Gas Constraints Whitepaper Update

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NYISO

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Revision: Error in Derate (%) calculation corrected on slides 12 and 13 (see corrections in red)

Agenda

- Background
- Initial Fuel Constraint Recommendation
- 2025-2026 IRM Study Recommended Inputs
- Future Considerations
- Next Steps
- Appendix

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Background

Background

- The goal of this project is to reflect the impact of fuel constraints during varying winter load levels in Load Zones F – K
- Historical gas production during peak winter conditions (see Slide 5) and weekly fuel surveys were analyzed to develop an initial fuel constraint recommendation (see Slide 7)
  - Gas Constraints Whitepaper Update (1/3/2024 ICS): https://www.nysrc.org/wp-content/uploads/2023/12/Gas-Constraints-Whitepaper-Update-01032024-ICS25831.pdf
- Derates are applied to the capacity of existing units to reflect the impact of the fuel constraints based on the load level in the installed reserve margin (IRM) model
- Currently targeting to complete the whitepaper for ICS meeting #287 (scheduled for 2/27/2024)

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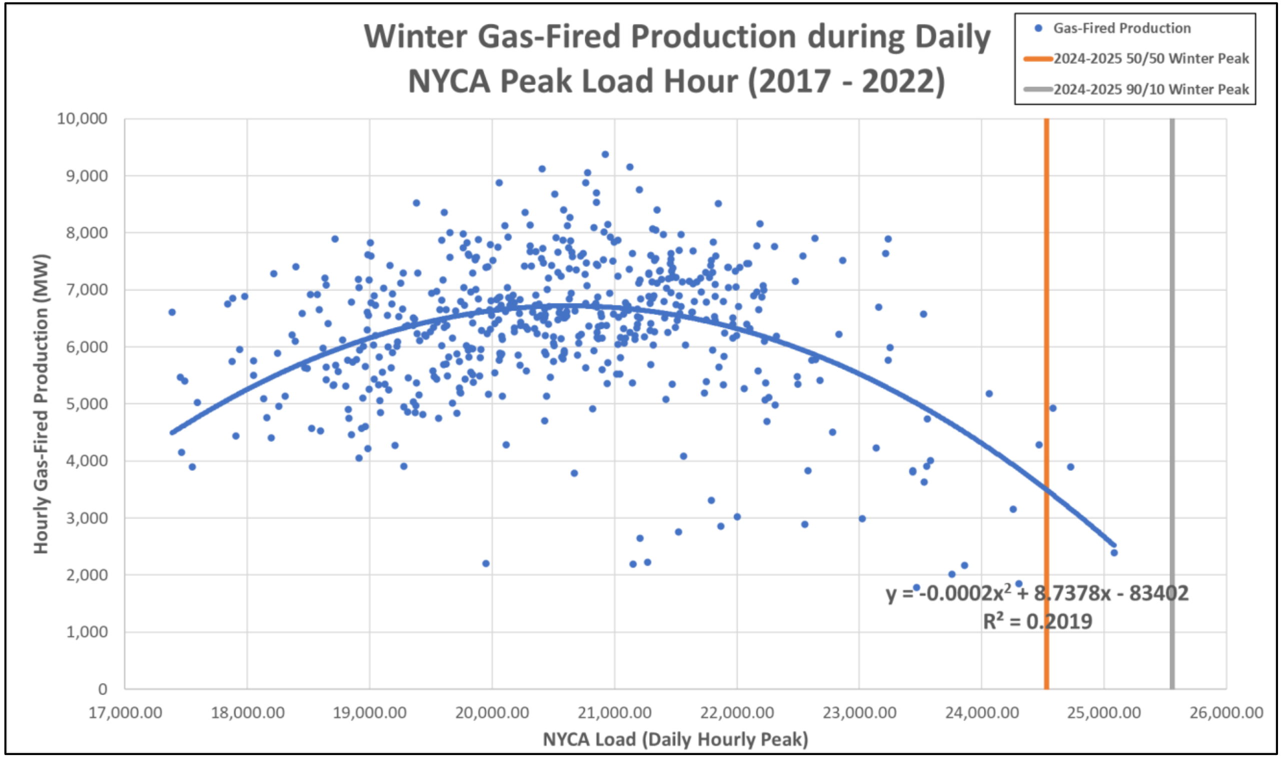
Historical Winter Gas-Fired Production



