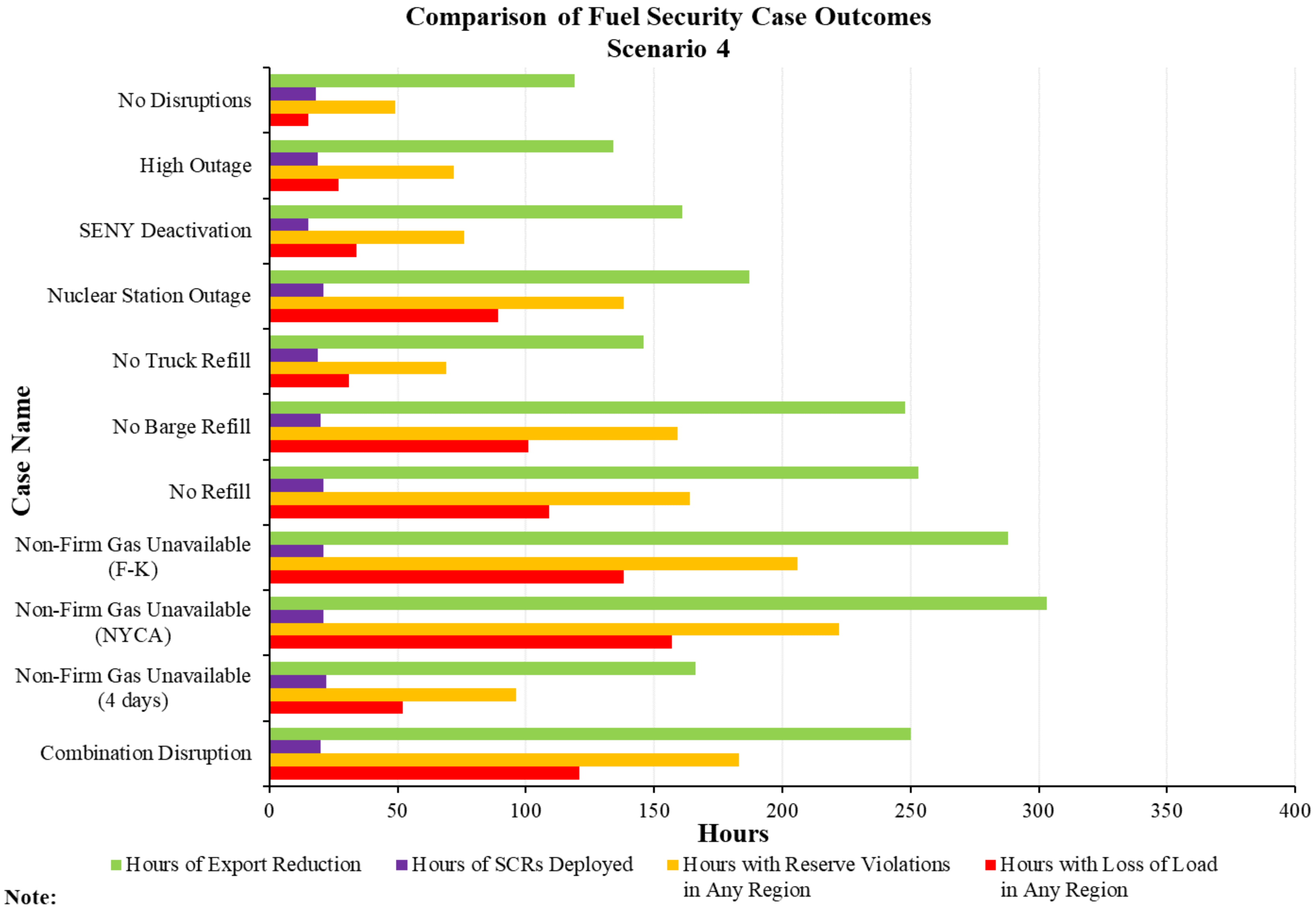
Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 3 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

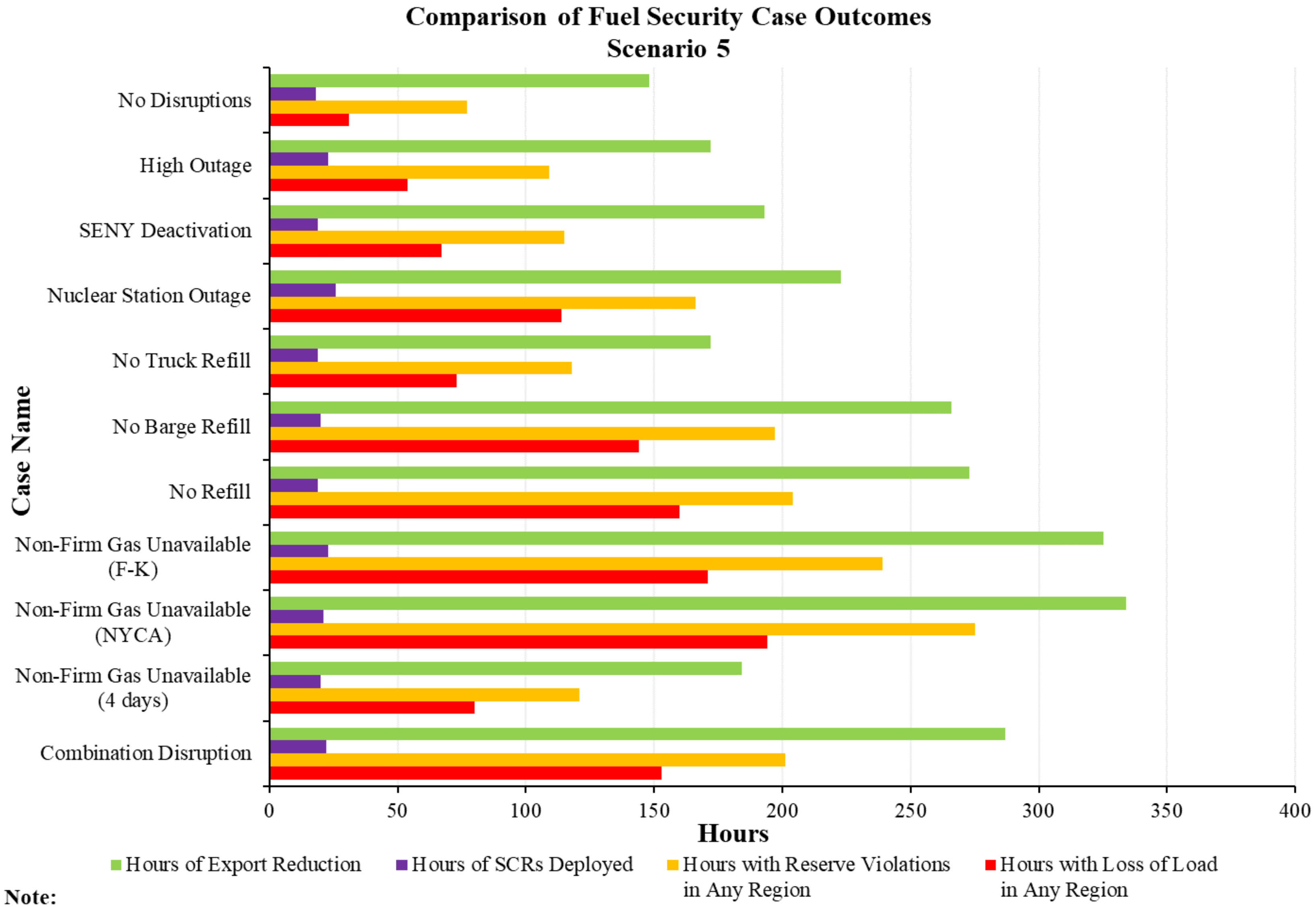
Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 4 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, and high starting fuel storage assumptions (50% increase in starting storage levels).

