ISO new england

memo

To: NEPOOL Markets Committee

From: ISO New England, Inc.

Date: January 4, 2024

Subject: Gas Resource Accreditation under Resource Capacity Accreditation (RCA) Reforms

Executive Summary

This memorandum discusses the ISO's proposed method for accrediting gas resources under the RCA reforms. During cold weather conditions, the quantity of gas available for power generation is limited. This **"regional gas constraint"** affects gas resources' ability to contribute to system reliability. As part of the RCA reforms, the ISO has committed to accounting for this gas constraint when determining capacity market compensation. This memo discusses several options that have been raised, where there are also potential variations on these options:

Baseline: The current capacity market rules, which do not account for the regional gas constraint in gas resources' capacity market compensation (particularly under the existing summer peaking framework.) This baseline serves as a useful benchmark against which the options can be compared.

Option 1: The **"market constraint"** approach would not incorporate the gas constraint into resources' compensation by changing individual gas resources' accreditation, but instead require gas resources to compete to provide capacity within the limitations of the gas constraint. This approach would decrease the amount of gas capacity procured in the winter (if/when the constraint binds) and would pay that capacity a lower price.

Option 2: The **"MRI = 0"** approach would hold the gas available for power generation constant when measuring gas resources' marginal reliability impact, resulting in zero winter accredited capacity (and thus zero compensation in the winter) for gas resources without fuel arrangements. (Note that this approach serves as a proxy for several options that hold the gas constraint fixed in accreditation, where some could result in a MRI > 0.)

Option 3: The **"derating"** approach approximates the aggregate gas resource awards that would be obtained by the market constraint approach by decreasing the accredited capacity of all gas resources without fuel arrangements. Unlike the market constraint approach, the gas resources without fuel arrangements that sell capacity would be paid the same price, per MW, as other resources.

This memo examines the performance of these approaches. In summary:

- A market constraint approach would procure a quantity of gas capacity that accurately reflects the reliability impact of the gas constraint while paying the gas capacity a lower price
- The MRI = 0 approach would not procure a socially optimal quantity of gas capacity nor would it pay the gas capacity an appropriate price
- The derating approach would approximate[1] the aggregate quantity of gas capacity that would be procured by a market constraint approach, but would not change the rate paid to the gas resources

Overall, the market constraint approach is preferred but is not implementable for FCA 19 or a one-year delayed auction timeline and likely requires a seasonal market construct. While the ISO further studies the market constraint approach for potential implementation, **the ISO proposes a derating approach as a reasonable transition mechanism**. The ISO cannot support the MRI = 0 approach (or similar variations), even as a transition, as it may lead to the inefficient exit of gas resources from the capacity market. Such inefficient exits could raise reliability concerns and increase costs to consumers. As a transition measure, the derating approach is preferred to the MRI = 0 approach because it addresses many of the shortcomings associated with the MRI = 0 approach.

This memo begins with an overview of the motivation behind the RCA reforms and discusses the difficulties associated with incorporating the regional gas constraint into capacity market compensation through the accreditation process. The memo then discusses the baseline and each of the three options in greater detail, with corresponding numerical examples to demonstrate how the options compare.

Economic Motivation behind Accreditation Reforms

To procure the optimal resource mix at least cost, resources' capacity market compensation should reflect their reliability contributions: all else being equal, resources that contribute more to reliability should be paid more than those who contribute less. Failing to compensate resources in such a manner increases costs to consumers when resources inefficiently enter and exit New England's capacity market. Many factors influence a resource's reliability contribution, including (but not limited to) their size, location, outage rate, technology type, and access to fuel. Some of these factors (e.g. outage rate and access to fuel) are not fully accounted for in the current capacity market compensation.

The RCA reforms change a resource's capacity market compensation to better reflect their reliability contributions by changing the quantity they can sell (known as "accredited capacity"). By incorporating many of the resource attributes important for system reliability into the accreditation process, the RCA reforms will change capacity market compensation to better reflect expected reliability value.

The RCA reforms will improve on the ISO's current accredited capacity (Qualified Capacity or "QC") by replacing it with Qualified Marginal Reliability Impact Capacity (QMRIC). While QC is generally based on a resource's physical capability, QMRIC will be calculated using each resource's estimated marginal impact

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[1] How effectively the derating approach approximates the aggregate quantity procured by the market constraint approach would depend on the shape of the gas demand curve. If the gas demand curve is vertical, the aggregate approximation would likely be accurate, while if the gas demand curve is sloped, the approximation will depend on the relative economics of the gas resources.

on system reliability (MRI). To calculate each resource's MRI, the ISO will estimate how small changes (i.e., perturbations) in their capability affect system reliability using the ISO's resource adequacy modeling tools. As a high-level example, to calculate the MRI for a 100 MW thermal resource, the ISO would model increasing/perturbing the thermal resource's QC from 100 MW to 100.5 MW and measure the estimated impact that increase has on expected unserved energy (EUE). As we will see, there is no perfect method to incorporate the region's gas constraint into capacity market compensation through changes to accreditation, and any approach that does so will involve tradeoffs.