- Historical winter gas-fired production in Load Zones F - K, as depicted in this chart, was utilized to assess production trends under different load conditions
- As NYCA winter load increases, the historical trend illustrates that gas-fired production decreases beyond approximately 21,000 MW
- The historical trend was used to estimate the amount of gas production available under varying NYCA load conditions (see Slide 7)

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Initial Fuel Constraint Recommendation

Initial Fuel Constraint Recommendation

- Based on the analysis of the historical gas production and weekly fuel surveys, the NYISO developed the following initial recommendation of fuel constraints to model in the Preliminary Base Case (PBC) of the 2025-2026 IRM study

Tier	NYCA Load Conditions (MW)	Available Gas (MW)	Available Oil (MW)	Total Available Fuel (MW) (Gas + Oil)	*Illustrative Modeled Derate (Rounded MW)* *- Detailed on Slide 12 Example 1*
1	>26,000	0	11,000	11,000	*8,800*
2	25,000 - 26,000	750		11,750	*8,100*
3*	24,000 - 25,000	2,750		13,750	*6,100*
4*	23,000 - 24,000	4,500		15,500	*4,300*
5	22,000 - 23,000	5,500		16,500	*3,300*
6	<22,000	No Constraint		No Constraint	*0*

* Tier 3 and 4 load levels comprise the actual peak loads observed in recent winter operating conditions. The illustrative MW derates are generally consistent with the typical reduction in generator capability experienced during those operating conditions.

- The available gas will be reevaluated on an annual basis as new winter data is added to the analysis
- Based on the NYISO's currently proposed capacity accreditation enhancements, the available oil would be updated each August once fuel availability elections are finalized
  - The elections should provide a reasonable estimate of the amount of reliable oil-fired production anticipated to be available each winter

Initial Recommendation Test Results

- At the 1/3/2024 ICS meeting, the NYISO presented Tan45 results with the initial fuel constraint recommendations implemented on the 2024-2025 IRM Final Base Case (FBC)
  - Gas Constraints Whitepaper Update
    https://www.nysrc.org/wp-content/uploads/2023/12/Gas-Constraints-Whitepaper-Update-01032024-ICS25831.pdf
- ICS also requested a test be conducted considering the transmission security limit (TSL) floor values to provide a comparison to the TSL floor assessment presented at the 11/1/2023 ICS
  - Impact Assessment of TSL Floor Implementation:
    https://www.nysrc.org/wp-content/uploads/2023/10/TSL-Floor-Assessment-ICS-11012023-Draft-v5-Market-Sensitive22933.pdf

Case	IRM (Delta)	J LCR (Delta)	K LCR (Delta)	G – J (Delta)
2024-2025 IRM FBC (Base Case)	23.1%	72.7%	103.2%	84.6%
Initial Fuel Constraint Recommendation (Tan45)*	23.4% (+0.3)	72.7% (-)	103.1% (-0.1)	84.6% (-)
2024-2025 IRM FBC Sensitivity (Respecting TSL floor values)	21.5%	81.7%	105.3%	81.0%
Initial Fuel Constraint Recommendation (Respecting TSL floor values)*	21.7% (+0.2)	81.7%	105.3%	81.0%

* Fuel constraints applied in the modeling using "UCAP Method" described later in this presentation on Slide 11

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2025-2026 IRM Study Recommended Inputs

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Derating Existing Generators to Model Available Fuel