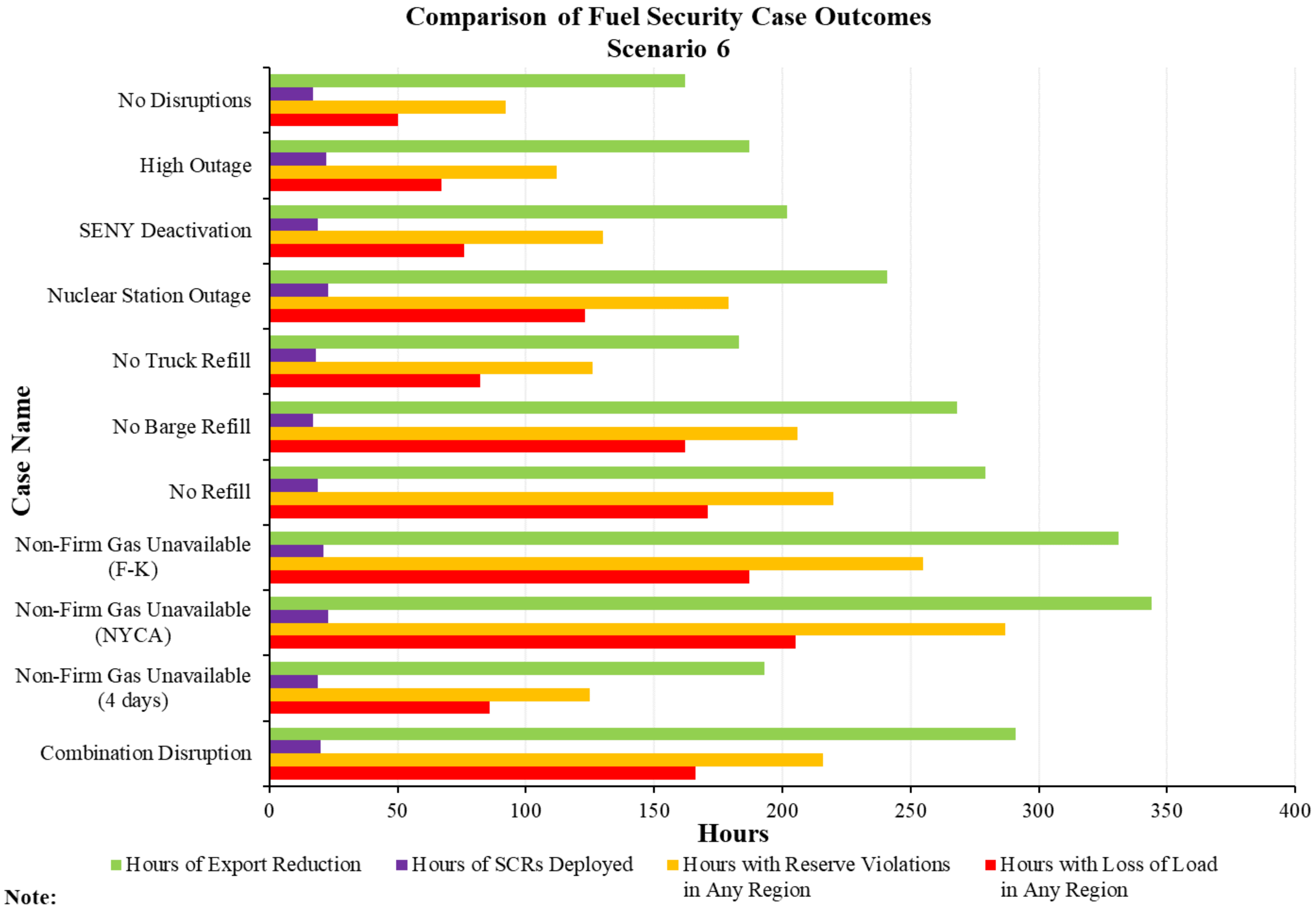
Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 5 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, and a 20% decrease in 2021-2040 Outlook Policy 1 Case utility-scale solar, land-based wind, and offshore wind additions.