Shared Physical Constraints and Resource Compensation

Most resource attributes important for system reliability can be incorporated into capacity accreditation to yield appropriate capacity market compensation. Shared physical constraints are an exception; their impact can more accurately be handled through the price resources are paid, rather than through changes to their accredited capacity. This is a well-established result in power system economics and optimization theory. In an optimization problem, when a shared physical constraint binds, an appropriate way to measure the value of a resource behind the constraint is to measure the impact of a small increase in the shared constraint itself, rather than to measure the impact of a small increase in the resource's capacity.

More generally, to obtain an accurate estimate of a resource's marginal value, we need to perturb the relevant binding constraint on each resource's contribution to system reliability. For most resources, this means perturbing their capacity. That is, the constraint preventing most resources from contributing more to system reliability is their maximum capability, such that a small increase in their capacity would result in a greater reliability contribution. For the gas fleet, the relevant binding constraint is not capacity, but the gas constraint itself. As such, to obtain an accurate estimate of the marginal contribution of the gas resources, we must perturb the gas constraint.

Consider the capacity market's zonal demand curves. Physical location is an important resource attribute that determines, in part, how much a resource contributes to reliability. Resources that can easily deliver energy to major load centers may contribute more to reliability during tight system conditions than resources that are behind transmission constraints. Transmission constraints are shared physical constraints in that the amount of energy that can flow across the constraint is limited, and, when the constraint binds, more energy provided by one resource behind the constraint must come at the expense of the energy provided by another resource behind the constraint.

The ISO implemented zonal demand curves to address the shortcomings that would be associated with accounting for these shared physical constraints in the accreditation (i.e., the existing qualification) process. Export-constrained demand curves require resources in export-constrained capacity zones (i.e., resources behind a shared transmission constraint) to compete to provide capacity in that zone. When an export constraint binds, its zonal demand curve results in less capacity in that zone receiving an award and a lower price paid to that capacity. The export-constrained demand curves are determined by perturbing the shared physical constraint (the transmission constraint) and measuring the impact that perturbation has on system reliability. Through the use of export-constrained demand curves, resources behind shared physical constraints receive capacity market compensation that accurately reflects the impact their location has on their reliability contributions.[2]

Like some locations on the transmission system, the regional gas constraint represents a shared physical constraint: during tight winter conditions, there is limited natural gas available for power generation in New England and any gas used by one gas resource to produce energy cannot be used by another. As with transmission constraints, the challenges associated with accounting for the gas constraint in capacity market compensation can be sensibly addressed using a market constraint approach. The next section demonstrates this point with numerical examples.

While reflecting the gas constraint in resources' compensation through a market constraint is preferred, the ISO cannot implement a market constraint approach for FCA 19 for three reasons:

1. Substantial detailed design work remains before a market constraint can be implemented. This work will require evaluating the impacts of the design, and possible changes, in other areas of the capacity market (e.g., impacts on auction design given interactions with the zonal demand curves);

2. Because the gas constraint only binds during the winter, it is not clear a market constraint can be implemented in an annual market. Instead, a seasonal market is required so that different quantities of gas resources can receive awards in the summer and winter, reflecting the fact that the gas constraint only binds in the winter. While the ISO is currently considering the implementation of a prompt and/or seasonal market for Capacity Commitment Period (CCP) 19, the RCA reforms currently under consideration for FCA 19 assume an annual market for that auction; and

3. Implementation of such a market constraint will involve significant software development and testing.

Numerical Examples

This section discusses three approaches that would incorporate the gas constraint into capacity market compensation using four numerical examples to demonstrate how the approaches would function and compare their performance. The examples are described at a high level in the bullets below. The following subsections discuss the examples in greater detail.

- Example 0 demonstrates outcomes in a market that does not incorporate the regional gas constraint into resource compensation. (For brevity, we will refer to this case as "current rules".) The example serves as a baseline point of comparison for the market constraint, MRI = 0, and derating approaches.

- Example 1 introduces the market constraint approach, and shows that a market constraint achieves the same level of reliability obtained under current rules, but at lower cost by procuring

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[2] For more information on zonal demand curves, see the FCM Zonal Demand Curve Methodology memo.

a quantity of gas resource capacity that reflects the gas constraint while paying that capacity a lower price.

- Example 2 provides outcomes with the MRI = 0 approach, where gas resources without fuel arrangements receive no accredited capacity. To achieve the same level of reliability in Examples 0 and 1, the MRI = 0 approach requires additional, more expensive capacity to receive an award, increasing social costs. As such, the MRI = 0 approach does not procure the optimal quantity of gas resource capacity nor does it pay that capacity the optimal price.

- Example 3 introduces the derating approach, and shows that it achieves the same level of reliability at less cost than the MRI = 0 approach, but at some greater cost than the market constraint approach. The derating approach improves on the MRI = 0 approach and the "current rules" by procuring the approximate aggregate quantity that would be purchased by the market constraint approach, but, unlike the market constraint approach, it does not pay this capacity a lower price consistent with the constraint.

Set-up and Assumptions

The following numerical examples consider four resources: a low-cost gas resource without fuel arrangements (Gas A), a more expensive gas resource without fuel arrangements (Gas B), a non-gas resource (Non-Gas A), and a more expensive non-gas resource (Non-Gas B). The total costs and QCs for these resources are given in the table below. Note that the QC values listed below represent the physical capabilities of the four resources. The actual accredited capacity values (QMRIC) will vary across the examples depending on which approach is being considered.