- The NYISO recommends modeling the available fuel as follows prior to initial fuel availability elections (i.e., firm/partial firm vs non-firm optionality) anticipated to occur in August 2024 under the NYISO's currently proposed capacity accreditation enhancements:
  - The assumed quantity of "available oil" (see Slide 7) is distributed across the dual fuel units in the model
    - The assumed quantity of "available oil" was determined based on a historical review of oil production capability reported by dual fuel units in weekly fuel surveys submitted to the NYISO
    - Oil-only units are assumed with their full capability prior to the first fuel availability elections
  - The assumed quantity of "available gas" (see Slide 7) is distributed across the gas-only units and remaining capacity of the dual fuel units in the model
- Once the fuel availability election decisions (i.e., firm, partial firm, or non-firm) are known for each generator, the assumed quantities of available fuel will be applied as follows:
  - The assumed quantity of "available oil" will be updated to reflect the total firm MW of oil-fired capability indicated in the fuel availability elections of dual fuel and oil-only units and will be distributed across the dual fuel and oil-only units in the model
  - The assumed quantity of "available gas" (see Slide 7) is distributed across the gas-only units and remaining capacity of the dual fuel units in the model
- The modeling of the assumed quantity of available gas and/or oil is applied by derating the capacity of each impacted generator (more details on following slides)

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Derate Calculation Considerations

- Two methodologies were considered for calculating the derate percentages to be applied to existing generators in the IRM model in order to reflect the fuel constraints:
  1. "ICAP Method": Calculating the derate based on modeled capacity values
  2. "UCAP Method": Calculating the derate based on unforced capacity (UCAP) values (modeled capacity factoring in the impact of the equivalent demand forced outage rate (EFORd))
- Below is an example of the two calculation methodologies in practice based off the tier 1 constraints (see Slide 7)
  - This comparison of the two methodologies illustrates the derated capacity that would be available after applying the EFORd and derate % to the modeled winter capacity in order to provide an estimate of the expected capacity that could be available under an average GE MARS iteration
    - The actual capacity would vary based on the different simulated forced outages in each iteration
  - Derated Capacity = Modeled Winter Capacity x (1 – EFORd) x (1 – Derate %)

Derate Methodology	Modeled Winter Capacity (MW)	EFORd	Modeled Winter UCAP (MW)	Total Available Fuel (MW)	Derate (%)	Derated Capacity (MW)
ICAP Method	21,573	8.2%	19,803	11,000	1 – (11,000 / 21,573) = 49%	10,097
UCAP Method					1 – (11,000 / 19,803) = 44%	11,000

- After review, the NYISO recommends calculating fuel constraint derates using the "UCAP Method" as this should align the amount of capacity on average in each iteration closer to the amount of capacity intended with the total available fuel in each tier

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Generator Derate Scenario: Example 1

- Below is an illustrative example of the generator derates applied prior to the first fuel availability election under the initial fuel constraint recommendation (see Slide 7) utilizing the modeled capacity from the 2024-2025 IRM Study (based on 2023 Gold Book and modeled EFORd)
- In the modeling, the actual derates applied to each generator will vary by unit type (i.e., gas-only, dual fuel)

Tier	NYCA Load Conditions (MW)	Available Gas (MW)	Available Oil (MW)	Modeled Winter UCAP (MW)	Derate (%)
1	>26,000	0	11,000	19,803	1 – ((0 + 11,000) / 19,803) = 44%
2	25,000 - 26,000	750			1 – ((750 + 11,000) / 19,803) = 41%
3	24,000 - 25,000	2,750			1 – ((2,750 + 11,000) / 19,803) = 31%
4	23,000 - 24,000	4,500			1 – ((4,500 + 11,000) / 19,803) = 22%
5	22,000 - 23,000	5,500			1 – ((5,500 + 11,000) / 19,803) = 17%
6	<22,000	No Constraint			No Constraint

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Generator Derate Scenario: Example 2

- Below is an illustrative example of the generator derates applied under a post-first fuel availability election scenario where 13,000 MW of firm oil is elected by dual fuel and oil-only generators
- Under this scenario, the fuel availability election decisions would be known for each generator and therefore would be considered when applying the derates in the modeling

Tier	NYCA Load Conditions (MW)	Available Gas (MW)	Available Oil (MW)	Modeled Winter UCAP (MW)	Derate (%)
1	>26,000	0	13,000 (Illustrative Example)	20,905 (Illustrative Example)	1 – ((0 + 13,000) / 20,905) = 38%
2	25,000 - 26,000	750			1 – ((750 + 13,000) / 20,905) = 34%
3	24,000 - 25,000	2,750			1 – ((2,750 + 13,000) / 20,905) = 25%
4	23,000 - 24,000	4,500			1 – ((4,500 + 13,000) / 20,905) = 16%
5	22,000 - 23,000	5,500			1 – ((5,500 + 13,000) / 20,905) = 12%
6	<22,000	No Constraint			No Constraint