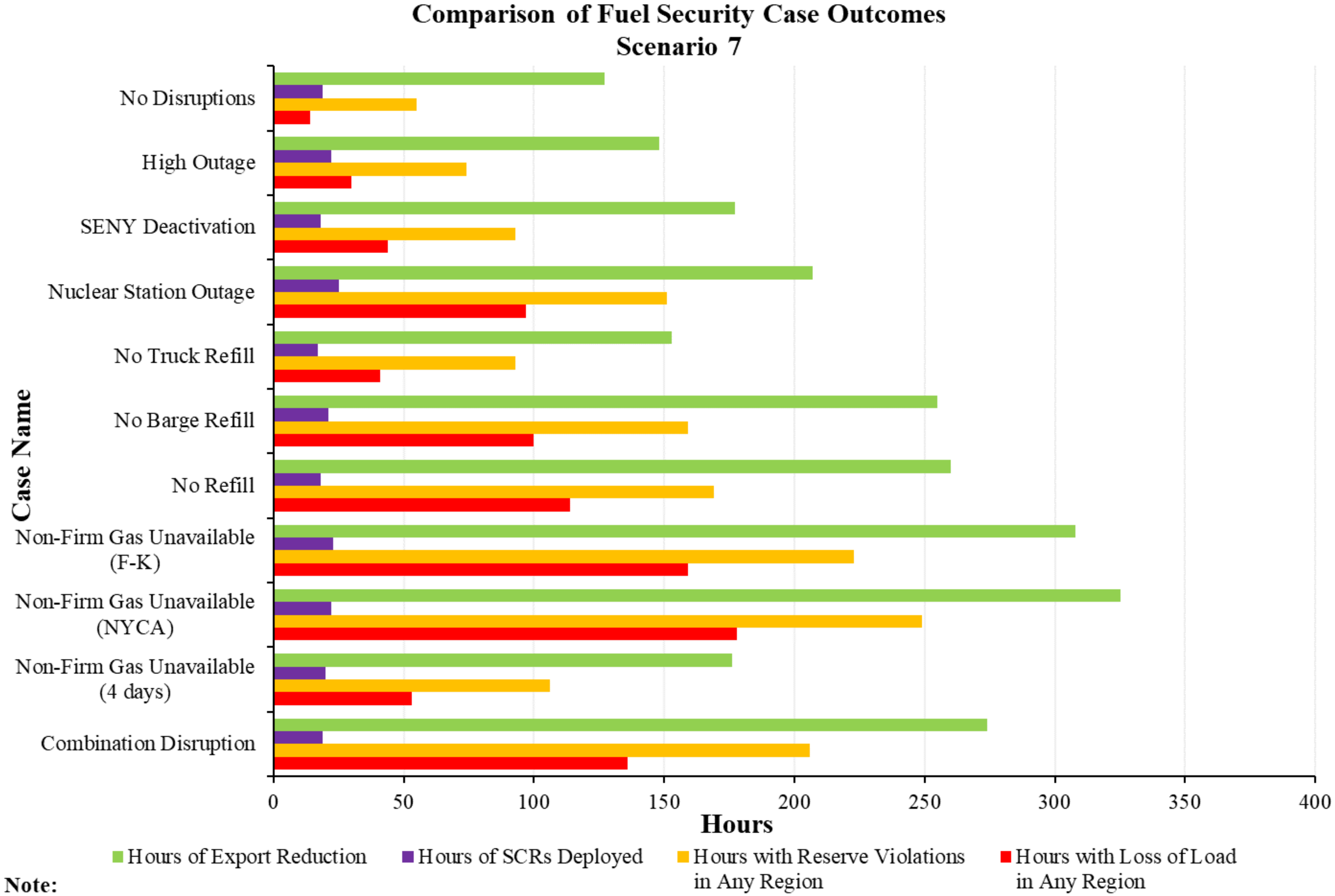
Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 6 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, and a 20% decrease in 2021-2040 Outlook Policy 1 Case utility-scale solar, land-based wind, and offshore wind additions.

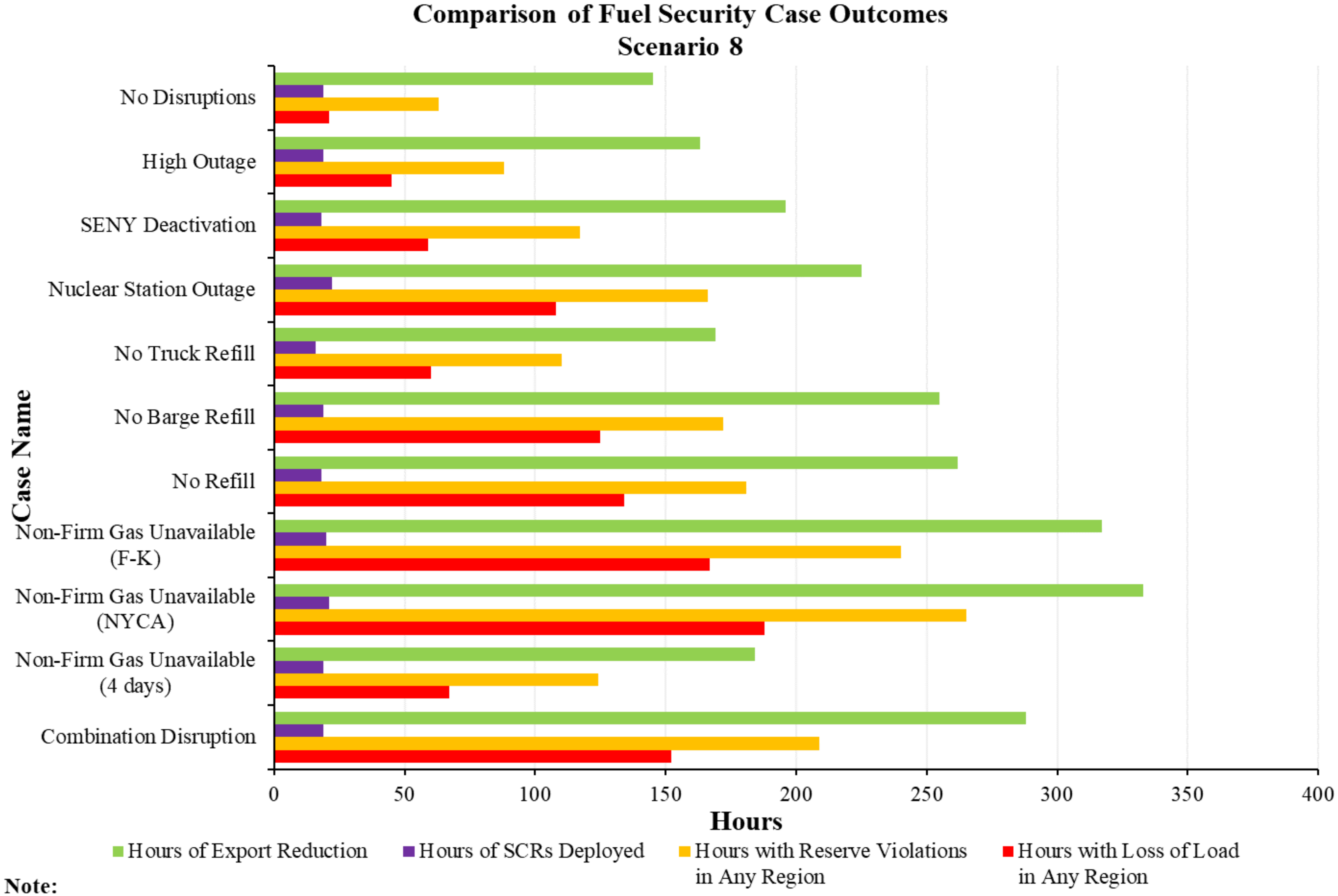
Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 7 includes inital conditions with 1,200 MW capacity imports and a minimum of 300 MW capacity exports, high starting fuel storage assumptions (50% increase in starting storage levels), and a 20% decrease in 2021-2040 Outlook Policy 1 Case utility-scale solar, land-based wind, and offshore wind additions.