Summary of Costs and Physical Capability (QC)

		Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]	\$2,000	\$4,000	\$2,500	\$12,000
QC	[2]	2,000 MW	2,000 MW	500 MW	2,000 MW

The numerical examples compare the approaches by considering how much it would cost each approach to achieve a given level of reliability. To do so, the examples assume that each MW of QC from each of the four resources contribute equally to reliability, except for Gas A and Gas B: Gas A and Gas B's QC provide the same reliability contribution as the other resources, until there is 2,000 MW[3] of capacity from either Gas A or Gas B. As such, 2,000 MW represents the gas constraint: an additional MW of Gas A or Gas B's QC provides no reliability value when there are already at least 2,000 MW of their capacity in the system because that additional MW would not be able to procure fuel to produce energy. Note that this shared physical constraint is assumed to apply in all four examples.

A few additional assumptions before diving into the examples:

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[3] Note that, while the gas constraint of 2,000 MW represents the exact point on the supply curve where Gas A and Gas B's offers intersect, this is a simplifying assumption. The results provided in the numerical examples would also generalize to instances where the gas constraint intersected the supply offers of one of the resources (e.g., a gas constraint of 1,500 MW.) In fact, the results generalize to any gas constraint between 0 and 4,000 MW, where 4,000 MW is the existing gas fleet.

- The examples assume all of the system's reliability risk occurs in the winter. This allows us to focus on the impact of the gas constraint. We also assume that, in any winter hour with risk, the gas constraint binds.

- In Example 0, there is a vertical demand curve for capacity at 4,250 MW[4]. The quantity of reliability procured by this fixed capacity requirement will serve as the standard for the other examples as well. That is, the other examples will not have a fixed capacity requirement and instead will procure capacity until the system is as reliable as the system in Example 0. In practice, the different approaches will require different quantities of capacity to provide that level of reliability. How much capacity is procured and what resources provide it will drive the differences in social costs across the approaches, but procuring equal levels of reliability across examples allows for an apples-to-apples comparison of the costs.

- Any resource that does not receive an award will not contribute to reliability. This is equivalent to assuming that any existing resource that does not receive an award would retire or be mothballed and any potentially new resource that does not receive an award would not be built.

- While the RCA reforms will include rules for gas resources that have fuel arrangements (e.g., firm transport contracts), this example assumes the two gas resources (Gas A and Gas B) do not have such arrangements to focus on the impact of the gas constraint.[5]

Example 0: Market does not Account for the Gas Constraint in Compensation

Example 0 demonstrates how the market would set prices and awards under current rules, where the gas constraint is not incorporated into resources' compensation. For the numerical example, this means that Gas A and Gas B will have their accredited capacity (QMRIC) equal to their physical capability (QC). That is, Gas A and Gas B's QMRIC is intentionally equal to their QC to reflect the fact that this example does not incorporate the gas constraint into either the amount of capacity the gas resources can sell or the price they are paid.

CSO will be awarded to resources from the cheapest offer to the most expensive until 4,250 MW of capacity are procured. Table 0 below summarizes market outcomes.

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[4] The specific fixed requirement of 4,250 was chosen so that: 1) the demand curve did not intersect the supply curve at a kink, 2) both gas resources would sell CSO in the baseline Example 0, but that 3) neither of the gas resources would be marginal.

[5] While the potential interaction between a gas demand curve and gas resources without fuel arrangements is still being studied, conceptually gas resources with fuel arrangements would not be subject to the demand curve, and instead would shift the gas demand curve towards 0 MW. That is, as gas resources make more fuel arrangements, less gas would be available for gas resources that do not have such arrangements, and so the more the gas constraint would bind.

Table 0: Summary of Market Outcomes in Example 0

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$4,000	$2,500	$12,000
QC	[2]		2,000 MW	2,000 MW	500 MW	2,000 MW
QMRIC	[3]		2,000 MW	2,000 MW	500 MW	2,000 MW
Offer	[4]	=[1]/[3]	$1/MW	$2/MW	$5/MW	$6/MW
CSO Award	[5]		2,000 MW	2,000 MW	250 MW	0 MW
Total Social Cost	[6]	=SUM([4]*[5])	$7,250			
Clearing Price	[7]		$5/MW			
Resource Payments	[8]	=[7]*[5]	$10,000	$10,000	$1,250	$0

Rows [1] and [2] are the total costs and physical capability of the resources from the summary table. Row [3] provides each resources' accredited capacity. Note that, in this example, all resources have their accredited capacity (QMRIC) equal to their physical capability (QC).[6] It is appropriate for Gas A and Gas B to have QC = QMRIC in this example because Example 0 does not incorporate the gas constraint into Gas A and Gas B's accredited capacity.

Row [4] provides each resources' offer, where the resources are assumed to submit offers consistent with their costs.[7] Row [5] provides the QMRIC awards, where resources receive awards in order from least cost to most expensive until 4,250 MW of capacity are procured. Note that, because both Gas A and Gas B receive awards and the gas constraint binds at 2,000 MW, only 2,250 MW of the 4,250 MW of procured capacity contribute to reliability.

Row [6] displays the total social costs, defined as the sum of the individual resource costs that receive awards in the market. Because only a portion of Non-Gas A receives an award, only that portion of their costs contribute to the total social costs.[8] Note that total social costs are important because an approach that minimizes social costs at a given level of reliability also maximizes social surplus at that level of reliability.