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Assumptions Matrix

- The NYISO will include a new attachment in the IRM study assumptions matrix for the fuel constraints (see example below)
- This new attachment will include the total modeled capacity impacted by the fuel constraints and the percentage of the derate on the modeled UCAP at the aggregated level
  - In the actual modeling, the derates may vary by location based on fuel availability election decisions (i.e., firm, partial firm, or non-firm)
- The attachment will be updated as needed when new information (e.g., available gas, Gold Book, fuel availability elections) becomes available

<table>
<tr><th colspan="7">Attachment XX – Fuel Constraint Derate by Tier</th></tr>
<tr><th>Tier</th><th>NYCA Load Conditions (MW)</th><th>Available Gas (MW)</th><th>Available Oil (MW)</th><th>Total Available Fuel (MW) (Gas + Oil)</th><th>Modeled UCAP (MW)</th><th>Derate (%)*</th></tr>
<tr><td>1</td><td>>26,000</td><td>0</td><td rowspan="6">11,000</td><td>11,000</td><td rowspan="6">19,803</td><td>44%</td></tr>
<tr><td>2</td><td>25,000 - 26,000</td><td>750</td><td>11,750</td><td>41%</td></tr>
<tr><td>3</td><td>24,000 - 25,000</td><td>2,750</td><td>13,750</td><td>31%</td></tr>
<tr><td>4</td><td>23,000 - 24,000</td><td>4,500</td><td>15,500</td><td>22%</td></tr>
<tr><td>5</td><td>22,000 - 23,000</td><td>5,500</td><td>16,500</td><td>17%</td></tr>
<tr><td>6</td><td><22,000</td><td>No Constraint</td><td>No Constraint</td><td>No Constraint</td></tr>
</table>

* Values represent aggregate level derate. Actual derate % applied on each units may vary by individual generator and/or generator type

Future Considerations

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Future Considerations

- The fuel constraints modeling is an important first step in properly reflecting winter risk in the IRM model
- On-going refinement and modeling updates should be considered with additional market intelligence and further research
- Areas for future modeling improvements include:
  - Monitoring changing market behavior of firm fuel procurement and reassessing historical data trends
  - Aligning the load model to the forecasted winter peak load level
  - Impact of liquefied natural gas (LNG) on fuel constraints
  - Extension of constraints to other areas of the state not included as part of the initial modeling (Load Zones A – E)
  - Improvements to modeling fuel constraints if future MARS improvements allow

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Next Steps

Next Steps

- The NYISO currently anticipates completing the whitepaper for the next ICS meeting (scheduled for 2/27/2024)
- Incorporate the fuel constraints modeling into the 2025-2026 IRM PBC as a parametric case if accepted by the NYSRC
- Based on the accepted fuel constraint model, NYISO will review appropriate methodologies for Capacity Accreditation Factor (CAF) calculations related to fuel availability elections by generators
  - Considerations include the methodology for modeling the marginal proxy unit for the applicable CAF calculations
  - The discussion on CAF related topics will be conducted in the ICAP Working Group meetings

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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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Questions?

Appendix

Background

- **As supported by the NYSRC and stakeholders, the NYISO is conducting research analyzing the impact of extreme winter conditions on gas availability to New York electric power generators**
- **The gas constraints whitepaper is part of the 5-year strategic plan for Resource Adequacy ("RA") modeling improvements**
  - The scope of this whitepaper was discussed and accepted at the 2/1/2023 ICS meeting and an update on the modeling and research was presented at the 5/30/2023 ICS meeting

    Gas Constraints Whitepaper: Scope (2/1/2023 ICS):
    https://www.nysrc.org/PDF/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20273/Gas%20Constraints%20Whitepaper_Scope_2023.02.01_revised[13443].pdf
    Gas Constraints Whitepaper Update (5/30/2023 ICS):
    https://www.nysrc.org/wp-content/uploads/2023/07/11_ICS_GasConstraintsWhitepaperUpdate_2023.05.30_v415826.pdf
  - A Winter Constraints sensitivity relating to this modeling effort was presented at the 8/29/2023 ICS meeting