Winter 2030/2031 – Initial Case Results



Note:

[1] Scenario 8 includes inital conditions with 300 MW capacity imports and a minimum of 300 MW capacity exports, high starting fuel storage assumptions (50% increase in starting storage levels), and a 20% decrease in 2021-2040 Outlook Policy 1 Case utility-scale solar, land-based wind, and offshore wind additions.

Additional Input Detail

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Gas Pipeline Supply – As Presented 6/14/23

- Based on review of LDC documents, essentially all of pipeline export capacity from New York to New England is assumed to be under firm contract to deliver flowing gas or transport stored gas
- Gas available for electric generation on LDC Design Day = [Expected Pipeline Imports
  – Max Pipeline Exports to NE
  – LDC Design Day Demand]
- No LNG or storage capacity is assumed to be available for delivery to generators
- Gas supply is assumed to be transferable within New York; except for certain assumed limitations downstate
  - Specifically, in Load Zones J and K, gas availability is reduced starting at effective degree days greater than 50
- Model will reflect limitations of supply to gas generators based on temperature

New York State Modeling Period Gas Supply and Demand (MMCF/d)

Gas Supply/Demand	MMCF/d	Calculation	Source
Modeling Period Supply			
Max New York State Imports from PJM	10,186	[A]	EIA
Expected New York State Imports from Ontario	400	[B]	NYISO
Gas Available within New York	***10,586***	***[C] = [A] + [B]***	
Modeling Period Demand			
Expected New York State Exports to Ontario	(100)	[D]	NYISO
Max Exports to New England	(4,087)	[E]	EIA
New York Design Day LDC Demand from Pipeline Gas	(4,805)	[F]	NYDPS
Total Outflows/LDC Demand	***(8,992)***	***[G] = [D]+[E]+[F]***	
Max Gas Available for Electric Generation in New York	**1,594**	**[H] = [C] + [G]**	
Equivalent MW of Gas Generation Capacity each Hour at 9 MMBtu/MWh Heat Rate	**7,651**	**[I] = [H] * 4.8**	

Note:
[1] Design Day LDC Demand aggregated from Winter Supply forms for New York State LDCs.

Sources:
[1] EIA, State to State Pipeline Capacity, January 31, 2023.
[2] NYDPS/NYPSC, Case 22-M-0247 - Winter Supply 2022-2023 Forms, Table 1.

Gas Pipeline Supply – Winter 2026/2027

- Small increase in New York LDC design-day peak demand (item [E]) based on LDC winter 2026/2027 forecasts in filings to NYPSC
- Apply separately calculated weighted average growth rate to upstate and downstate LDCs

Gas Supply/Demand	MMCF/d	Calculation	Source
Modeling Period Supply			
Max New York State Imports from PJM	10,186	[A]	EIA
Expected New York State Imports from Ontario	945	[B]	S&P Global
Gas Available within New York	*11,131*	*[C] = [A] + [B]*	
Modeling Period Demand			
Expected Exports to New England	(3,550)	[D]	S&P Global
New York Design Day LDC Demand from Pipeline Gas	(7,318)	[E]	NYDPS
Total Outflows/LDC Demand	*(10,868)*	*[F] = [D]+[E]*	
Max Gas Available for Electric Generation in New York	**263**	[G] = [C] + [F]	
Equivalent MW of Gas Generation Capacity each Hour at 9 MMBtu/MWh Heat Rate	**1,261**	[H] = [G] * 4.8	

Note:
[1] Design Day LDC Demand aggregated from Winter Supply forms for New York State LDCs.

Sources:
[1] EIA, State to State Pipeline Capacity, January 31, 2023.
[2] NYDPS/NYPSC, Case 22-M-0247 - Winter Supply 2022-2023 Forms, Table 1 and Table 2.
[3] S&P Global.