Non-Gas A is the marginal resource and so sets the clearing price at $5/MW, seen in Row [7]. Finally, Row [8] provides the total payments to the individual resources.

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[6] Non-Gas A and Non-Gas B having QC = QMRIC implies that all of their attributes important for system reliability are incorporated in their QCs. This is a simplifying assumption that allows us to focus on the impact of the gas constraint in future examples. An equivalent assumption would be that Non-Gas A and Non-Gas B are "perfect capacity" resources, defined as resources that are able to provide their full capacity in every hour.

[7] The examples assume that the market is competitive.

[8] The example assumes that the resources submit non-lumpy offers, but this assumption is not necessary. Instead of viewing Non-Gas A as one resource, we could view them as many small resources with the same per MW cost and obtain the same results.

Key Takeaway: Because clearing prices and awards do not account for the gas constraint, both Gas A and Gas B receive full awards, despite the fact that only 2,000 of their 4,000 MWs contribute to reliability.

Example 1: Market Constraint Approach

The market constraint approach would implement a demand curve for gas resources without fuel arrangements. Example 1 uses the same set of assumptions as Example 0, except there is a vertical demand curve for the gas resources (Gas A and Gas B) at 2,000 MW. The vertical demand curve for gas resources reflects the gas constraint by limiting the total amount of gas capacity that can receive an award to 2,000 MW. Note that, in practice, the gas demand curve could be sloped, much like the export- and import-constrained capacity zone demand curves today. A vertical demand curve for gas is assumed here for simplicity, though the results generalize.

Table 1 below provides the market outcomes for Example 1. Note a key difference highlighted in yellow: the gas resources that receive capacity awards are paid a lower price with the market constraint. This is consistent with the treatment of resources behind transmission constraints in export-constrained capacity zones who are paid lower prices when the constraint binds.

Table 1: Summary of Outcomes with Market Constraint (Example 1)

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$4,000	$2,500	$12,000
QC	[2]		2,000 MW	2,000 MW	500 MW	2,000 MW
QMRIC	[3]		2,000 MW	2,000 MW	500 MW	2,000 MW
Offer	[4]	=[1]/[3]	$1/MW	$2/MW	$5/MW	$6/MW
CSO Award	[5]		2,000 MW	0 MW	250 MW	0 MW
Total Social Cost	[6]	=SUM([4]*[5])	$3,250			
Clearing Price	[7]		$1/MW		$5/MW	
Resource Payments	[8]	=[7]*[5]	$2,000	$0	$1,250	$0

A few notes:

- As in Example 0, each resource's QMRIC equals their QC. With the market constraint approach, the impact of the gas constraint is not incorporated into the accreditation process. In Examples 2 and 3, Gas A and Gas B's QMRIC will not equal their QC.

- Row [5] provides the CSO awards. Example 1's awards are the same as Example 0's, except Gas B does not receive an award. With the vertical gas demand curve for gas resource capacity at 2,000 MW, only Gas A receives a CSO award. Note that Gas A receives an award and not Gas B because Gas A has the lower offer.

- Despite the fact that the market constraint approach only procures 2,250 MW of capacity compared to 4,250 MW in Example 0, the two examples are consistent with the same level of reliability. This is possible because Example 0 awarded 4,000 MW of CSO to Gas A and Gas B even though the gas constraint results in only 2,000 of those 4,000 MW contributing to reliability. By not awarding CSO to both Gas A and Gas B, the market constraint achieves the same level of reliability while procuring less capacity.

- As seen in Row [6], Example 1 has lower total social costs than Example 0: $3,250 vs. $7,250. Note the $4,000 difference between these costs is Gas B, which does not receive an award with the market constraint approach and so does not contribute to total social costs.
- Note that, in Row [7], Gas A is paid $1/MW rather than the $5/MW paid to Non-Gas A. This is a result of the market constraint: the gas resources that receive awards under the market constraint are paid a price consistent with the offer of the marginal gas resource. In this case, Gas A is marginal among the gas resources and so their offer of $1/MW sets the gas price.[9]
- Just as the export-constrained demand curves yield resource compensation that accurately reflects the impact the transmission constraints have on the reliability contributions of resources behind those constraints, the gas demand curve will also yield resource compensation that accurately reflects the impact the gas constraint has on reliability contributions of the gas resources.

<u>Key Takeaway:</u> The market constraint approach achieves the same level of reliability as current rules, but at least cost. Indeed, the awards determined by the market constraint are cost-minimizing: no other set of awards could achieve the same level of reliability at lower social costs.

Example 2: The MRI = 0 Approach

With the MRI = 0 approach, the gas constraint is held constant when determining Gas A and Gas B's marginal impact on reliability. Recall that when calculating a resource's MRI, the ISO will increase their capacity by a small quantity and measure the impact that small increase has on system reliability. (Note that this option serves as a proxy for a number of potential approaches that hold the gas constraint constant in the accreditation process, where some of these approaches could yield non-zero (but close to zero) MRI values for gas resources without fuel arrangements.)