    Winter Constraints Sensitivities (8/29/2023 ICS):
    https://www.nysrc.org/wp-content/uploads/2023/08/WinterConstraintsSensitivities_2023.08.2921424.pdf
  - This effort is also being coordinated with the Capacity Market Design's Modeling Improvements for Capacity Accreditation Project (Previous discussions on next slide)
- **The objective of the whitepaper is to develop enhancements to appropriately reflect the impact of gas constraints during the winter period in the IRM study, via answering the following questions:**
  - What are the characteristics of winter gas constraints on the availability of electric power generators?
  - What are the reasonable levels of such gas constraints to be reflected in the IRM study while avoiding potential double counting with an electric power generator's forced outage rate?
  - What is the recommended modeling approach to represent these characteristics in the RA model?

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Timeline

Milestone	Date
Present Scope to NYSRC	2/1/2023
Finalize Scope	2/15/2023
Monthly ICS Updates	Ongoing
Identify Factors for Reasonable Gas Constraint Modeling Characteristics	Q1 2023
Additional Analysis and Gas Constraint Characterization	Q2 2023
Research Completed	Q2 2023
Present Findings of Research at ICS	End of Q2 2023
MARS Modeling Development and Testing	Q3 – Q4 2023
Present Findings/Modeling Enhancement Recommendations to NYSRC	December ICS Meeting
Implement NYSRC Approved Changes to IRM Model -- *sensitivity in the PBC and possible base case adoption in 2025-2026 IRM Study*	Following NYSRC Review

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Previous Presentations

- 2/1/2023 ICS: Gas Constraints Whitepaper: Scope
  - https://www.nysrc.org/wp-content/uploads/2023/05/Gas-Constraints-Whitepaper_Scope_2023.02.01_revised13443.pdf
- 5/30/2023 ICS: Gas Constraints Whitepaper Update
  - https://www.nysrc.org/wp-content/uploads/2023/07/11_ICS_GasConstraintsWhitepaperUpdate_2023.05.30_v415826.pdf
- 8/29/2023 ICS: Winter Constraints Sensitivities – 2024 - 25 IRM
  - https://www.nysrc.org/wp-content/uploads/2023/08/WinterConstraintsSensitivities_2023.08.2921424.pdf
- 10/4/2023 ICS: Gas Constraints Whitepaper Update
  - https://www.nysrc.org/wp-content/uploads/2023/10/IRM24_GasConstraintsWhitepaperUpdate_2023.10.0422503.pdf
- 11/1/2023 ICS: Gas Constraints Whitepaper Update
  - https://www.nysrc.org/wp-content/uploads/2023/10/GAS-Constraint-Whitepaper-Update-ICS-110122936.pdf
- 11/28/2023 ICS: Gas Constraints Whitepaper Update
  - https://www.nysrc.org/wp-content/uploads/2023/11/Gas-Constraints-Modeling-11282023-ICS23376.pdf
- 1/3/2024 ICS: Gas Constraints Whitepaper Update
  - https://www.nysrc.org/wp-content/uploads/2023/12/Gas-Constraints-Whitepaper-Update-01032024-ICS25831.pdf

Gas Constraint Modeling: Initial Characteristics

- **Gas constraints are to be applied to certain thermal units in Load Zones F – K**
  - Prior analysis by the MMU demonstrates the current significance of pipeline bottlenecks in southeast NY https://www.nyiso.com/documents/20142/33916814/MMU%20Gas%20Availability%20Presentation__20221020.pdf
  - Gas constraints will not initially be applied to units in Load Zones A – E
    - Further analysis is required to determine the prevalence of significant gas constraints in Load Zones A - E
    - Gas constraints can be applied to Load Zones A – E if needs are identified in the future
- **Gas constraints are to be applied in December, January, and February**
  - Winter cold weather conditions are most likely to occur during these months
- **Load level will be used as a proxy for temperature to trigger the gas constraint in the model**
  - Demand for gas is closely related to temperature during winter
- **Different magnitude levels of gas constraints are to be applied to represent different winter weather scenarios across the different load forecast uncertainty (LFU) bins in the model**
  - This is to represent different gas constraints effects due to different weather conditions