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Gas Pipeline Supply – Update Winter 2030/2031

- Small decrease to New York LDC design-day peak demand (item [E]) based on the following criteria:
  - Decrease LDC design-day peak demand for LDCs that project design-day peak demand reductions through winter 2026/2027 in filings to NYPSC
  - Decrease LDC design-day peak demand to winter 2023/2024 forecast values from filings to NYPSC for LDCs that project demand growth through winter 2026/2027

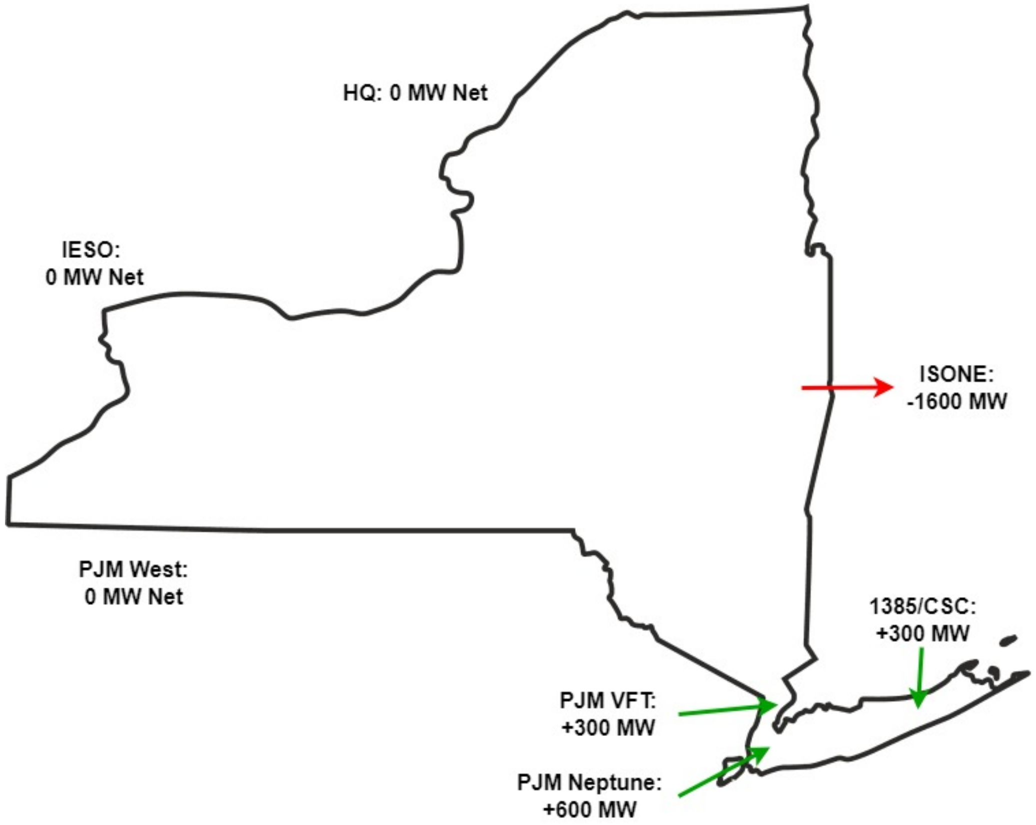
Gas Supply/Demand	MMCF/d	Calculation	Source
Modeling Period Supply			
Max New York State Imports from PJM	10,186	[A]	EIA
Expected New York State Imports from Ontario	945	[B]	S&P Global
Gas Available within New York	***11,131***	***[C] = [A] + [B]***	
Modeling Period Demand			
Expected Exports to New England	(3,550)	[D]	S&P Global
New York Design Day LDC Demand from Pipeline Gas	(7,044)	[E]	NYDPS
Total Outflows/LDC Demand	***(10,594)***	***[F] = [D]+[E]***	
Max Gas Available for Electric Generation in New York	**537**	**[G] = [C] + [F]**	
Equivalent MW of Gas Generation Capacity each Hour at 9 MMBtu/MWh Heat Rate	**2,578**	**[H] = [G] * 4.8**	

Note:
[1] Design Day LDC Demand aggregated from Winter Supply forms for New York State LDCs.

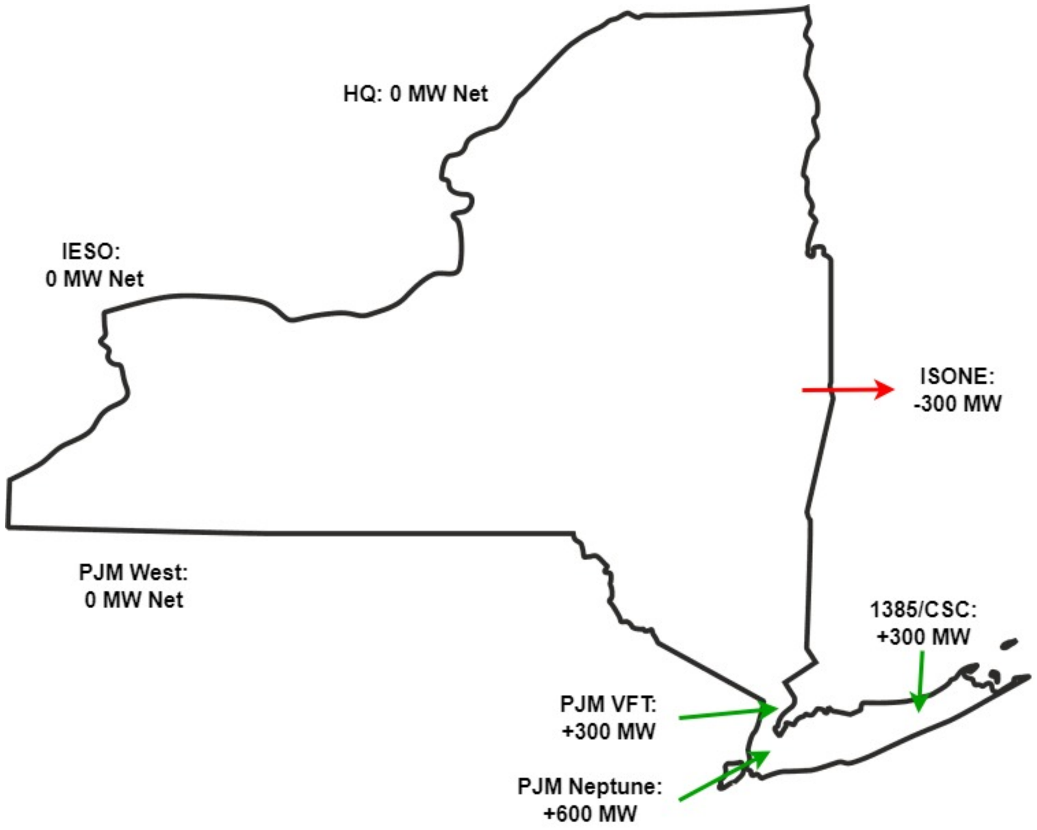
Sources:
[1] EIA, State to State Pipeline Capacity, January 31, 2023.
[2] NYDPS/NYPSC, Case 22-M-0247 - Winter Supply 2022-2023 Forms, Table 1 and Table 2.
[3] S&P Global.