Consider such a calculation in the context of this numerical example, with 4,000 MW of existing gas resources and a 2,000 MW gas constraint. Recall that the numerical examples assume all of the system's reliability risk occurs in the winter and that, in these winter hours, the gas constraint binds. Given 4,000 MW of existing gas capacity, increasing the gas capacity to 4,000.5 MW would not improve system reliability because the gas constraint limits the amount of capacity these resources can provide during tight system conditions to 2,000 MW. That is, whether there is 4,000 MW, 4,000.5 MW, or 3,999.5 MW of gas resource capacity is immaterial from the perspective of system reliability, because the total amount of energy that can be provided by the gas resources is capped at 2,000 MW per hour, regardless. Consistent with this calculation, Example 2 assumes Gas A and Gas B have MRI = 0 and so have QMRIC = 0.

Table 2 below provides the market outcomes for Example 2.

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[9] Note this is consistent with the existing export constrained zonal demand curve design.

Table 2: Summary of Outcomes with MRI = 0 (Example 2)

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$4,000	$2,500	$12,000
QC	[2]		2,000 MW	2,000 MW	500 MW	2,000 MW
QMRIC	[3]		0 MW	0 MW	500 MW	2,000 MW
Offer	[4]	=[1]/[3]	N/A	N/A	$5/MW	$6/MW
CSO Award	[5]		0 MW	0 MW	500 MW	1,750 MW
Total Social Cost	[6]	=SUM([4]*[5])	$13,000			
Clearing Price	[7]		$6/MW			
Resource Payments	[8]	=[7]*[5]	$0	$0	$3,000	$10,500

A few notes:

- Unlike Examples 0 and 1, Gas A and Gas B do not have their QMRIC equal to their QC. Because Gas A and Gas B have MRI = 0, they receive no accredited capacity in Row [3].

- Without QMRIC, Gas A and Gas B cannot receive capacity awards, as displayed in Row [5]. This results in $0 of payments to Gas A and Gas B in Row [8]. In these examples, we assume that resources that do not sell CSO are either mothballed or retire. If Gas A retires, the system would lose a resource that is part of the optimal mix, increasing social costs. If, instead, the resources were mothballed, the capacity market would procure additional, expensive capacity that is not needed, also increasing social costs and costs to consumers.

    - Note that, because the examples assume that resources that do not receive CSO are either mothballed or retire, the MRI = 0 approach results in a quantity of gas capacity that *does not* cause the gas constraint to bind. That is, because both Gas A and Gas B would exit the market, the total quantity of gas QC after the auction would be less than the gas constraint, which would imply that the MRI for gas resources would be greater than 0. While this initially may appear like a contradiction of the assumptions, it points to a larger issue of the MRI = 0 approach. To incorporate the gas constraint into the accreditation process, the ISO would have to make ex-ante assumptions about the magnitude of the gas constraint and whether the gas constraint binds. These ex-ante assumptions can have an enormous impact on the total accredited capacity of the gas fleet (potentially differences as great as 9 GW of accredited capacity). Further, these assumptions can prove to be inaccurate ex-post once the auction has cleared. This potential for large year-to-year swings in accredited capacity values, and the potential sensitivity of these swings to the ex-ante assumptions, are additional shortcomings of the MRI = 0 approach.

- Like the market constraint approach in Example 1, the MRI = 0 approach in Example 2 procures 2,250 MW of capacity. Given the assumption that, outside of the gas constraint, each MW of capacity contributes the same to reliability, the MRI = 0 approach achieves the same level of reliability as the market constraint approach in Example 1 and current rules in Example 0.

- While the MRI = 0 approach can achieve the same level of reliability as the market constraint approach, it does so at greater cost: $13,000 vs. $3,250. Because Gas A and Gas B receive no capacity award and thus do not contribute to reliability, the system must procure additional capacity from the more expensive Non-Gas A and Non-Gas B to acquire 2,250 MW of capacity. This additional expensive capacity drives up the total social costs.
- Note that, in these numerical examples, the MRI = 0 approach results in higher social costs than observed in Example 0 with current rules. This fact is not generalizable to all examples[10], but is demonstrative of the fact that the MRI = 0 approach can result in an increase in consumer costs.

Key Takeaways: The MRI = 0 approach requires higher social costs to achieve the same level of reliability as the market constraint approach. Gas A does not receive a CSO award and so is mothballed or exits the market, even though they are part of the optimal resource mix.

Example 3: The Derating Approach

Like the MRI = 0 approach, the derating approach incorporates the gas constraint into capacity accreditation. Instead of setting the gas resource QMRIC to zero as with the MRI = 0 approach, the derating approach decreases the accredited capacity of all gas resources so that their total accredited capacity equals the gas constraint. For more details on the derating approach and how the gas constraint will be estimated, see the December 2023 MC materials.[11]

It is important to note that the derating approach is not an average accreditation approach. Average accreditation is a well-defined concept, involving the removal of an entire resource class from the mix and measuring the amount of perfect capacity that would be required to replace it while maintaining a given level of reliability. The derating approach does not measure the reliability value of the individual gas resources in this way, and so is not an average accreditation approach. The derating approach approximates elements of the clearing outcomes that would be achieved with the market constraint approach (specifically, the aggregate CSO awards for the gas resources without fuel arrangements.) In this way, the derating approach serves as a transition to a fully marginal approach to resource compensation.

Table 3 below provides the market outcomes for our numerical example with a derating approach.

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[10] For example, if the increased costs of Non-Gas 2 were lower, the social costs under MRI = 0 would be less than under current rules. See Appendix B.