These characteristics should be revised and, as necessary, updated as new information becomes available

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Modeling Concepts

- **Four modeling concepts are currently being considered:**
  - Modeling Concept 1: Gas Constraint Triggered by Load Condition via Dummy Profile
  - Modeling Concept 2: Gas Constraint Triggered by Load Condition via Specific Dates
  - Modeling Concept 3: Gas Constraint Modeled with Dummy Bubbles and Topology Limits
  - Modeling Concept 4: Gas Constraint Modeled with Negative EOP Step
- **The NYISO has worked with GE to conduct screening of these modeling concepts to select an option for further modeling development. The screening considerations are:**
  - Feasibility to implement the modeling concept in GE MARS
  - Ability to implement without affecting base case results
  - Ability to differentiate gas constraints by bin level
  - Ability to customize the constraint to the daily/hourly level
  - Ability to dynamically account for generator outages

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Modeling Concept Screening

Screening Considerations	Modeling Concepts			
	Gas Constraint Triggered by Load Condition via Dummy Profile	Gas Constraint Triggered by Load Condition via Specific Dates	Gas Constraint Modeled with Dummy Bubbles and Topology Limits	Gas Constraint Modeled with Negative EOP Step
Feasiblity in the GE MARS Model	Medium High	Medium High	Medium	High
Ability to implement without affecting base case results	High	High	Low	High
Ability to differentiate gas constraint by bin level	High	High	High	Low
Ability to customize constraint to daily/hourly level	High	Medium	High	Medium Low
Ability to dynamically account for generator outages	Medium Low	Medium Low	High	Medium Low
Overall Comparison of Pros/Cons	Straightforward implementation Highly customizable No undesired impacts	Straightforward implementation Customizable to an extent No undesired impacts	Complex implementation Highly customizable May have undesired impacts	Simplest implementation Limited customization No undesired impacts

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Modeling Concept 1

- **Gas Constraint Triggered by Load Condition via Dummy Profile**
  - A dummy intermittent resource is added to the GE MARS model with hourly production profiles
    - Unit will be added to a dummy zone as to not impact base case results
  - The hourly production profiles are used to derate gas constrained generators to remove the desired amount of ICAP from the simulation

Pros	Cons
• No GE development needed • Straightforward modeling implementation • No impact to base case results • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily or hourly level	• Unable to dynamically account for generator outages (potential to undercount desired impact)

Modeling Concept 2

- **Gas Constraint Triggered by Load Condition via Specific Dates**
  - A date range condition predetermined based on the load shapes is added to the GE MARS model
  - During the date range implemented, the gas constrained generators are derated to remove the desired amount of ICAP from the simulation

Pros	Cons
• No GE development needed • Straightforward modeling implementation • No impact to base case results • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily level	• Unable to customize constraint down to the hourly level • Unable to dynamically account for generator outages (potential to undercount desired impact)

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Modeling Concept 3

- **Gas Constraint Modeled with Dummy Bubbles and Topology Limits**
  - Dummy bubbles connected to load zones are created in the GE MARS model (e.g., Zone G is connected to Zone G_Dummy)
  - All gas constrained generators are moved in the model from the load zone to the dummy bubble
  - Interface limits are implemented during predetermined periods to limit the amount of capacity that can be provided to the load zone from the dummy bubble

Pros	Cons
• No GE development needed • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily or hourly level • Able to dynamically account for generator outages	• Complex modeling implementation • May impact base case results (undesired impacts have been identified in testing when moving large numbers of generators to dummy bubbles)

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Modeling Concept 4

- **Gas Constraint Modeled with Negative EOP Step**
  - A negative EOP step is added to the GE MARS model that effectively removes generation from the system, similar to how Operating Reserves are modeled at EOP step 1

Pros	Cons
• No GE development needed • Simplest modeling implementation • No impact to base case results	• Unable to have different gas constraint magnitude at different load bins • Unable to customize down to the daily or hourly level • Unable to dynamically account for generator outages (potential to overcount desired impact)