Net Imports/Exports Assumptions – "IM All" Conditions

Without full export drawdown



With full export drawdown



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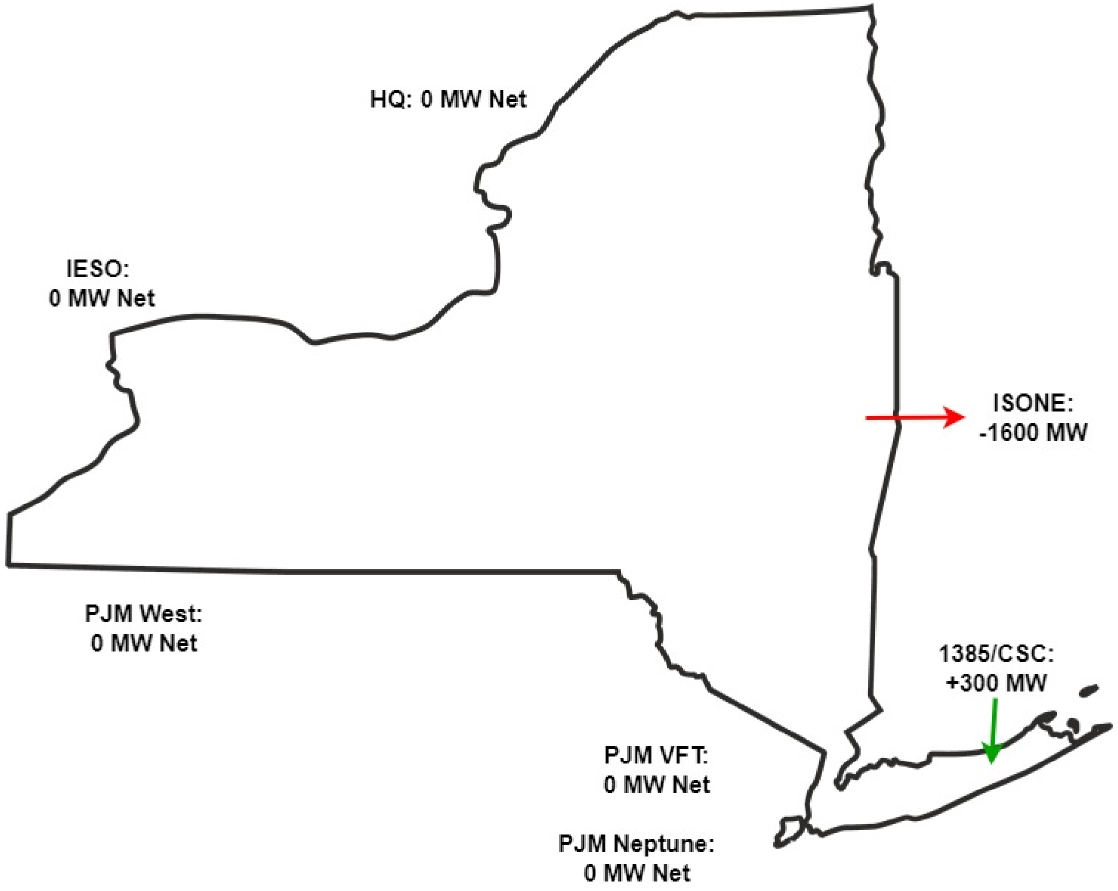
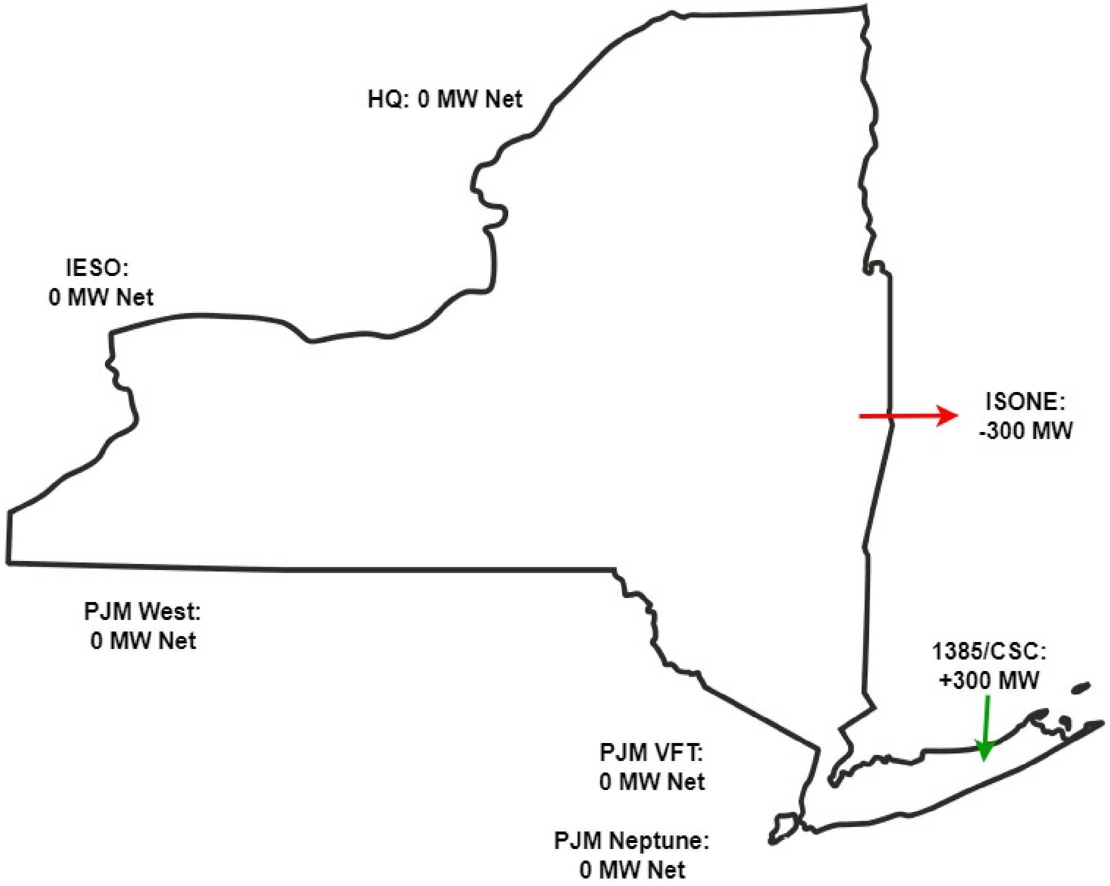
Net Imports/Exports Assumptions – "IM Net0" Conditions