[11] Note that the examples assume that the derating approach and the market constraint approach procure the same quantity of CSO from the gas resources. This is a reasonable assumption because, in practice, the same modeling methods that would be used to determine the gas market constraint will be used to determine the total quantity of QMRIC from gas resources under a derating approach.

Table 3: Summary of Market Outcomes with the Derating Approach (Example 3)

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$4,000	$2,500	$12,000
QC	[2]		2,000 MW	2,000 MW	500 MW	2,000 MW
QMRIC	[3]		1,000 MW	1,000 MW	500 MW	2,000 MW
Offer	[4]	=[1]/[3]	$2/MW	$4/MW	$5/MW	$6/MW
CSO Award	[5]		1,000 MW	1,000 MW	250 MW	0 MW
Total Social Cost	[6]	=SUM([4]*[5])	$7,250			
Clearing Price	[7]		$5/MW			
Resource Payments	[8]	=[7]*[5]	$5,000	$5,000	$1,250	$0

A few notes:

- As with Example 2, Gas A and Gas B do not have their QMRIC equal to their QC. Instead, the sum of their QMRIC equals the gas constraint: 2,000 MW.

- Because they can sell less CSO, Gas A and Gas B must submit higher offers to recover their costs, relative to the previous examples. (See Row [3].) Despite their higher offers, they still receive capacity awards up to their QMRIC because their offers are less than Non-Gas A's offer, who is marginal.

- Note that this example yields the same level of reliability as the previous examples. Consider a comparison with Example 1 and the market constraint approach. With the market constraint approach, Gas A sells CSO up to their QMRIC (meaning that all 2,000 MW of their physical capability represented by QC contribute to system reliability) and Non-Gas A sells 250 MW of CSO. In Example 3, Gas A also sells CSO up to their QMRIC (in this case, only 1,000 MW due to the derating approach) and Non-Gas A also sells 250 MW of CSO. This 1,250 MW of CSO sold by Gas A and Non-Gas A represents enough physical capability to provide the same reliability value as the 2,250 MW of CSO procured in Example 1 because the 1,000 MW of CSO sold by Gas 1 comes with all 2,000 MW of Gas 1's QC. That is, in this example, when the system purchases 1,250 MW of CSO from Gas 1 and Non-Gas 1, it is actually purchasing 2,250 MW of physical capability, where this 2,250 MW of physical capability is the same physical capability purchased under the market constraint approach. In addition to the 1,250 MW of CSO sold by Gas A and Non-Gas A, Gas B also sells 1,000 MW of CSO under the derating approach. The capacity procured from Gas B provides no additional reliability value, however, because Gas A has also sold CSO consistent with its entire physical capability. That is, despite the fact that the derating approach procures Gas B in addition to both Gas A and a portion of Non-Gas A, it achieves the same level of reliability as the market constraint approach because of the gas constraint.

- The derating approach achieves the same amount of reliability as the MRI = 0 approach, but at lower social cost: $7,250 vs. $13,000. Given the assumption that resources that do not sell capacity do not contribute to reliability, the ISO expects the derating approach will result in less total social costs than the MRI = 0 approach, where a more general proof is available in Appendix A. However, the market constraint approach achieves the same level of reliability at lower social cost: $3,250 vs. $7,250.

- Unlike the market constraint approach, the derating approach pays the gas resources the same price as the other resources. That is, while the derating approach successfully approximates the optimal aggregate quantity of CSO that should be procured from the gas resources, it does not pay that CSO the optimal price.

- Note that, in this example, the derating approach achieves the same level of reliability as Example 0 at the same social cost. This result is not generalizable. Indeed, an example in Appendix B with the same set-up but different resource costs shows that the derating approach can decrease social costs relative to current rules by pushing Gas B out of the market.

Key Takeaways: The derating approach achieves the same level of reliability as the previous examples at less cost than the MRI = 0 approach but it is at a greater cost than the market constraint approach. Unlike the MRI = 0 approach, the derating approach does not lead to the inefficient exit of Gas A, who is part of the optimal resource mix.

Additional Considerations

- The market constraint, MRI = 0, and derating approaches will converge as the gas constraint becomes increasingly stringent. For example, if the quantity of fuel arrangements made by gas resources was such that the gas constraint bound at 0 MW, the three approaches would all yield $0 in compensation for gas resources without fuel arrangements.

- The ISO also considered variations of the derating approach where a lower price would be paid to the gas resources without fuel arrangements that sell CSO. At a high-level, such an approach would attempt to approximate not only the quantity of gas capacity the market constraint approach would procure, but also the price that capacity would be paid. Accurately approximating this price would require information on which gas resources would receive awards under the market constraint approach, and their costs associated with selling CSO. The ISO does not have confidence we could approximate this information well. Indeed, a primary function of markets is the collection of such information.

- The MRI = 0 approach may yield greater year-to-year volatility in prices and the accreditation of gas resources without fuel arrangements due to i) year-to-year changes in the summer/winter risk split and ii) the potential for large ex-ante/ex-post differences in the gas resource MRI values. As an example of ii), in Example 2, the MRI = 0 approach causes the existing gas resources to receive no accredited capacity and so to exit the market. With Gas 1 and Gas 2's exit, the gas constraint no longer binds, which would result in positive accredited capacity values for the gas resources, incenting them to enter the market. In general, the MRI = 0 approach could cause gas resources to face substantial uncertainty in their future accredited capacity values and future capacity market compensation, particularly given that small changes in the penetration of gas resources could result in substantial swings in their accredited capacity values.