Without full export drawdown



With full export drawdown



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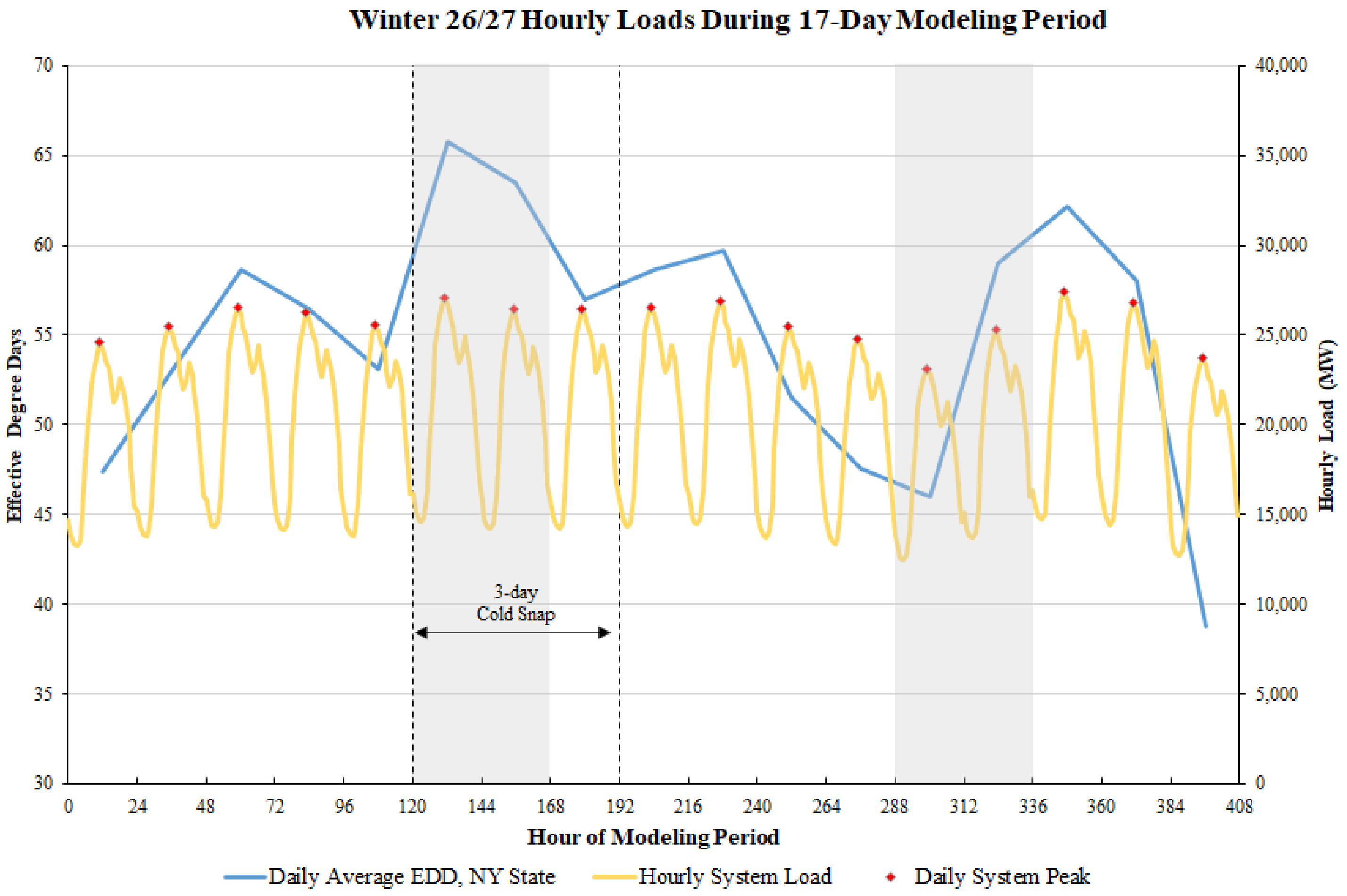
Winter 2026/2027 Hourly Electric Load



Notes:
[1] Weekends are shaded in gray.
[2] Effective degree day is defined as 65 degrees F - Temperature.
Source:
[1] NYISO Weather and Load Data 1993-2023.

- Hourly load calibrated to fall between the 90/10 and 99/1 winter coincident winter peak forecast for 2026/2027 from the 2023 Gold Book
- Modeling period maximum peak hourly load: 27,371 MW