Key Takeaways

1. During tight winter conditions, the amount of natural gas available for power generation can be limited, reducing the gas fleet's reliability contributions. Accurately accounting for the impact to reliability contributions, and incorporating this impact into resources' compensation is essential to procuring capacity in a cost-effective manner, and so the ISO has committed to reflecting the gas constraint in capacity market compensation for FCA 19.

2. The market constraint approach can more optimally capture the gas constraint's impact on reliability and incorporate the gas constraint in resources' compensation, but a gas market constraint cannot be implemented for FCA 19 and cannot be designed effectively in an annual market design when the constraint only occurs in one season. Instead, as a transition to the market constraint, the ISO will incorporate the gas constraint through changes to accreditation. Two approaches (including related variants) have been considered: the MRI = 0 approach and the derating approach.

3. The ISO is not proposing the MRI = 0 approach, or other approaches that hold the gas constraint fixed when calculating gas resources' MRI values, because they could lead to the inefficient exit of existing gas resources, which would raise reliability concerns and increase costs to consumers. Indeed, the MRI = 0 approach could result in higher social costs than even under current rules where the gas constraint is not accounted for in resources' compensation. Additionally, the MRI = 0 approach may result in substantial market instability, where small changes in ex-ante assumptions around the gas constraint could yield substantial changes in the total accredited capacity of the gas fleet.

4. Instead, the ISO proposes to implement a derating approach as part of the RCA reforms. Unlike the MRI = 0 approach, the derating approach is less likely to lead to the inefficient exit of existing gas resources, and so does not raise the same reliability and consumer cost concerns as the MRI = 0 approach. Additionally, the derating approach is not subject to the same instability inherent to the MRI = 0 approach.

5. The derating approach is not an average accreditation approach because the derating approach does not estimate the reliability contribution of gas resources by removing all of the gas resources from the mix. The derating approach approximates elements of the clearing outcomes that would be achieved with the market constraint approach (specifically, the aggregate CSO awards for the gas resources without fuel arrangements.) In this way, the derating approach serves as a transition to a fully marginal approach to resource compensation.

Appendix A

This appendix provides a proof which demonstrates that, given a series of assumptions, the derating approach will achieve a given level of reliability at social costs less than or equal to what would be required to achieve the same level of reliability under the MRI = 0 approach.

Assume there are a set of gas resources without fuel arrangements, denoted $G1, G2, \ldots, GZ$. Let DF be the derate factor for the derating approach, and let $QC_{G1}, QC_{G2}, \ldots, QC_{GZ}$ be the qualified capacity values for these gas resources. Let $Cost_{G1}, Cost_{G2}, \ldots, Cost_{GZ}$ be the per MW costs for each of the gas resources. Let $NG1$ be the least cost non-gas resource with per MW cost = $Cost_{NG1}$ and qualified capacity = QC_{NG1}. We will assume that $NG1$ is the least cost non-gas resource that will replace any gas capacity that exits the market with the MRI = 0 approach. Finally, assume that $G1, G2, \ldots, GZ$ all receive awards under the derating approach and that they submit offers consistent with their costs, such that their per MW offers are less than NG1's per MW offer:

$$\frac{Cost_{G1}}{(1-DF)} < \frac{Cost_{G2}}{(1-DF)} < \cdots < \frac{Cost_{GZ}}{(1-DF)} < Cost_{NG1}$$

Note that this proof ignores any gas resources with derated costs/MW higher than $NG1$, because they would not receive awards under either the derating approach or the MRI = 0 approach, and so are not relevant for determining which approach will achieve a given level of reliability at lowest social cost.

Define N such that:

$$\sum_{i=1}^{N} QC_{Gi} = \sum_{i=1}^{GZ} QC_{Gi} * (1-DF)$$

, where the right-hand side of the above equation is the gas constraint. That is, N is such that $G1, G2, \ldots, GN$ are part of the optimal resource mix and so would receive awards under the market constraint approach, where we assume that the market constraint approach would yield a vertical demand curve for gas resources without fuel arrangements. Note we assume here that the gas constraint binds completely at $\sum_{i=1}^{N} QC_{Gi}$, such that any gas capacity added before $\sum_{i=1}^{N} QC_{Gi}$ is not impacted by the gas constraint, and any gas capacity added after $\sum_{i=1}^{N} QC_{Gi}$ provides no reliability value.

Assume that, up to the gas constraint, all of the gas resources and $NG1$ provide the same reliability contribution per MW. Finally, assume that gas resources that do not receive awards do not contribute to reliability.