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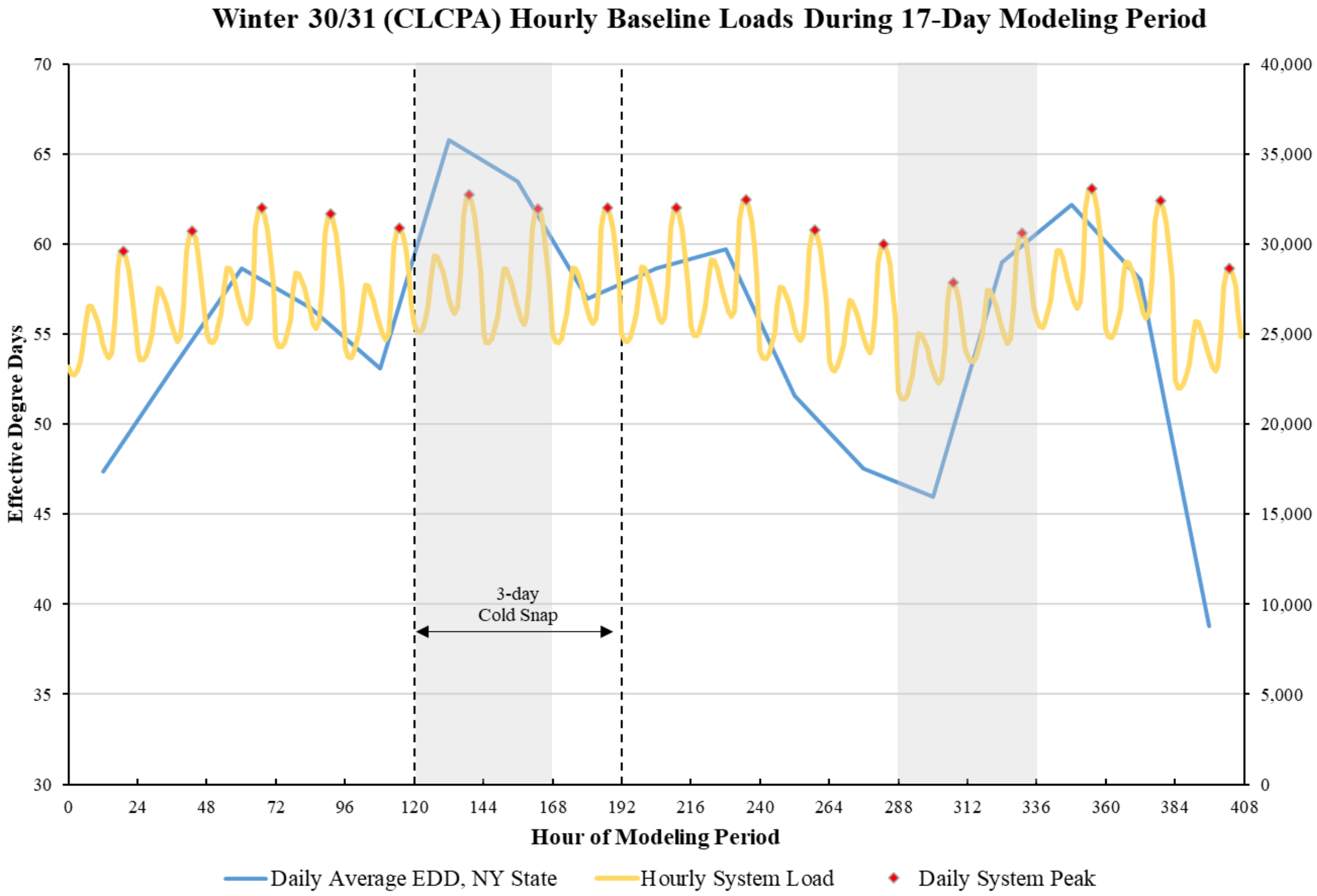
Winter 2030/2031 Hourly Electric Load



Notes:
[1] Weekends are shaded in gray.
[2] Effective degree day is defined as 65 degrees F - Temperature.
Source:
[1] NYISO Weather and Load Data 1993-2023.

- Hourly load calibrated to align with CLCPA load forecast for 2030/2031 winter peak from the 2021-2040 Outlook
- Modeling period maximum peak hourly load: 33,096 MW

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Updated Scenarios Relative to the 2019 Study

2019 Study Scenarios

Table ES-1: System Scenarios

Scenario Type	Infrastructure	Imports	Oil	Natural Gas
Description	**REN:** delayed construction of new renewables, such that solar capacity is reduced to 38.5% and wind capacity is reduced to 48% of 2017 CARIS Phase 1 "System Resource Shift" case assumed levels	**IM900:** 900 MW capacity imports **IM0:** 0 MW capacity imports	**PK:** potential retirements in response to the requirements for 2023 set forth in the proposed "peaker rule"	**NGR:** Reduced non-firm gas availability to support ~2000 MW of gas-fired generation in zones A-F, ~1000 MW of gas-fired generation in zones G-I, and no non-firm gas to support generation in zones J and K
Scenario 1		**IM900**		
Scenario 2		**IM900**	**PK**	
Scenario 3		**IM0**		
Scenario 4		**IM0**	**PK**	
Scenario 5		**IM900**	**PK**	**NGR**
Scenario 6	**REN**	**IM0**	**PK**	
Scenario 7		**IM0**	**PK**	**NGR**
Scenario 8	**REN**	**IM0**	**PK**	**NGR**

- Peaker retirements and tighter gas availability to generators is found in all scenarios for the 2023 study, driven by updated information about system conditions
  - Peaker retirements based on the 2023 Gold Book (see Tables IV-4, 5, and 6)
  - Less gas available to generators due to improved accounting for firm transportation associated with certain LDC use of gas storage to meet retail demand (see Slides 15, 67 and 68)
- Updated conditions for Winter 2023/2024 in 2023 study scenarios are closer to scenarios 5, 7 and 8 from the 2019 study

2019 Study Disruptions

Table ES-2: Physical Disruptions

#	Disruption Name	Description
1	**Starting Conditions**	No physical disruptions
2	**SENY Deactivation**	Loss of significant capability (1,000 MW) in SENY (specifically, zones G-I)
3	**High Outage**	Double unit forced outage rate compared to historical averages
4	**Nuclear Outage**	Loss of major nuclear facility upstate
5	**No Truck Oil Refill**	Unavailability of truck oil fuel delivery based on historical events such as snow storms
6	**No Barge Oil Refill**	Unavailability of barge oil fuel delivery based on historical events such as rivers freezing
7	**No Oil Refill**	Unavailability of any oil fuel delivery due to severe fuel limitations affecting both barge and truck refueling
8	**Non-Firm Gas Unavailable F-K**	No gas-fired generation capability available in zones F-K
9	**Low Fuel Inventory**	Reduction of initial oil storage by unit and oil fill max tank quantity to half of historical averages
10	**Non-Firm Gas Unavailable NYCA**	No gas-fired generation capability available anywhere in the New York Control Area (NYCA)
11	**Extreme Disruption**	Combination of no gas-fired generation capability available anywhere in NYCA, loss of significant dual fuel capability in zones G-I, and unavailability of any oil refill capability

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