Given these assumptions, this proof will consider if there is a set of costs for these resources such that the MRI = 0 approach could obtain the same reliability benefit as the derating approach at less cost. The social costs avoided with the MRI = 0 approach are the total costs of the Z gas resources procured under the derating approach (under MRI = 0 approach, no gas resource receives an award and so their social costs are avoided):

$$Cost_{G1} * QC_{G1} + Cost_{G2} * QC_{G2} + \cdots + Cost_{GN} * QC_{GN} + \cdots + Cost_{GZ} * QC_{GZ}$$

To meet the same level of reliability as would be provided by the Z gas resources procured under the derating approach, the MRI = 0 approach must procure a quantity of MWs from $NG1$ equal to the quantity of gas MWs that contribute to reliability (i.e., the gas constraint):

$$\left(\sum_{i=1}^{GZ} QC_{Gi} * (1-DF)\right) * Cost_{NG1} =$$
$$\left(QC_{G1} * (1-DF) + QC_{G2} * (1-DF) + \cdots + QC_{GZ} * (1-DF)\right) * Cost\_NG1$$

That is, the left-hand side of the above equation is the total costs to procure the same reliability benefit provided by all gas resources from $NG1$. Thus, for the MRI = 0 approach to meet a given level of reliability at lower total social costs, the following must be true:

$$\left(QC_{G1} * (1-DF) + QC_{G2} * (1-DF) + \cdots + QC_{GZ} * (1-DF)\right) * Cost\_NG1 <$$

$$Cost_{G1} * QC_{G1} + Cost_{G2} * QC_{G2} + \cdots + Cost_{GN} * QC_{GN} + \cdots + Cost_{GZ} * QC_{GZ}$$

Because $\frac{Cost_{G1}}{(1-DF)} < \frac{Cost_{G2}}{(1-DF)} < \cdots < \frac{Cost_{GZ}}{(1-DF)} < \ Cost_{NG1}$, we know the following must also be true:

$$Cost_{G1} < \ Cost_{G2} < \cdots < Cost_{GZ} < \ Cost_{NG1} * (1-DF)$$

As a result, the following must be true (assuming each resource has QC > 0):

$$QC_{G1} * (1-DF) * Cost_{NG1} > Cost_{G1} * QC_{G1};$$
$$QC_{G2} * (1-DF) * Cost_{NG1} > Cost_{G2} * QC_{G2};$$
$$\ldots$$
$$QC_{GZ} * (1-DF) * Cost_{NG1} > Cost_{GZ} * QC_{GZ}$$

Summing these inequalities, we have:

$$\left(QC_{G1} * (1-DF) + QC_{G2} * (1-DF) + \cdots + QC_{GZ} * (1-DF)\right) * Cost_{NG1} >$$

$$Cost_{G1} * QC_{G1} + Cost_{G2} * QC_{G2} + \cdots + Cost_{GN} * QC_{GN} + \cdots + Cost_{GZ} * QC_{GZ}$$

This contradicts the requirement for the MRI = 0 approach to achieve a given level of reliability at lower total social costs. As a result, given the above assumptions, the derating approach will obtain a given level of reliability at lower total social costs than the MRI = 0 approach given the above assumptions.

Appendix B

Table B.1: Summary of Market Outcomes with Current Rules

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$6,000	$7,500	$12,000
QC	[2]		2,000 MW	2,000 MW	1,500 MW	2,000 MW
QMRIC	[3]		2,000 MW	2,000 MW	1,500 MW	2,000 MW
Offer	[4]	=[1]/[3]	$1/MW	$3/MW	$5/MW	$6/MW
CSO Award	[5]		2,000 MW	2,000 MW	250 MW	0 MW
Total Social Cost	[6]	=SUM([4]*[5])	$9,250			
Clearing Price	[7]		$5/MW			
Resource Payments	[8]	=[7]*[5]	$10,000	$10,000	$1,250	$0

Table B.2: Summary of Market Outcomes with Derating Approach

			Gas A	Gas B	Non-Gas A	Non-Gas B
Total Cost	[1]		$2,000	$6,000	$7,500	$12,000
QC	[2]		2,000 MW	2,000 MW	1,500 MW	2,000 MW
QMRIC	[3]		1,000 MW	1,000 MW	1,500 MW	2,000 MW
Offer	[4]	=[1]/[3]	$2/MW	$6/MW	$5/MW	$6/MW
CSO Award	[5]		1,000 MW	0 MW	250 MW	0 MW
Total Social Cost	[6]	=SUM([4]*[5])	$3,250			
Clearing Price	[7]		$5/MW			
Resource Payments	[8]	=[7]*[5]	$5,000	$0	$1,250	$0

In this example, the total cost of Gas 2 has increased from $4,000 to $6,000, relative to Examples 0 through 3. Additionally, Non-Gas 1 is now able to provide up to 1,500 MW instead of 500 MW. Under the current rules, we continue to observe Gas 1, Gas 2, and Non-Gas 1 clearing in the market where we have a vertical requirement of 4,250 MW. Due to the cost increase for Gas 2, the total social cost also increases from $7,250 to $9,250. However, only 2,250 of the procured MWs contribute to reliability due to the gas constraint that binds at 2,000 MW.

In Table B.2, we see that the derating approach causes Gas B's offer to increase above Non-Gas A's offer. To procure capacity to provide the same reliability as Table B.1, Gas A sells 1,000 MW of CSO and Non-Gas A sells 250 MW of CSO. Note that this CSO provides the same reliability benefit as the 4,250 MW of CSO procured in Table B.1 because Gas B's capacity provided no reliability benefit in Table B.1. No capacity is procured from Gas B because i) their offer is higher than Non-Gas A, and ii) their capacity is not needed to meet the level of reliability procured in Table B.1.

Despite only procuring 1,250 MW of CSO, the derating approach achieves the same level of reliability as current rules at less social cost: $3,250 vs. $9,250.